

Toolbox Introduction

Toolbox Help Documentation

Help version created 1/31/2018

YASKAWA

Toolbox Introduction



Yaskawa has created several IEC-61131 projects for MotionWorks IEC which can be imported for use by another project as a User Library, or "Toolbox." These toolboxes were designed to save time by providing application code for a wide variety of situations.

- Cam Toolbox contains functions that increase the power of the PLCopen cam function in the firmware library by providing extras such as functions for calculating motion profiles, making adjustments based on latch inputs, and EStop recovery.
- Communications toolbox provides advanced communication protocol function blocks (DNS, SMTP, FTP).
- File Read / Write Toolbox builds upon the basic file manipulation functions available in the ProConOS firmware library to more quickly read and write application data files.
- Gantry Toolbox provides functions useful for operating an XY table with or without a Z (vertical) axis.
- Group Toolbox is the successor to Gantry Toolbox and provides enhancements to PLCopen Part 4 for interpolation, including G Code support.
- Kinematics Toolbox contains forward and inverse kinematics for selected mechanisms.
- Math Toolbox provides compatibility with the built in function that include EN and ENO outputs, and also provides other tools such as ATAN2, and Floating Point Remainder (REM).
- PackML is both a Template and Toolbox for designing applications to take advantage of the PackML specification. It emphasizes machine state and transition logic and provides predefined PackML data structures.
- Pendant Toolbox makes it easy to add manual mode and position teaching support for any application involving groups such as robots. It is specifically designed to interface via Modbus TCP to Yaskawa's teach Pendant, but other pendants or HMI's can also take advantage of this Toolbox.
- PLCopen Toolbox contains functions that build upon the PLCopen standard functions. It can serve as a starting point for every project.
- Yaskawa Toolbox contains functions that add basic functionality, such as PID Control, or a Moving Average Filter.

A toolbox or user library is just another project. What makes it a user library is the import method. When a project is imported as a user library, only the functions, function blocks and datatypes are available to the main project. None of the hardware specific information of the user library applies.

Please refer to the document [TN.MCD.08.130](#) on www.yaskawa.com for a comprehensive look at how user libraries can increase programming efficiency by reducing development time.

See our [Youtube channel](#) for video tutorials and examples for MotionWorks IEC and many of our toolboxes.

Common DataTypes

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Data Type: AXIS_ARRAY

AXIS_ARRAY is a sub structure of the AXES_GROUP_REF structure which identifies the physical motors or virtual axes that participate in the group.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|------------|--|--|-------------------------------------|
| C | AXIS_ARRAY | ARRAY: [1..32] OF AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). Note that this array is 1 based, not zero. | MyAXES_GROUP_REF.AxisRef[1].AxisNum |

Example

Watch Window

| Variable | Value | Type |
|----------------|-------|----------------|
| [-] GantryDemo | | AXES_GROUP_REF |
| [+] Name | | STRING32 |
| Handle | 1 | UINT |
| [+] Mechanism | | STRING32 |
| [-] AxisRef | | AXIS_ARRAY |
| [-] [1] | | AXIS_REF |
| AxisNum | 5 | UINT |
| [-] [2] | | AXIS_REF |
| AxisNum | 3 | UINT |
| [-] [3] | | AXIS_REF |
| AxisNum | 4 | UINT |
| [-] [4] | | AXIS_REF |
| AxisNum | 6 | UINT |



AXES_GROUP_REF

An AXES_GROUP_REF identifies a group of axes that work together as a single mechanical unit. AXES_GROUP_REF is used as a VAR_IN_OUT for PLCopen Part 4 - Interpolation Function Blocks.

Variables of this type are automatically declared in the Global Variables grid when the MotionWorks IEC project is configured with a Group in the Hardware Configuration. When a group is configured with Mechatrolink axes, the group structure is mapped to a %M memory area at specific location, and a portion of the contents of the structure is updated by the MPiec firmware at the task interval to which the group I/O is assigned.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-------------------------|--|--|---|
| | MyAXES_GROUP_REF | AXES_GROUP_REF | | |
| C | Name | STRING32 | ARRAY[1..32] OF BYTE. An array of ASCII characters representing the Group name as entered in the Hardware Configuration. Tip: Use the BUF_TO_STRING function block to convert this data to a STRING type. See example below. | MyAXES_GROUP_REF.Name |
| C | Handle | UINT | This is a unique value used internally to identify the group with lower level function blocks. | MyAXES_GROUP_REF.Handle |
| C | Mechanism | STRING32 | ARRAY[1..32] OF BYTE] Reserved for future use. | MyAXES_GROUP_REF.Mechanism |
| C | AxisRef | AXIS_ARRAY | Array of AXIS_REF identifying the physical motors or virtual axes. Note that this array is 1 based, not 0. | MyAXES_GROUP_REF.Axis[1].AxisNum |
| C | Padding1 | UINT | reserved | |
| C | Status | <u>GROUP_STATUS</u> | Structure containing status and alarm information. | |
| C | Axis | <u>GROUP_COORD_SYS</u> | Structure containing position, velocity and acceleration data for the Axis Coordinate System. | MyAxesGroup.Axis.CmdPos[1] |

| * | Element | Data Type | Description | Usage |
|---|-----------------------|---------------------------------|--|---|
| | MyAXES_GROUP_REF | AXES_GROUP_REF | | |
| C | Machine | GROUP_COORD_SYS | Structure containing position, velocity and acceleration data for the Machine Coordinate System. | MyAxesGroup.Machine.CmdPos[1] |
| C | World | GROUP_COORD_SYS | Structure containing position, velocity and acceleration data for the World Coordinate System. | MyAxesGroup.World.CmdPos[1] |
| C | Part | GROUP_COORD_SYS | Structure containing position, velocity and acceleration data for the Part Coordinate System. | MyAxesGroup.Part.CmdPos[1] |
| C | Tool | GROUP_COORD_SYS | Structure containing position, velocity and acceleration data for the Tool Coordinate System. | MyAxesGroup.Tool.CmdPos[1] |
| C | Limits | GROUP_LIMITS | Position, Velocity, Acceleration and Jerk limits for the Axes, Machine and Tool Coordinate Systems | MyAxesGroup.Limits.MachineLimits.MaxVelocity[1] |
| C | Reserved | Reserved | Reserved for future expansion. | --- |
| C | Host_ID | INT | 0 = Group is operated locally on the MPic via Mechatrolink. 1 = group is operated remotely via MLX200 gateway. | MyAXES_GROUP_REF.Host_ID |
| C | Mechanism_ID | INT | Indicates the type of mechanism: 0 = Gantry, 1 = Scara, 2 = MPP3, custom = 32767 | MyAXES_GROUP_REF.Mechanism_ID |
| C | Interface_ID | INT | Required when Host_ID = 1. This identifies on which of the potentially 8 MLX200 interfaces in the system the AxesGroup exists. | MyAXES_GROUP_REF.Interface_ID |
| C | Device_ID | INT | Robot number within the MLX200 Gateway. This value must be 1. | MyAXES_GROUP_REF.Device_ID |
| C | MaxLinearVelocity | LREAL | Maximum linear velocity of the TCP | MyAXES_GROUP_REF.MaxLinearVelocity |
| C | MaxAngularVelocity | LREAL | Maximum angular velocity of the TCP | MyAXES_GROUP_REF.MaxAngularVelocity |
| C | MaxLinearAcceleration | LREAL | Maximum linear acceleration of the TCP | MyAXES_GROUP_REF.MaxLinearAcceleration |

| * | Element | Data Type | Description | Usage |
|---|-------------------------|-----------------------|--|---|
| | MyAXES_GROUP_REF | AXES_GROUP_REF | | |
| C | MaxAngularAcceleration | LREAL | Maximum angular acceleration of the TCP | MyAXES_GROUP_REF.MaxAngularAcceleration |
| C | MaxLinearJerk | LREAL | Maximum linear jerk of the TCP | MyAXES_GROUP_REF.MaxLinearJerk |
| C | MaxAngularJerk | LREAL | Maximum angular jerk of the TCP | MyAXES_GROUP_REF.MaxAngularJerk |
| C | ActiveCoordinateFrame | INT | ACS, MCS, PCS... | MyAXES_GROUP_REF.ActiveCoordinateFrame |
| C | ActiveCoordinateSystem | INT | Cartesian, Polar, Spherical. (Only Cartesian is supported.) Others for future use. | MyAXES_GROUP_REF.ActiveCoordinateSystem |
| C | ActiveTool | INT | As entered in the UserApplicationData structure. | MyAXES_GROUP_REF.ActiveTool |
| C | ActivePartFrame | INT | As entered in the UserApplicationData structure. | MyAXES_GROUP_REF.ActivePartFrame |



Data Type: AXIS_REF

The AXIS_REF data type identifies an axis and thus provides the interface to the hardware or virtual axes. AXIS_REF is referenced as a VAR_IN_OUT in all function blocks. It is represented as an input and an output connected by a horizontal line in the graphical representation of a function block.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-----------|-----------|--|-------------------|
| | MyAxisRef | AXIS_REF | | |
| U | AxisNum | UINT | The value of AxisNum is determined by the logical axis number assigned by the Hardware Configuration. See the Configuration tab under each axis. | MyAxisRef.AxisNum |



AxisParameterStruct

For use with the [CamSlave_FeedToLength](#) and [CamSlave_WindowCheck](#) function blocks.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|------------------------------|----------------------------|-------------|--|
| | MyAxisParameterStruct | AxisParameterStruct | | |
| C | ActualPosition | LREAL | 1000 | MyAxisParameterStruct.ActualPosition |
| C | ActualPositionCyclic | LREAL | 1005 | MyAxisParameterStruct.ActualPositionCyclic |
| C | ActualPositionNonCyclic | LREAL | 1006 | MyAxisParameterStruct.ActualPositionNonCyclic |
| C | ActualTorque | LREAL | 1004 | MyAxisParameterStruct.ActualTorque |
| C | ActualVelocity | LREAL | 1001 | MyAxisParameterStruct.ActualVelocity |
| C | AtVelocity | BOOL | 1141 | MyAxisParameterStruct.AtVelocity |
| C | BufferedMotionBlocks | LREAL | 1600 | MyAxisParameterStruct.BufferedMotionBlocks |
| C | CamMasterCycle | LREAL | 1512 | MyAxisParameterStruct.CamMasterCycle |
| C | CamMasterPosition | LREAL | 1500 | MyAxisParameterStruct.CamMasterPosition |
| C | CamMasterShiftedCyclic | LREAL | 1502 | MyAxisParameterStruct.CamMasterShiftedCyclic |
| C | CamMasterShiftedPosition | LREAL | 1501 | MyAxisParameterStruct.CamMasterShiftedPosition |
| C | CamMasterScale | LREAL | 1510 | MyAxisParameterStruct.CamMasterScale |
| C | CamMasterShift | LREAL | 1511 | MyAxisParameterStruct.CamMasterShift |
| C | CamOffset | LREAL | 1531 | MyAxisParameterStruct.CamOffset |
| C | CamScale | LREAL | 1530 | MyAxisParameterStruct.CamScale |
| C | CamShiftRemaining | LREAL | 1513 | MyAxisParameterStruct.CamShiftRemaining |
| C | CamState | LREAL | 1540 | MyAxisParameterStruct.CamState |
| C | CamTableIDEngaged | LREAL | 1541 | MyAxisParameterStruct.CamTableIDEngaged |
| C | CamTableOutput | LREAL | 1520 | MyAxisParameterStruct.CamTableOutput |
| C | CommandedAcceleration | LREAL | 1012 | MyAxisParameterStruct.CommandedAcceleration |
| C | CommandedPosition | LREAL | 1010 | MyAxisParameterStruct.CommandedPosition |
| C | CommandedPositionCyclic | LREAL | 1015 | MyAxisParameterStruct.CommandedPositionCyclic |
| C | CommandedPositionNonCyclic | LREAL | 1016 | MyAxisParameterStruct.CommandedPositionNonCyclic |
| C | CommandedTorque | LREAL | 1014 | MyAxisParameterStruct.CommandedTorque |
| C | CommandedVelocity | LREAL | 1011 | MyAxisParameterStruct.CommandedVelocity |
| C | InPosition | BOOL | 1140 | MyAxisParameterStruct.InPosition |
| C | LatchPositionNonCyclic | LREAL | 1031 | MyAxisParameterStruct.LatchPositionNonCyclic |
| C | PositionError | LREAL | 1130 | MyAxisParameterStruct.PositionError |
| C | PositionWindow | LREAL | 1120 | MyAxisParameterStruct.PositionWindow |



Data Type: COORD_SYS_LIMITS_6

COORD_SYS_LIMITS_6 is a sub structure of [AXES_GROUP_REF](#).Limits.WorldLimits and PartLimits. This structure is for the MCS and PCS Coordinate systems.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-------------------------------|------------------------------|-------------|---|
| | MyAxesGroup.Limits.AxisLimits | COORD_SYS_LIMITS | | |
| C | MinPosition | MC_COORD_REF | | MyAxesGroup.Limits.AxisLimits.MinPosition |
| C | MinVelocity | MC_COORD_REF | | MyAxesGroup.Limits.AxisLimits.MinVelocity |
| C | MinAcceleration | MC_COORD_REF | | MyAxesGroup.Limits.AxisLimits.MinAcceleration |
| C | MinJerk | MC_COORD_REF | | MyAxesGroup.Limits.AxisLimits.Jerk |
| C | MaxPosition | MC_COORD_REF | | MyAxesGroup.Limits.AxisLimits.MaxPosition |
| C | MaxVelocity | MC_COORD_REF | | MyAxesGroup.Limits.AxisLimits.MaxVelocity |
| C | MaxAcceleration | MC_COORD_REF | | MyAxesGroup.Limits.AxisLimits.MaxAcceleration |
| C | MaxJerk | MC_COORD_REF | | MyAxesGroup.Limits.AxisLimits.MaxJerk |



Data Type: GROUP_LIMITS

GROUP_LIMITS is a sub structure of [AXES_GROUP_REF](#) and contains the following information.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|---------------------------|------------------------------------|-------------|----------------------------------|
| | MyAxesGroup.Limits | GROUP_LIMITS | | |
| C | AxisLimits | COORD_SYS_LIMITS | | MyAxesGroup.Limits.AxisLimits |
| C | MachineLimits | COORD_SYS_LIMITS | | MyAxesGroup.Limits.MachineLimits |
| C | WorldLimits | COORD_SYS_LIMITS_6 | | MyAxesGroup.Limits.WorldLimitis |
| C | PartLimits | COORD_SYS_LIMITS_6 | | MyAxesGroup.Limits.PartLimits |



Data Type: GROUP_STATUS

GROUP_STATUS is a sub structure of [AXES_GROUP_REF](#) and contains the following information.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|---------------------|-------------------------------------|---|--|
| | GROUP_STATUS | | | |
| C | Active | BOOL | Indicates if the group is made active via the MC_GroupEnable function block. | MyAXES_GROUP_REF.Status.Active |
| C | Padding | BYTE | Reserved for future use | |
| C | State | UINT | Reserved for future use | MyAXES_GROUP_REF.Status.State |
| C | Alarm | UDINT | Indicates if there is an alarm for the group or any axis of the group. | MyAXES_GROUP_REF.Status.Alarm |
| C | NumMotionSegments | UINT | The number of motion segments currently in the motion queue. | MyAXES_GROUP_REF.Status.NumMotionSegments |
| C | FreeMotionSegments | UINT | The number of motion segments available to be added to the motion queue. | MyAXES_GROUP_REF.Status.FreeMotionSegments |
| C | AxisStatus | GRP_AXIS_STATUS_ARRAY | Array which reports the power status of each axis. For Mechatrolink Servo axes, this is equivalent to the PON flag. | MyAXES_GROUP_REF.Status.AxisStatus[1] |
| | <i>Reserved</i> | <i>256 bytes of reserved space.</i> | --- | --- |



Data Type: VECTOR

The VECTOR data type specifies a coordinate position for a grouped system. This datatype has other applications also, such as TransitionParameter.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|-----|---------|------------------------|--|--------------|
| U/C | Vector | Array [1..32] of LREAL | This datatype is generically used in several instances where an array of LREAL values is required. | MyVector [1] |

Example

Consider the following code for a simple XYZ gantry mechanism. MyVector and AnotherVector can be connected directly to the MC_MoveLinearAbsolute or MC_MoveLinearRelative function blocks "Position" VAR_INPUT.

```
MyVector[1]:=LREAL#25.0; (* Specify the X axis position *)
```

```
MyVector[2]:=LREAL#25.0; (* Specify the Y axis position *)
```

```
MyVector[3]:=LREAL#3.5; (* Specify the Z axis position *)
```

```
AnotherVector[1]:=LREAL#1..765; (* Specify the X axis position *)
```

```
AnotherVector[2]:=LREAL#2.131; (* Specify the Y axis position *)
```

```
AnotherVector[3]:=LREAL#0.220; (* Specify the Z axis position *)
```




RTC Struct

This datatype is for use with the [Y_SetRTC](#) function block from the Y_Motion firmware library and the RealTimeClock function block from the Yaskawa Toolbox.

Data Type Declaration

| | * | Element | Data Type | Description | Usage |
|-----|---|--------------------|-------------------|-------------|-------------------------|
| | | MyRTCStruct | RTC_STRUCT | | |
| U/C | | Year | INT | | MyRTCStruct.Year |
| U/C | | Month | INT | | MyRTCStruct.Month |
| U/C | | Day | INT | | MyRTCStruct.Day |
| U/C | | Hour | INT | | MyRTCStruct.Hour |
| U/C | | Minute | INT | | MyRTCStruct.Minute |
| U/C | | Second | INT | | MyRTCStruct.Second |
| U/C | | Millisecond | INT | | MyRTCStruct.Millisecond |



Data Type: TRIGGER_REF

This data type is for use with the MC_TouchProbe and MC_AbortTrigger function blocks.

MC_TouchProbe requires a trigger referenced via a variable of the type TRIGGER_REF.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|--------------|-------------------|--|-----------------------|
| | MyTriggerRef | TRIGGER_REF | | |
| U | Bit | UINT | See chart below for required value based on the device and physical input pin used. | MyTriggerRef.Bit |
| U | ID | UINT | Unique ID for each trigger on the same axis; used as a link between MC_TouchProbe and MC_AbortTrigger. Typically the value should be zero as only one trigger per axis is supported on Mechatrolink II and the MP2000iec style option cards. If using simultaneous MC_TouchProbe function blocks with a Mechatrolink-III Servopack, specify unique IDs. | MyTriggerRef.ID |
| U | Input | Input_REF | Reserved for future use | MyTriggerRef.Input.ID |
| U | Pattern | DETECTION_PATTERN | Reserved for future use | MyTriggerRef.Pattern |

Notes

Prior to firmware 2.5, the TRIGGER_REF.ID element was not used by the MP2000iec controllers and any value would be accepted. In 2.5, the TRIGGER_REF.ID field must be a zero for MP2000iec series controllers. In older help documentation, an example showed the ID set to 1, and many users set TRIGGER_REF.ID to 1 in their projects, which causes MC_TouchProbe to output ErrorID 4630 when using firmware 2.5 or higher. The solution is to set MyTriggerRef.ID to zero which will work for all firmware versions. Only on the MP3000iec controllers can another value be used for the case of multiple latches configured on the same axis.

The following chart details the correct values for the TRIGGER_REF structure based on the hardware latch to be detected.

| Device | Signal | Hardware Pin # | Software Default Variable Name | TRIGGER_REF | | | |
|-----------|--------------------|----------------|--------------------------------|-------------|--|-----------|----------------|
| | | | | Bit | ID | Input | Pattern |
| | | | | | | Input_Ref | |
| | | | | | | ID | |
| UINT | UINT | UINT | ENUM | | | | |
| LIO-01 | Encoder C Channel | A3/B3 | n/a | 0 | Set to 0 for LIO, MP2600iec, or Mechatrolink -II ServoPacks. | Not used | For future use |
| | DI-01 | A22 | M□□_DI_01 | 1 | | | |
| LIO-02 | Encoder C Channel | A3/B3 | n/a | 0 | | | |
| | DI-01 | A22 | M□□_DI_01 | 1 | | | |
| LIO-06 | Encoder C Channel | 35 | n/a | 0 | | | |
| | DI-01 | 39 | M□□_DI_01 | 1 | | | |
| MP2600 | External C Channel | 35 | n/a | 0 | | | |
| | Cn13 DI-01 | 39 | MO1_DI_01 | 1 | | | |
| SGDH | C Channel | n/a | n/a | 0 | | | |
| | EXT1 | 44 | AX□□_SI4_EXT1 | 1 | | | |
| | EXT2 | 45 | AX□□_SI5_EXT2 | 2 | | | |
| | EXT3 | 46 | AX□□_SI6_EXT3 | 3 | | | |
| SGDS | C Channel | n/a | n/a | 0 | | | |
| | EXT1 | 10* | AX□□_SI4_EXT1 | 1 | | | |
| | EXT2 | 11* | AX□□_SI5_EXT2 | 2 | | | |
| | EXT3 | 12* | AX□□_SI6_EXT3 | 3 | | | |
| SGDV | C Channel | n/a | n/a | 0 | | | |
| | EXT1 | 10* | AX□□_SI4_EXT1 | 1 | | | |
| | EXT2 | 11* | AX□□_SI5_EXT2 | 2 | | | |
| | EXT3 | 12* | AX□□_SI6_EXT3 | 3 | | | |
| SGD7S | C Channel | n/a | n/a | 0 | | | |
| | EXT1 | 10* | AX□□_SI4_EXT1 | 1 | | | |
| | EXT2 | 11* | AX□□_SI5_EXT2 | 2 | | | |
| | EXT3 | 12* | AX□□_SI6_EXT3 | 3 | | | |
| SGD7W (A) | C Channel | n/a | n/a | 0 | | | |
| | EXT_A1 | 6* | AX□□_SI4_EXT1 | 1 | | | |
| | EXT_A2 | 7* | AX□□_SI5_EXT2 | 2 | | | |
| | EXT_A3 | 8* | AX□□_SI6_EXT3 | 3 | | | |
| SGD7W (B) | C Channel | n/a | n/a | 0 | | | |
| | EXT_B1 | 12* | AX□□_SI4_EXT1 | 1 | | | |
| | EXT_B2 | 13* | AX□□_SI5_EXT2 | 2 | | | |
| | EXT_B3 | 14* | AX□□_SI6_EXT3 | 3 | | | |

* denotes the default pin, which can be changed by setting Pn 511 in the drive.



Data Type: Y_DISENGAGE_DATA

This data type is for use with the [Y_CamOut](#) function block. Y_DisengageMethod#AtPosition is the only disengage method supported. To disengage the slave from a master when the machine is already stopped, use MC_Stop for the slave axis.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|------------------|-----------------------------------|---|-------------------------------|
| | MyYDisengageData | Y_DISENGAGE_DATA | | |
| U | EndMode | Y_DisengageMethod | Enumeration: 0:Y_DisengageMethod#AtPosition 1:Y_DisengageMethod#Immediate 2:Y_DisengageMethod#EndOfProfile | MyYDisengageData.EndMode |
| U | RampOut | INT | Reserved for future use | MyYDisengageData.RampOut |
| U | RampOutData1 | LREAL | Reserved for future use | MyYDisengageData.RampOutData1 |
| U | RampOutData2 | LREAL | Reserved for future use | MyYDisengageData.RampOutData2 |
| U | RampOutData3 | LREAL | Reserved for future use | MyYDisengageData.RampOutData3 |
| U | RampOutData4 | LREAL | Reserved for future use | MyYDisengageData.RampOutData4 |

Code Example:



Data Type: Y_ENGAGE_DATA

This data type is for use with the [Y_CamIn](#) function block.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|---------------|--------------------------------|--|-------------------------|
| | MyYEngageData | Y_ENGAGE_DATA | | |
| U | StartMode | Y_EngageMethod | <p>Enumeration:</p> <p>0:Y_EngageMethod#AtPosition (Default)</p> <p>The slave will engage when the master position is within the range of [EngagePosition +/- (EngageWindow/2)]. Master-Relative is ignored. Use this setting for normal circumstances. The intended usage requires setting YCamIn.Execute:=TRUE at some point before the master and slave are to be synchronized. The motion engine, operating at the MECHATROLINK or dual port RAM update interval will monitor for the exact position to start the camming process.</p> <p>1:Y_EngageMethod#Immediate</p> <p>Y_CamIn does not wait for the master position to reach the EngagePosition. The EngagePosition and the EngageWindow inputs are ignored. This mode is intended for use when the master is not moving, such as during fault or E-Stop recovery in the middle of a cam cycle. In this scenario, the slave may be moved to the equivalent cam position of the master, then the cam can be re-engaged immediately using MasterRelative:=FALSE to preserve the original synchronization. If MasterRelative=TRUE, then CamMasterShift (Parameter 1511) is adjusted so that the master position at the time YCamIn.Execute changes to TRUE corresponds to the start of the table domain. This scenario would change the synchronization between the master and slave. Immediate Mode is not recommended for application scenarios where the master is in motion, as a position drift or phase lag may be introduced.</p> <p>2:Y_EngageMethod#Linked</p> <p>The new cam profile will be switched on the fly at the end of the current cam table. This mode is intended for use when cams with different Machine Cycles are to be run without stopping. Use the Linked mode or applications where the product size must be changed on the fly. Do not use linked mode if Y_CamShift is used for the same slave axis.</p> <p>3: Y_EngageMethod#AtAbsolutePosition (requires firmware 3.2.0 or higher)</p> <p>The slave will engage when the master axis absolute position crosses the position specified by the EngagePosition input of the function block. The intended usage requires setting YCamIn.Execute:=TRUE at some point before the master's absolute position reaches the specified position. The motion engine, operating at the MECHATROLINK or dual port RAM</p> | MyYEngageData.StartMode |

| | | | | |
|---|----------------|-------|---|------------------------------|
| | | | update interval will monitor for the exact position to start the camming process. The slave will start to follow the master when the master crosses the specified Engage position according to the Y_CamIn function block input. | |
| U | MasterRelative | BOOL | Only MasterRelative: =FALSE is supported. | MyYEngageData.MasterRelative |
| U | SlaveAbsolute | BOOL | When SlaveAbsolute: =FALSE, the initial position of the slave will be used as the base offset for the camming operation. For example, if the cam slave table data goes from 0 to 20, back to 0, but the slave's commanded position when the engage event occurs is 4.5, the slave will travel from 4.5 to 24.5, and back to 4.5. If SlaveAbsolute: =TRUE for the same scenario, the slave will jump from 4.5 to 0 when the engage event occurs. (This is not desirable behavior.) If SlaveAbsolute mode is used, the application program must ensure that the slave axis is positioned at the proper position for camming to operate correctly. | MyYEngageData.SlaveAbsolute |
| | RampIn | INT | Reserved for future use | --- |
| | RampInData1 | LREAL | Reserved for future use | --- |
| | RampInData2 | LREAL | Reserved for future use | --- |
| | RampInData3 | LREAL | Reserved for future use | --- |
| | RampInData4 | LREAL | Reserved for future use | --- |

Code Example:

```
MyYEngageData.StartMode: =Y_EngageMethod # AtAbsolutePosition;
```

Some blocks accept an enumerated type (ENUM), which is a keyword (or constant) representing a value which will configure the operation of the function block. Enumerated types are equivalent to zero-based integers (INT). Therefore, the first value equates to zero, the second to 1, etc. The format for enumerated types is as follows: ENUM:(0, 1, 2...) as displayed in the example below (MC_BufferMode#Aborting).

The following is an alphabetical listing of the Enumerated Types defined in the MotionBlockTypes file:

| Enumerated Type | #INT Value | Enum Value | Description |
|----------------------|------------|--------------------|---|
| MC_BufferMode | 0 | Aborting | This is the Default mode. The FB aborts an ongoing motion and the command affects the axis immediately. |
| | 1 | Buffered | The FB affects the axis as soon as the previous movement is complete. The axis will stop between the movements. |
| | 2 | BlendingLow | The FB controls the axis after the previous FB has finished, but the axis will not stop between the movements. The velocity is blended with the lowest velocity of both commands. |
| | 3 | BlendingPrevious | The FB controls the axis after the previous FB has finished (equivalent to buffered), but the axis will not stop between the movements. Blending with the velocity of the previous move. |
| | 4 | BlendingNext | The FB controls the axis after the previous FB has finished, but the axis will not stop between the movements. Blending with velocity of this (next) function. |
| | 5 | BlendingHigh | The FB controls the axis after the previous FB has finished (equivalent to buffered), but the axis will not stop between the movements. Blending with highest velocity of the previous and this (next) function. |
| | | | |
| MC_Detection_Pattern | 0 | Rising_Edge | |
| | 1 | Falling_Edge | |
| | | | |
| MC_Direction | 0 | Positive_Direction | In a rotary application, forces the axis to move in a positive direction. |
| | 1 | Shortest_Way | For use in applications where the Load Type is configured as a rotary or modularized axis. |
| | 2 | Negative_Direction | In a rotary application, forces the axis to move in a negative direction. |
| | 3 | Current_Direction | For use in applications where the Load Type is configured as a rotary or modularized axis. Only applies if an existing move is in progress and another function block such as MC_MoveAbsolute or MC_MoveRelative is executed. Once the axis is at StandStill, using MC_Direction_CurrentDirection will default to the positive direction |
| | | | |
| MC_ExecutionMode | 0 | Immediately | Functionality is immediately valid. May influence ongoing motion, but not the state. |
| | 1 | Delayed | Functionality is valid when the ongoing motion command set Done, Aborted, or Error outputs. |
| | 2 | Queued | Functionality is valid when ALL previous motion commands set Done, Aborted, or Error outputs. |
| | | | |
| MC_PathChoice | 0 | ClockWise | |
| | 1 | CounterClockWise | |
| | | | |
| MC_SwitchMode | 0 | On | Unsupported |
| | 1 | Off | Unsupported |
| | 2 | EdgeOn | |
| | 3 | EdgeOff | Unsupported |
| | 4 | EdgeSwitchPositive | Unsupported |
| | 5 | EdgeSwitchNegative | Unsupported |

| | | | |
|-------------------|--|----------------------|---|
| MC_TransitionMode | 0 | TMNone | No transition curve inserted. Motion blocks are not modified. The only TransitionMode usable with the "Buffered" BufferMode. |
| | 1 | TMStartVelocity | Transition with given start velocity. Adds a segment to the motion queue unless motion is tangent. |
| | 2 | TMConstantVelocity | Transition with given constant velocity. Adds a segment to the motion queue unless motion is tangent. |
| | 3 | TMCornerDistance | Transition with given corner distance. Adds a segment to the motion queue unless motion is tangent. |
| | 4 | TMMaxCornerDeviation | Transition with given maximum corner deviation. Adds a segment to the motion queue unless motion is tangent. |
| | | | |
| Y_AdjustMode | 0 | MasterDistance | The cam adjustment starts immediately, and completes when the master has travelled the specified distance. If MasterDistance is 0.0, then the cam adjustment finishes in the same scan it starts. |
| | 1 | ElapsedTime | The cam adjustment starts immediately, and completes within the specified time. If Time=0.0, then the adjustment completes in the same scan it starts. |
| | 2 | WithinRange | The cam adjustment starts when the master is crosses the StartPosition, and completes when the master reaches the EndPosition. If the master position is already between StartPosition and EndPosition, then the adjustment starts immediately, but still completes at the EndPosition, which means that the correction speeds may be higher. |
| | | | |
| Y_ControlMode | This enumerated type is for use with Y_DirectControl | | |
| | 0 | NoControlMode | This is not a valid value. |
| | 1 | PositionMode | The ServoPack will be controlled in position mode. A new command target must be calculated in the controller at a frequency suitable for the application. No acceleration or speed profiling is added by the system, except for the command filtering provided by pn 811/812, or pn 216/217 if using the MP2600iec. |
| | 2 | VelocityTLMode | The ServoPack will be operated in velocity mode. The Torque input of the Y_DirectControl function block will serve as the torque Limit in this mode. |
| | 3 | TorqueVLMode | The ServoPack will be operated in torque mode. The Velocity input of the Y_DirectControl function block will serve as the velocity limit in this mode. If the velocity limit is reached, the servo will apply increased torque if necessary to keep the velocity within the limits. |
| | 4 | PositionTrqFFMode | The ServoPack will be operated in position mode. The Torque input of the Y_DirectControl function block will serve as the torque feed forward value in this mode. |
| | 5 | VelocityTrqFFMode | The ServoPack will be operated in velocity mode. The Torque input of the Y_DirectControl function block will serve as the torque feed forward value in this mode. |
| | | | |
| Y_TableType | 0 | Undefined | |
| | 1 | MasterSlaveArray | This is the only TableType supported. |
| | | | |
| | | | |

Cam Toolbox

Toolbox Help Documentation

Help version created 1/31/2018

YASKAWA



Getting Started with Cam Toolbox

The Cam Toolbox contains function blocks that combine PLCopen blocks like Y_CamIn, Y_CamShift, Y_SlaveOffset, Y_CamSlave, Y_ReleaseCamTable etc. These toolbox function blocks provide enhanced application level functionality that can be used on cam applications like random rotary knife, linear flying shear, labeler, bottle filler etc.

Requirements for v340

To use the Cam Toolbox, your project must also contain the following:

Firmware libraries:

- YMotion (only if using [CamSlave_FeedToLength2](#))

User libraries:

The following User Libraries must be listed above the Cam Toolbox and in the following order:

- Math_Toolbox (v300 or higher)
- DataTypes_Toolbox (v300 or higher)
- PLCopen_Toolbox (v300 or higher)

Using the Cam Toolbox

Cam Toolbox contains functions which provide enhanced support for the [Y_Cam] PLCopen function blocks.

See Yaskawa's Youtube video - [Camming Demonstration with Yaskawa MP2300Siec](#) for more info.



Cam Toolbox Revision History

Starting in Cam Toolbox v204 – All firmware library DataType definitions were moved to a new toolbox called the DataTypes Toolbox. Formerly, the PLCOpen Toolbox contained the MotionInfoTypes and the PLCTaskInfoTypes datatype files. These were removed and are now included in the DataTypes Toolbox. If upgrading from an older version of Cam Toolbox, you must do the following:

- 1) Include the DataTypes Toolbox in your project.
- 2) Remove any other Yaskawa supplied datatype files with firmware library definitions such as:
 - a. ControllInfoTypes
 - b. YDeviceCommTypes

Note: Compiler issues yielding the message "Error during generating native code" will be experienced under the following combined conditions: 1) Using Cam Toolbox v204 or higher AND using an MP3000iec series controller AND using MotionWorks IEC v2.x. The remedy is to downgrade to Cam Toolbox v203 or use MotionWorks IEC v3.x.

Current Version:

(***** 2017-12-06 v340 released *****)

- 1) CamTableManager - Added VAR_INPUT to specify the number of cam tables to keep in memory before removing. DCR 1104 .
- 2) CamGenerator - Improved reporting of a resolution ErrorID 10039. DCR 1171.

Previous Versions:

(***** 2016-09-18 v302 released *****)

- 1) CamControl FB - Changed CamControl to set ControlData.Shifting based on CamShift.Done instead of Busy. DCR 780.
- 2) Added EngageWindow to CamSynchStruct. This will help to map user values into Y_CamIn for features like the new "Labeler" Function Block. DCR 782.

(***** 2015-01-31 v301 released *****)

- 1) CamGenerator - DCR 766, fixed Tangent Blending to blend with non-zero slave starting position. Change also added for Cam Editor in MotionWorks IEC v3.1
- 2) CamShift_Control - Changed line 215 to ControlData.Shifting:=Y_CamShift_1.Busy OR Y_CamShift_1.Done. DCR 682.

(***** 2015-01-31 v300 created *****)

- 1) Identical to v206, but recompiled specifically for MotionWorks IEC v3.x.

(***** 2014-11-14 v206 released. Developed using firmware 2.6 *****)

(**** 2015-01-31 v300 released. Identical to v206, but recompiled specifically for MotionWorks IEC v3.x. *****)

- 1) CalcBezier - Improved code.
- 2) SlaveOffset_Control - Changed equation for first correction. Added manual offset input for adjusting while in motion.
- 3) CamGenerator - ParabolicVelocityBlend formula - Code added for blending improvement (Lines 132- 138)
- 4) CamTableUpdate - Changes made to prevent outputs from flickering (Refer to DCR 467)
- 5) CamControl - Changes made to iActive code to prevent flickering outputs in case of an Error and also lookup of function if data in CamControl structure changes after function block goes dormant.
- 6) SlaveRegistrationCheck - Added (DefaultSize * LREAL 1.1) to NextCheckPoint calculation on rising edge of Enable (line 27)
- 7) SetCamMasterCycle - Improvement by adding Y_CamShift with zero phaseshift to keep prm 1502 updating after this block executes.

(***** 2014-03-07 v205 released. Developed using firmware 2.5 *****)

- 1) CamBlend - Changed EngageData.SlaveAbsolute to FALSE. This is to support changing master cycles without changing the position scale in the Hardware Configuration.
- 2) CamBlend - Removed NC CamOutBusy from rung 11. This bit could cause the RampOut bit to fire twice.
- 3) CamBlend - Changes made to improve RampIn to RampOut transition without entering Running mode. Added NC RampOutBusy on rung 4. Added ActiveTable_RampIn in rung 11. Added ActiveTable_RampOut on Rung 4 to allow RampOut to RampIn transition in consecutive cycles. Added NC RampOutBusy and NC RampInBusy on rung 19 to prevent iActive from turning off prematurely.
- 4) CamBlend - Removed CamOut FB from CamBlend. Non periodic RampOut is sufficient. This eliminates false error outputs.
- 5) CamShift_Control - Added new datatype 'SynchPosition'. This is the position in the cam table where the master and slave become synchronized.
- 6) CamShift_Control - Simplified the equation for correction for initial shift for modes 1 and 2.
- 7) SlaveOffset_Control - New FB, similar to CamShift_Control. Buffered offsets on a slave axis can be accomplished by buffering registration marks. New datatype SlaveOffsetStruct accompanies SlaveOffset_Control FB.
- 8) SetCamMasterCycle - New FB in this version. Sets the cam master cycle the first time to change it from default of 1.0 to the Master cycle of the cam table to be used. Only necessary for applications that use Y_CamShift before engaging the cam.
- 9) CamGenerator - CalcSpline formula completely re written with new algorithm.
- 10) CamGenerator - New Bezier curve added. Bezier segment requires straight segments before and after the Bezier curve. This is a modified bezier which will never cause reverse motion.
- 11) CamSlaveFeedToLength - Further improvement based on customer feedback for the change made in v204. TestTrack DCR 7. SlaveRegistrationCheck is completely shut down if no cam is active, this prevents MissedLatchError from occurring.
- 12) CamControl, CamShift_Control - Added support for Multi Use Latches, which is a new feature of the PLCopen Toolbox v206 ProductBuffer function block.

(***** 2013-09-01 v204 released. Developed using 2.4.0 firmware *****)

- 1) CamBlend - Added ErrorID 10084. One of the Cam Tables has an invalid TableID.
- 2) CamBlend - Fixed ExecuteStandStill contact in RETURN rung to be normally closed.
- 3) CamGenerator - Corrected mistake with Tangent Match & Tangent Blend formulas introduced in v202 when CamGenerator was improved to allow blending segments.
- 4) CamBlend - Added check: If BlendData.Window = 0, then the code defaults the value to 1% of the CamMasterCycle.
- 5) CamGenerator - Added curve type 32 for Arc profile. Also added radius and direction to CamSegmentStruct

- 6) Removed references to Math Toolbox functions where possible. Now only the CamShiftControl function block requires the Math Toolbox.
- 7) Because of the reintroduction of functions with EN/ENO, the MP2600 requires firmware 2.1.
- 8) SlaveRegistrationCheck - Added ErrorID 10086 to report if the MaxPosCorrection or MaxNegCorrection are not set correctly.
- 9) CamSlaveFeedToLength - Added RecordedPosition as output. Also included interlock to prevent adjustments from occurring if the slave is not engaged.
- 10) CamGenerator - Added Parabolic with blended velocity as formula code 33. (for multi segment)
- 11) CamShift_Control - Consolidated Rotary Knife and Linear Flying shear math.

(***** 2013-01-16 v203 released. Created using 2.4.0 firmware *****)

- 1) CamGenerator - Improved to support wrap around cubic spline segments at the beginning and the end of the cam. (YEU) 7 spline categories tested.
- 2) CamGenerator - Added TableShift support into the CamSegmentStruct. Initial shifts can be applied to the cam data without using the Y_CamShift function block.

(***** 2012-11-19 v203 created using 2.3.0 firmware *****)

- 1) CamGenerator - Improved support for wrap around cubic spline segments at the beginning and the end of the cam. (YEU) 7 spline categories tested.
- 2) CamGenerator - Added TableShift support into the CamSegmentStruct for CamGenerator. Initial shifts can be applied to the data without using the Y_CamShift function block.

(***** 2012-10-18 v202 released. Created using 2.2.0 firmware *****)

- 1) CamGenerator - Improved to allow blending segments such as straight line, parabolic, modified sine without forcing a zero speed transition.
- 2) CamGenerator - Improved for blending of Cubic Spline segments to other segment types.
- 3) SlaveRegistrationCheck - Changed 'Missed Latch Error' to occur when the missed latch counter is \geq the MissedLatchLimit. Previously it was not causing error until the MissedLatchLimit was exceeded.
- 4) CamBlend - Added DisengageData to CamBlend's Y_CamOut for compatibility on MP2600iec and MP3200iec

(***** 2011-03-09 v201 released. Created using 2.1.0 firmware *****)

- 1) CamGenerator - Added Cubic Spline CurveType as Type #31.
- 2) CamAnalyzer - Added new function block.
- 3) CamFileMgmt - CamTableMgmt renamed CamTableManager.
- 4) CamSlave_Lookup - Fixed false 10113 ErrorID from occurring.
- 5) CamSlave_Recover - Fixed unconnected line in the first rung.
- 6) DataTypes - Increased CamPair and CamSegmentArray from 200 to 400.

(***** 2011-07-29 v200 released. Created using 2.0.0 firmware *****)

- 1) Built from v009beta for MotionWorks IEC 2.0

(***** 2011-04-02 v009 released. Created using 1.2.4 firmware *****)

- 1) Added CamSlave_Lookup and CamSlave_Recover function blocks for e-stop recovery capability.
- 2) Added input 'ExecuteStandstill' to CamBlend. This input causes the running cam to engage immediately, which enhances the E-Stop recovery capability of CamBlend.
- 3) Removed SETCOIL from CamBlend CommandAborted.

(***** 2011-04-01 v008 released. Created using 1.2.4 firmware *****)

- 1) Fixed Y_CamStructSelect in PathGenerator to comply with PLCopen rule to read TableID only on the scan.
when done is high. (Also to comply with firmware change made for 1.2.3.)
- 2) Reworked PathGenerator to support any variety of arcs beyond just simple 0,90,180,270 quadrants.
- 3) Removed spaces from project file name for improved usage with MotionWorks IEC 2.0.
- 4) Removed PathGenerator and MovePath, ported over to Gantry Toolbox.
- 5) Included YMotion firmware library in ZWT, required for CamSlaveFeedToLength2 function block.
NOTE: This toolbox will work with 1.2.3 firmware unless CamSlaveFeedToLength2 is used, which requires firmware 1.2.4.
- 6) Improved CamBlend's CommandAborted output behavior to ignore Commandaborted caused by itself.

(***** 2011-02-02 v007 released *****)

- 1) Fixed incorrect parameter in CamBlend for checking the half way point of the cam cycle.
Step 5 had 1520, it is changed to 1512. Also streamlined the code to only include one check for Halfway instead of two.
- 2) Added CamSlaveFeedToLength2, which incorporates Y_ProbeContinuous from the Y_Motion firmware library and requires firmware 1.2.4 or higher. NOTE: After the 2.0 product release, Y_ProbeContinuous will be available in PLCopenPlus firmware library v2_3.

(***** 2010-11-15 v006 released *****)

Moved on to v006, beta005 never released.

- 1) Increased flexibility of CamSlave_FeedToLength / SlaveRegistrationCheck by making Max Positive and Negative Correction inputs and outputs.
- 2) Added CamShift_Control FB for 'Rotary' and 'Out and Back' cam motions.
- 3) Added TB_CurveType#Polynomial345 to CamGenerator, Polynomial345.
- 4) Added Cam_Control FB which works with the Product Buffer for slaves that must stop when no product is coming.

(***** 2010-08-01 v005beta created *****)

Moved on to v005, beta004 never released.

- 1) Merged code changes with Doug Meyer, for CamSlavePullToLength and CamSlaveFeedToLength for MaxCorrection and Time based correction. NOTE: Function block interface changed for these functions.
- 2) Removed LatchError from occurring in CamSlavePullToLength and CamSlaveFeedToLength.
- 3) Moved window logic into the main Enable section of SlaveRegistrationCheck to allow on the fly updates.

(***** 2010-07-02 v004beta created *****)

Moved on to v004, beta003 never released.

- 1) Added logic to SlaveRegistrationCheck to add one CamCycle if the LatchTableReference is negative.

(***** 2010-03-15 v003beta created *****)

- 1) Fixed mistake in case statement to allow Simple Harmonic as one of the Valid Curve Types. Was 4, should be 3.
- 2) Changed Max CamSegmentArray size to 200 from 20.
- 3) Changed CamSlave_FeedToLength to use Stair Step method of latch lookup in cam table. Original method used an interpolated latch algorithm.
- 4) Removed Y_EngageMethod#Linked as a StartMode inside CamBlend.
- 5) Changed the second and third Y_CamIn functions inside CamBlend to use StartMode = Absolute to eliminate drifting caused by switching tables while master in motion.
- 6) Added NOT(Error) contact to prevent the CamSlave_FeedToLength function from running if there was an error.
- 7) Added PathGenerator and MovePath for creating XY paths with straight line and circular interpolation.
- 8) Added CamSlavePullToLength and supporting function CS_PTL_ScaleCalc.

(***** 2010-03-12 v002 released *****)

- 1) Changed CamGenerator straight line segment to include option for calculating points at spec'ed resolution.
- 2) Initial version would ignore resolution and just use beginning and end points for straight line.
- 3) Improved CamGenerator. It was recalculating the entire profile over and over each scan while execute was held high. Changed to F_TRIG to let initialize section run on the first scan, and the cam calcs on the second.
- 4) Improved CamBlend Output behavior. (Some bits remained on when both execute inputs were off.

(***** 2010-02-01 v001beta created *****)

Created Cam Toolbox by moving the following Function blocks from PLCopen Toolbox v019beta:

- 1) CamBlend
- 2) CamMaster_Lookup
- 3) CamSlave_FeedToLength
- 4) CamSlave_WindowCheck
- 5) CamGenerator
- 6) CamTableUpdate
- 7) SlaveRegistrationCheck
- 8) SlaveIndex_Lookup



Data Type: BlendStruct

Used by the [CamBlend](#) function block

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|----------------------|--------------------|--|------------------------------------|
| | MyBlendStruct | BlendStruct | | |
| U | RampInTableID | UINT | The TableID of the Cam profile which accelerates the slave to synchronize with the master. | MyBlendStruct.RampInTableID |
| U | RampInSwitchOverPos | LREAL | A position where the slave has the same position in both the RampIn and Running table, typically near the last 90 to 100% of the profile. | MyBlendStruct.RampInSwitchOverPos |
| U | RunningTableID | UINT | The TableID of the Cam profile is used in normal operation. | MyBlendStruct.TableID |
| U | StandStillEngagePos | LREAL | This input can be used if the slave is being engaged to the master at standstill. (E-Stop recovery where the slave engages to a stationary master). This input will engage the slave to the running table. | MyBlendStruct.StandStillEngagePos |
| U | RampOutTableID | UINT | TableID of the Cam profile which decelerates the slave to a stop at a desciared location. | MyBlendStruct.RampOutTableID |
| U | RampOutSwitchOverPos | LREAL | Specify a position where the slave would be at the same position in both the RampIn and Running table, typically near the last 90 to 100% of the profile. | MyBlendStruct.RampOutSwitchOverPos |
| U | Window | LREAL | Switchover / Engage window in master units. | MyBlendStruct.Window |



Data Type: CamPairs

Used by the [CamGenerator](#) function block.

Data Type Declaration

| | * | Element | Data Type | Description | Usage |
|---|---|-------------------|-----------------------|-------------|---------------|
| | | MyCamPairs | CamPairs | | |
| U | | CamPairs | ARRAY[0..20] OF UDINT | | MyCamPairs[0] |



Data Type: CamParameters

Supporting structure for [CamSegmentStruct](#). For use with the [CamGenerator](#) function block.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|------------------------|----------------------|--|--|
| | MyCamParameters | CamParameters | | |
| U | MasterEnd | LREAL | Position of the master at the end of the current segment. | MyCamSegmentStruct.MyCamParameters[x].MasterEnd |
| U | SlaveEnd | LREAL | Position of the slave at the end of the current segment. | MyCamSegmentStruct.MyCamParameters[x].SlaveEnd |
| U | CurveType | INT | Formula code to indicate the motion profile for the segment. | MyCamSegmentStruct.MyCamParameters[x].CurveType |
| U | Resolution | REAL | Determines how many data points are calculated along this segment. If the master delta for this segment is 10 units, and the resolution is 0.5, then 20 points calculated. | MyCamSegmentStruct.MyCamParameters[x].Resolution |



Data Type: CamSegmentArray

Supporting structure for [CamSegmentStruct](#). For use with the [CamGenerator](#) function block.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-------------------|--|-------------|----------------------|
| | MyCamSegmentArray | CamSegmentArray | | |
| U | CamSegmentArray | ARRAY[0..400] OF CamParameters | | MyCamSegmentArray[0] |

Notes:

This is an internal sub structure for CamSegmentStruct and is not intended to be referenced directly by the user.



Data Type: CamSegmentStruct

For use with the [CamGenerator](#) function block.

Data Type Declaration

| | * | Element | Data Type | Description | Usage |
|--|---|--------------------|------------------|---|--|
| | | MyCamSegmentStruct | CamSegmentStruct | | |
| | U | CamParameters | CamSegmentArray | | |
| | U | MasterEnd | LREAL | Location of the master at the end of the current segment | MyCamSegmentStruct.CamParameters[x].MasterEnd |
| | U | SlaveEnd | LREAL | Location of the slave at the end of the current segment | MyCamSegmentStruct.CamParameters[x].SlaveEnd |
| | U | CurveType | INT | Formula code to indicate the motion profile for this segment | MyCamSegmentStruct.CamParameters[x].CurveType |
| | U | Resolution | REAL | Determines how many data points are calculated along this segment | MyCamSegmentStruct.CamParameters[x].Resolution |
| | U | ArcRadius | LREAL | If CurveType = Arc, this element describes the radius. Not used for any other CurveTypes. | MyCamSegmentStruct.ArcRadius |
| | U | ArcDirection | INT | If CurveType = Arc, (1=ccw, -1=cw). Not used for any other CurveTypes. | MyCamSegmentStruct.ArcDirection |
| | U | SplineStartSlope | LREAL | If the first Segment is CurveType = CubicSpline, this value is the positional slope of the profile as the cam begins. Typically this value is zero unless the cam is blended with other cams, and the slope cannot be automatically determined by the CamGenerator. | MyCamSegmentStruct.SplineStartSlope |
| | U | SplineEndSlope | LREAL | If the last Segment is CurveType = CubicSpline, this value is the positional slope of the profile as the cam completes. Typically this is zero unless the cam is blended with other cams, and the slope cannot be automatically determined by the CamGenerator. | MyCamSegmentStruct.SplineEndSlope |
| | U | TableShift | LREAL | If non zero, this value represents the amount of initial shift in the master slave values that is applied to the table data. | MyCamSegmentStruct.TableShift |
| | U | LastSegment | INT | Informs the CamGenerator which element of the CamSegmentStruct contains the last segment of cam data to be | MyCamSegmentStruct.LastSegment |

| | | | | | |
|--|---|----------------|------|---|-----------------------------------|
| | | | | applied. | |
| | C | OutAndBackCam | BOOL | Flag which indicates if the first and last slave position are the same (out and back.) If they are different, the cam is reciprocating, and the slave will move away from the initial start position with each passing cycle. | MyCamSegmentStruct.OutAndBackCam |
| | U | UseSplineSlope | BOOL | Flag to indicate to use the SplineSlope parameters in this structure. | MyCamSegmentStruct.UseSplineSlope |

Example

```
RampInCam.SlaveStart:=LREAL#0.5; (* Slave home position at 12 O'Clock *)
```

```
RampInCam.LastSegment:=INT#2;
```

```
RampInCam.CamParameters[1].CurveType:=TB_CurveType#TangentBlending;
```

```
RampInCam.CamParameters[1].MasterEnd:=LREAL#0.9;
```

```
RampInCam.CamParameters[1].SlaveEnd:=LREAL#0.9; (* Slave moves SlaveEnd - SlaveStart during RampIn *)
```

```
RampInCam.CamParameters[1].Resolution:=REAL#0.01;
```

```
RampInCam.CamParameters[2].CurveType:=TB_CurveType#StraightLine;
```

```
RampInCam.CamParameters[2].MasterEnd:=LREAL#1.0;
```

```
RampInCam.CamParameters[2].SlaveEnd:=LREAL#1.0;
```

```
RampInCam.CamParameters[2].Resolution:=REAL#0.01;
```



Data Type: CamStruct

For use with Y_CamIn and Y_CamOut function blocks

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|--------------------|------------------|--|-------------------------------|
| | MyCamStruct | CamStruct | | |
| U | FileName | STRING | Filename that will be used by Y_CamFileSelect | MyCamStruct.FileName |
| U | TableType | INT | 0=Undefined, 1=M/S pair, 2=reserved, 3=reserved | MyCamStruct.TableType |
| U | TableSize | UDINT | The size of the cam table in bytes (Don't forget, 16 bytes per M/S pair) | MyCamStruct.TableSize |
| U | TableID | UINT | Number returned from Y_CamFileSelect | MyCamStruct.TableID |
| U | EngagePosition | LREAL | Master location where slave must start synchronization (Reference prm 1502 - CamMasterShiftedCyclic) | MyCamStruct.EngagePosition |
| U | EngageData | Y_ENGAGE_DATA | | MyCamStruct. |
| U | DisengagePosition | LREAL | Master location where slave must stop synchronization (Reference prm 1502 - CamMasterShiftedCyclic) | MyCamStruct.DisengagePosition |
| U | DisengageData | Y_DISENGAGE_DATA | | MyCamStruct. |
| | Window | LREAL | Size of the window in master units where the engage or dis-engage will take place | MyCamStruct.Window |
| U | MasterCycle | LREAL | | MyCamStruct.MasterCycle |
| U | SlaveCycle | LREAL | | MyCamStruct.SlaveCycle |



Data Type: CamSyncStruct

For use with the [CamControl](#) and [CamShift_Control](#) function blocks.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|-----|------------------------|----------------------|--|------------------------------------|
| | MyCamSyncStruct | CamSyncStruct | | |
| U | Mode | INT | Describes the application so the function blocks can apply the correct logic. 1 = Rotary Knife 2 = Linear Flying Shear 3 = Rotary Placer or Reciprocating Drill | MyCamSyncStruct.Mode |
| U | StartSyncPosition | LREAL | The first master position where the slave must be synchronized with the master. | MyCamSyncStruct.StartSyncPosition |
| U | EndSyncPosition | LREAL | The final master position where the slave must be synchronized with the master. | MyCamSyncStruct.EndSyncPosition |
| U | DecisionPosition | LREAL | Key location in the process where the controller must decide to disengage the slave from the process or continue camming and CamShift to the next product. | MyCamSyncStruct.DecisionPosition |
| U | MaxShift | LREAL | If Mode = 3, this value helps the CamShift_Control function block determine whether the slave should advance or retard to synchronize with the next product. For other modes, this input is not used. | MyCamSyncStruct.MaxShift |
| U/C | SafeEngageDistance | LREAL | The distance the master travels from the sensor until the product is less than one machine cycle away from the synchronization position. If zero is entered, the CamShift_Control function block will calculate the value automatically. If the MachineCycle is greater than the distance from the sensor to the synchronization point, enter LREAL#0.0. | MyCamSyncStruct.SafeEngageDistance |
| C | Shifting | BOOL | Status flag set by the CamShift_Control function block to signal the CamControl function block. | MyCamSyncStruct.Shifting |
| C | Pause | BOOL | Status flag set by the CamControl function block to signal the CamShift_Control function block. | MyCamSyncStruct.Pause |



Data Type: Matrix

For internal use by the [CamGenerator](#) for [Cubic Spline](#) calculations.

Data Type Declaration

| | * | Element | Data Type | Description | Usage |
|---|---|----------|---------------------------|-------------|-------------|
| | | MyMatrix | Matrix | | |
| U | | Matrix | ARRAY[0..20] OF SubMatrix | | MyMatrix[0] |



Data Type: SlaveOffsetStruct

For use with the [SlaveOffset_Control](#) function block.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|----------------------------|--------------------------|--|---------------------------------------|
| | MySlaveOffsetStruct | SlaveOffsetStruct | | |
| U | StartSyncPosition | LREAL | The first master position where the slave must be synchronized with the master | MySlaveOffsetStruct.StartSyncPosition |
| U | SyncPosition | LREAL | The master position that represents the center of the sync zone. Usually SyncPosition = (EndSyncPosition - StartSyncPosition)/2. | MySlaveOffsetStruct.SyncPosition |
| U | EndSyncPosition | LREAL | The final master position where the slave must be synchronized with the master, adjustments can start after. | MySlaveOffsetStruct.EndSyncPosition |



Data Type: TableIDStruct

For use with the [CamTableUpdate](#) function block.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|------------------------|----------------------|--|--------------------------|
| | MyTableIDStruct | TableIDStruct | | |
| U | Inactive | UINT | The CamTableID that is NOT currently being accessed to control motion. | MyTableIDStruct.Inactive |
| U | Active | UINT | The CamTableID that IS currently being accessed to control motion. | MyTableIDStruct.Active |



Data Type: UINTArray

For use with the [CamTableManager](#) Function Block.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-------------|------------------------|--|----------------|
| | MyUINTArray | UINTArray | | |
| U | UINTArray | ARRAY[0..4] OF UINT | An array for CamTableIDs that are released from memory in a FIFO method. | MyUINTArray[0] |



Data Type: Y_MS_CAM_STRUCT

This data type is for use with the Y_CamStructSelect, Y_ReadCamTable, and Y_WriteCamTable function blocks. Y_MS_CAM_STRUCT consists of the sub-structures found below. Refer to the Internally Created Cam Data diagram in the Cam Data Management section.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|-----|-------------------|------------------------|---|-----------------------------------|
| | MyCam | Y_MS_CAM_STRUCT | | |
| | Header | Y_CAM_HEADER | | |
| U | TableType | INT | INT #1 = Master/Slave pair. If using the Y_ReadCamTable function block, this value must be set by the user before executing the function. | MyCam.Header.TableType |
| | <i>Reserved1</i> | <i>UINT</i> | --- | --- |
| U | DataSize | UDINT | Total used size of MS_Data in bytes. (Each Y_MS_PAIR is 16 bytes.) | MyCam.Header.DataSize |
| | MS_Header | Y_MS_HEADER | | |
| U | SlaveIncremental | BOOL | If TRUE, the slave data from pair to pair is relative. | MyCam.MS_Header.SlaveIncremental |
| U | MasterIncremental | BOOL | If TRUE, the master data from pair to pair is relative. | MyCam.MS_Header.MasterIncremental |
| | <i>Reserved1</i> | <i>UINT</i> | --- | --- |
| | <i>Reserved2</i> | <i>UINT</i> | --- | --- |
| | <i>Reserved3</i> | <i>INT</i> | --- | --- |
| | MS_Data | MS_Array_Type | Array of all master / slave data pairs used for the cam. ARRAY [0..2880] OF Y_MS_PAIR | |
| U/C | Master | LREAL | Master position | MyCam.MS_Data[0].Master |
| U/C | Slave | LREAL | Slave position | MyCam.MS_Data[0].Slave |

Notes

- MS_Data[x].Master and MS_Data[x].Slave can be set by either the user or a function block depending on whether this datatype is used with Y_ReadCamTable or Y_WriteCamTable in the PLCopen Plus firmware library.

Code Example



Enumerated Types for Cam Toolbox

Some blocks accept an enumerated type (ENUM), which is a keyword (or constant) representing a value which will configure the operation of the function block. Enumerated types are equivalent to a zero-based integer (INT) list.

Enumerated Types Declaration

| Enumerated Type | #INT Value | Enum Value | Description |
|-----------------|---|-------------------|---|
| TB_Mode | ENUM Type for CamShift_Control to specify the application type. | | |
| | 0 | n/a | |
| | 1 | RotaryKnife | Rotary Knife, Rotary Punch, etc. |
| | 2 | LinearFlyingShear | Out and Back, like linear flying shear, walking beam, bottle filler |
| | 3 | RotaryPlacer | |

| TB_CurveType | Indicates the Cam formula to be applied between to positions. | | |
|--------------|---|--|---|
| 0 | n/a | | Not a valid CurveType |
| 1 | StraightLine | | |
| 2 | Parabolic | | |
| 3 | SimpleHarmonic | | |
| 4 | Cycloidal | | |
| 5 | ModifiedTrapezoid | | |
| 6 | ModifiedSine | | |
| 7 | ModifiedConstVelocity | | |
| 8 | AsymmetricalCycloidal | | |
| 9 | AsymmetricalModifiedTrapezoid | | |
| 10 | Trapecloid | | |
| 11 | OneDwellCycloidal_1 | | |
| 12 | OneDwellCycloidal_2_3 | | |
| 13 | OneDwellTrapezoid_1 | | |
| 14 | OneDwellTrapezoid | | |
| 15 | OneDwellTrapezoid_2_3 | | |
| 16 | OneDwellModifiedSine | | |
| 17 | OneDwellTrapecloid | | |
| 18 | NoDwellSimpleHarmonic | | |
| 19 | NoDwellModifiedTrapezoid | | |
| 20 | NoDwellModifiedConstVelocity | | |
| 21 | NC2Curve | | |
| 22 | TangentMatching | | |
| 23 | ReverseTrapecloid | | |
| 24 | DoubleHarmonic | | |
| 25 | ReverseDoubleHarmonic | | |
| 26 | TangentBlending | | |
| 27 | Unsupported27 | | Unsupported |
| 28 | Unsupported28 | | Unsupported |
| 29 | UserModifiedConstVelocity | | User specifies the accel / decel distances |
| 30 | Polynomial345 | | 5th order polynomial with C3 = 10, C4 = -15, C5 = 6 |
| 31 | CubicSpline | | Cubic spline interpolation |
| 32 | Arc | | |
| 33 | ParabolicVelocityBlend | | Parabolic curve with velocity blending |
| 34 | Bezier | | Non reversing profile between two straight lines |

Cam FBs

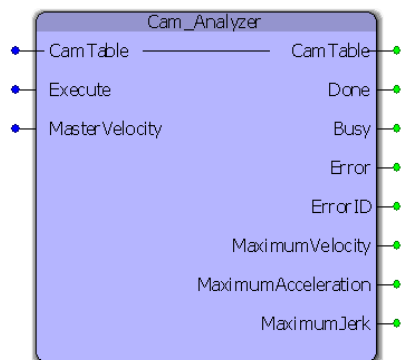
Toolbox Help Documentation

Help version created 1/31/2018

YASKAWA



Cam_Analyzer



The Cam_Analyzer function block provides the slaves maximum velocity, acceleration, deceleration and jerk values for a specific cam profile based on a maximum expected master velocity.

Library

Cam Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|----------------|---------------------------------|--|
| VAR_IN_OUT | | | |
| B | CamTable | Y_MS_CAM_STRUCT | This structure contains the resulting master/slave information for each data point and can be downloaded to the motion engine using Y_CamStructSelect. |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| B | MasterVelocity | LREAL | Master axis maximum velocity (in master user units/sec.) |
| VAR_OUTPUT | | | |

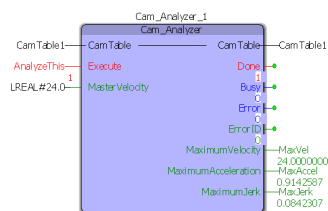
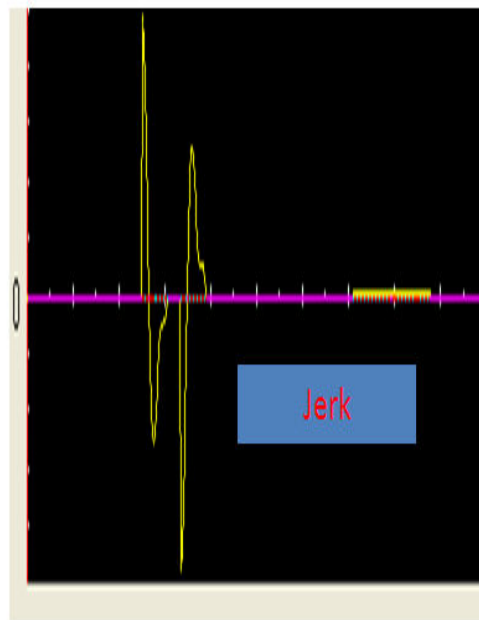
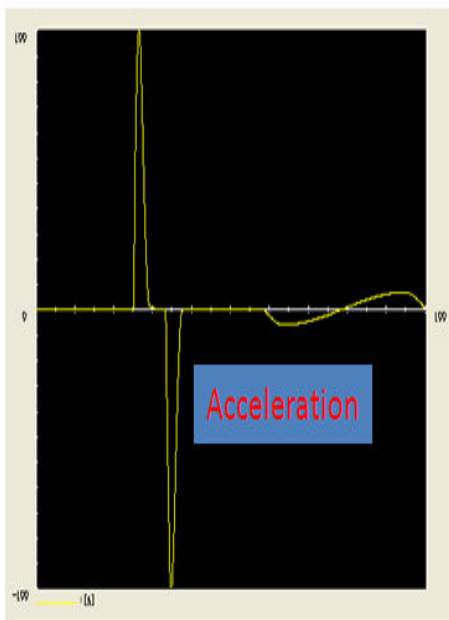
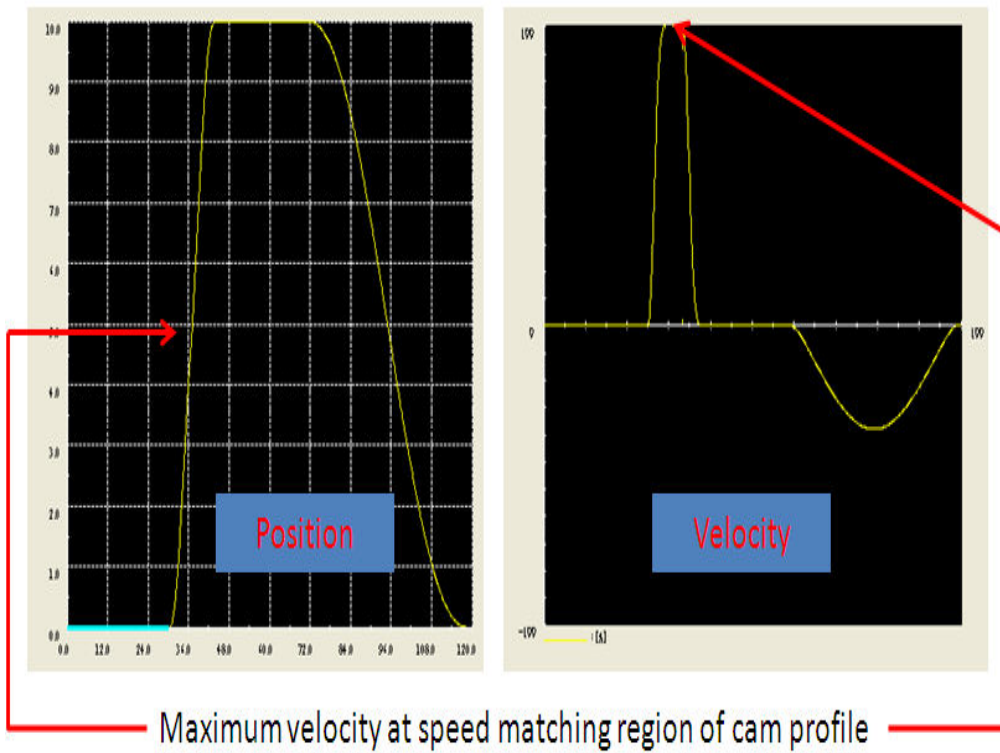
| | | | |
|---|---------------------|-------|--|
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |
| B | MaximumVelocity | LREAL | Peak slave velocity for the given cam profile at the maximum master velocity. |
| B | MaximumAcceleration | LREAL | Peak slave acceleration for the given cam profile at the maximum master velocity. |
| B | MaximumJerk | LREAL | Peak slave jerk for the given cam profile at the maximum master velocity. |

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 10113 | Incorrect cam table size (check the CamTable.Header.Datasize). |

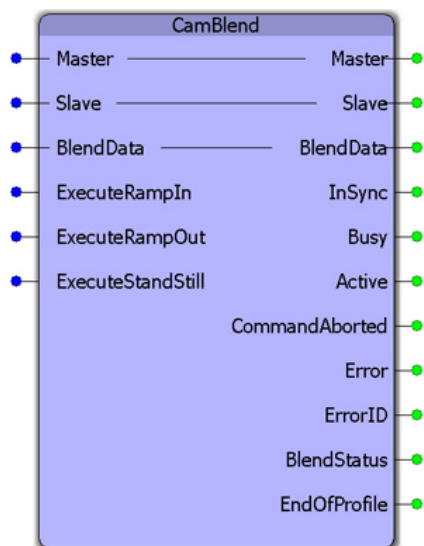
Example

Consider a linear flying shear application. The maximum slave velocity of the profile is in the speed matching region. The master maximum velocity was given as 24 units/sec and the maximum velocity output of the CamAnalyzer is 24.





CamBlend



This function block was designed for applications that require a one way cam profile, and the slave must be able to engage or disengage smoothly from a moving master. It requires three separate cam tables with a portion of equivalent slave data, so an on-the-fly changeover from one table to the next can occur. This function block uses three Y_CamIn functions blocks and one Y_CamOut function block.

Library

Cam Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|---------------|-----------------------------|--|
| VAR_IN_OUT | | | |
| B | Master | AXIS_REF | A logical reference to the master axis. |
| B | Slave | AXIS_REF | A logical reference to the slave axis. |
| V | BlendData | BlendStruct | Structure containing the information required for engaging, disengaging, ramping in, and ramping out. |
| VAR_INPUT | | | Default |
| V | ExecuteRampIn | BOOL | Upon the rising edge, this function block will prepare to engage the RampIn cam profile at the master position specified in the BlendData structure. |
| | | | FALSE |

| | | | | |
|-------------------|-------------------|------|--|-------|
| V | ExecuteRampOut | BOOL | Upon the rising edge, this function block will prepare to switch to the RampOut cam profile at the SwitchOver position specified in the BlendData structure. | FALSE |
| V | ExecuteStandStill | BOOL | Upon the rising edge, this function block will prepare to engage the slave to the Running cam profile at the StandstillEngage position (calculated after an E-Stop recovery routine) in the BlendData structure | FALSE |
| VAR_OUTPUT | | | | |
| E | InSync | BOOL | Set high when the axis or group is synchronized with the axis or group it is commanded to follow. Synchronized means that the two are position locked, any transitional period required to achieve synchronization has been completed. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |
| B | Active | BOOL | For buffered modes, this output is set high at the moment the block takes control of the axis. For non buffered modes, the outputs Busy and Active have the same value. | |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |
| V | BlendStatus | UINT | Outputs a value of 1 to indicate the RampIn Cam is operating, 2 indicates the Running cam is operating, and 3 indicates the RampOut cam is operating. | |
| E | EndOfProfile | BOOL | Pulsed output signaling the cyclic end of a CAM Profile | |

Notes

- Typically the RampInSwitchOverPos and the RampOutSwitchOverPos will be fixed at some predetermined position that is suitable for the application. Typically the RampInSwitchOverPos will occur very late in the cycle, and the RampOutSwitchOverPos will occur very early in the cycle. This will provide for the optimum motion performance by allowing as much time as possible for the slave to accelerate up to the master speed.
- If using the ExecuteStandStill mode, use the [CamMaster_Lookup](#) and [CamSlave_Recover](#) function blocks to determine the master position that corresponds to the current slave position, and set BlendData.StandStillEngagePos accordingly to preserve synchronization. The ExecuteStandStill mode was added to provide the capability of re-synchronizing after an E-Stop.

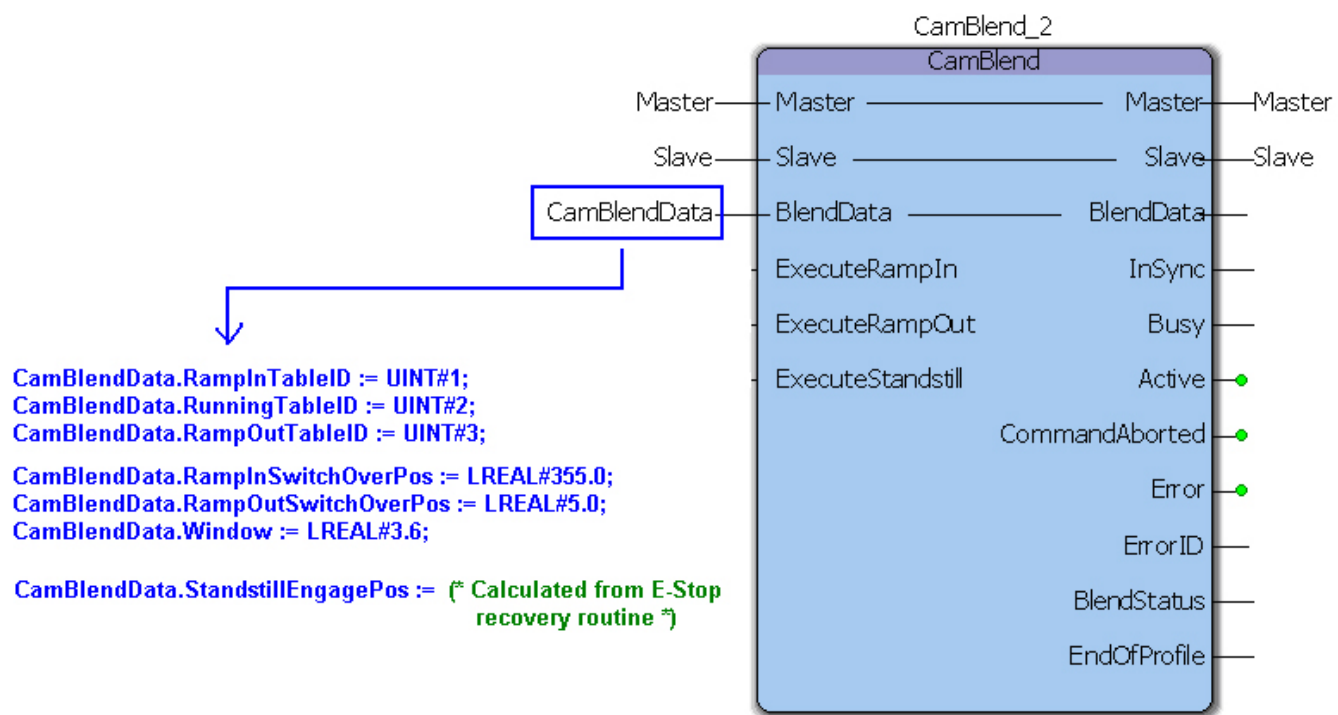
See the [CamBlend eLearning Module](#) on Yaskawa's YouTube Channel.

Error Description

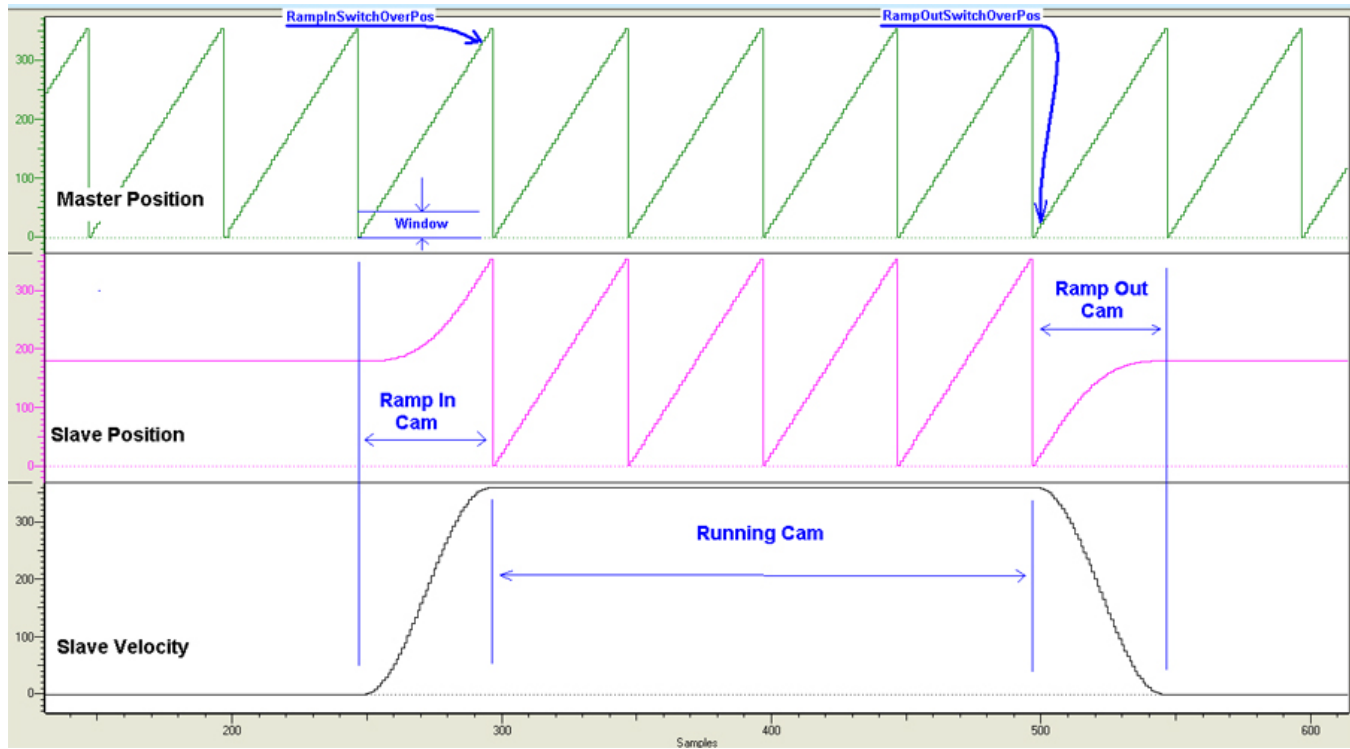
| ErrorID | Meaning |
|----------------------|--|
| 0 | No error. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4375 | CamOut called while not camming. |

| | |
|-----------------------|---|
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4394 | More than 10 Y_CamIn, Y_CamOut, or MC_GearInPos function blocks for a given axis are active at the same time. Most likely the application program is not coded correctly, and the Execute input is being fired too frequently. |
| 4395 | Window parameters are outside of the master axis' machine cycle. (0 to Prm 1502, the last master position in the active cam table.) |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4633 | Table size results in misaligned data. Refer to the help section "Internally Created Cam Data." A cam table will have a multiple of 16 bytes if created correctly. |
| 4643 | Start mode does not correspond to a valid enumeration value. |
| 4669 | Engage position is outside the cam table domain. |
| 4670 | Engage window is less than zero. |
| 467/1 | Disengage position is outside the cam table domain. |
| 4672 | Negative Disengage Window. |
| 4887 | CamTableID does not refer to a valid cam table. |
| 4891 | The slave axis can not be the same as the master axis. |
| 10084 | One of the Cam Tables has an invalid TableID. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. This error may occur because data passed to an 'Axis' input on a PLCopen function block is not an AXIS_REF. If you have included a data element into a user structure which includes an AXIS_REF, be sure that the input to the function block is entered correctly. |

Example 1

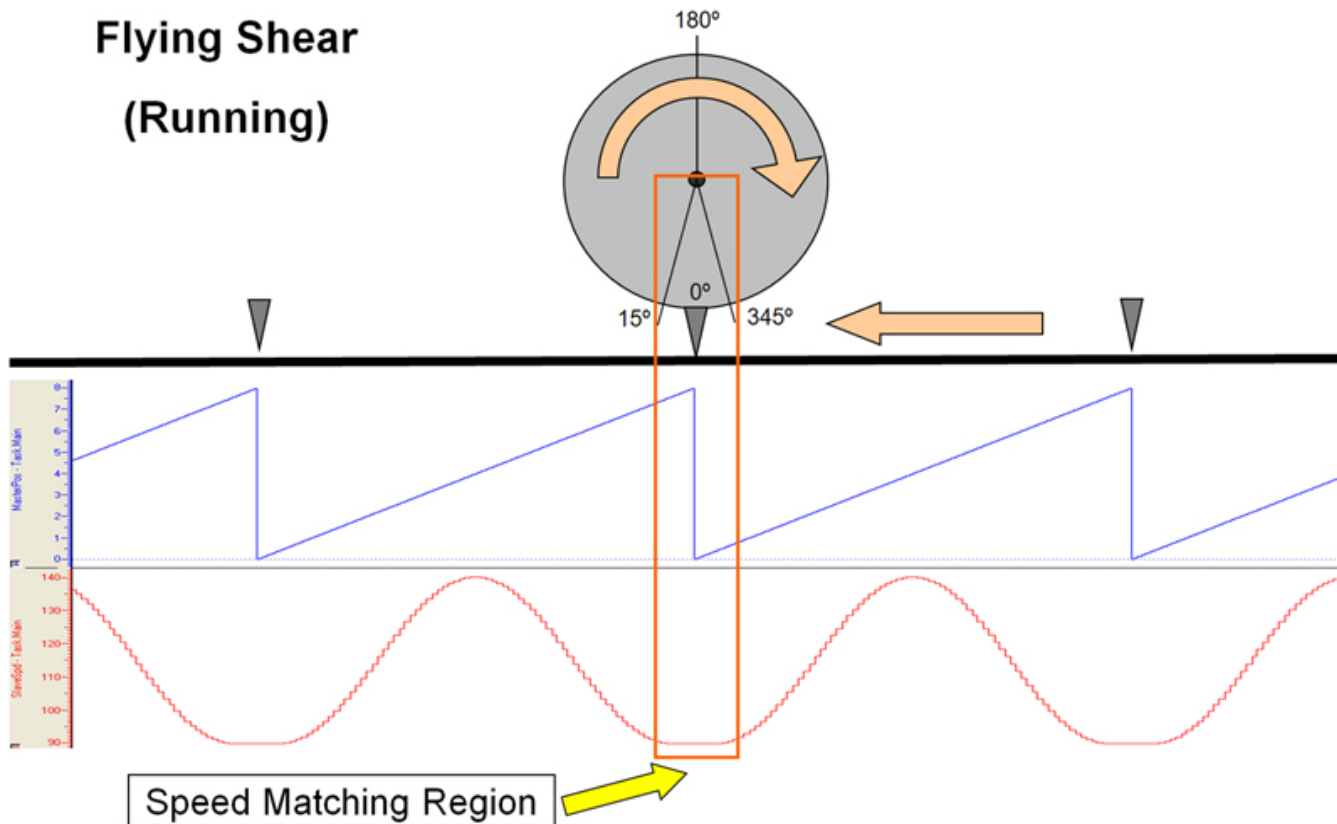


Timing Diagram



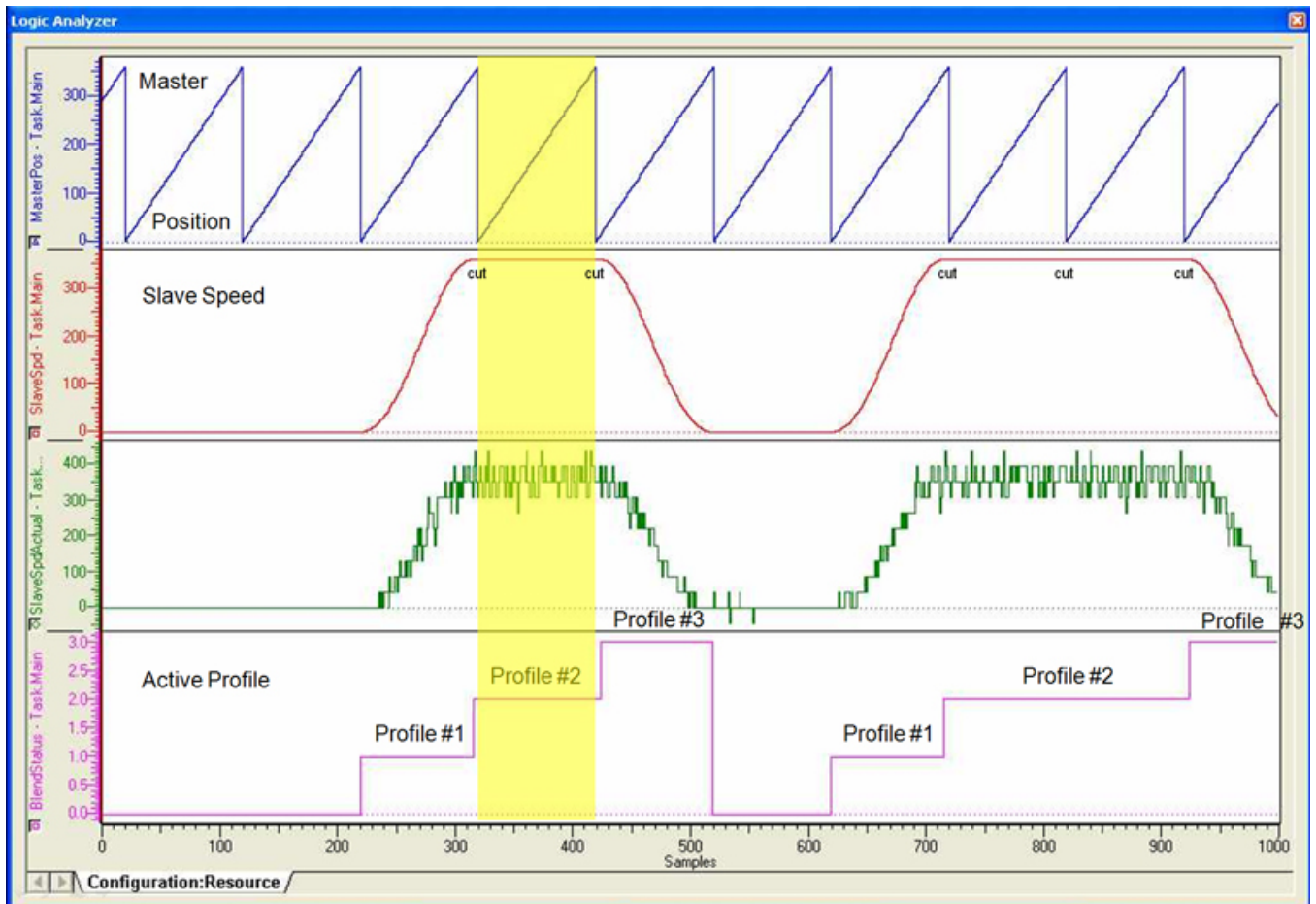
Application Example

Flying Shear (Running)



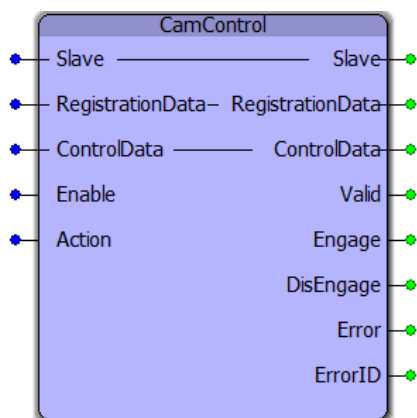
Timing Diagram

The speed matching, or normal running cam is designated as Profile #2. Profile #1 and Profile #3 will only run once, but Profile #2 will run indefinitely. A simple straight line profile for Profile #2 is not required, and reasonable motion can be used if the application requires it, keeping in mind that CamBlend was designed for one way slave motion that never stops while in normal operation, thus making it difficult to synchronize with the master smoothly without blending from one profile to another.





CamControl



The CamControl function makes decisions regarding Engage and Disengage logic for applications where products are buffered and processed at random intervals. This function block requires the [ProductBuffer](#) function block from the PLCopen Toolbox and the [CamShift_Control](#) block from the Cam Toolbox. The main inputs that feed the CamControl block are RegistrationData and ControlData. This function block was designed for applications such as a Linear Flying Shear, Random Rotary Placer, Knife, Drill, etc.

Library

Cam Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|------------------|-------------------------------------|---|
| VAR_IN_OUT | | | |
| B | Axis | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| V | RegistrationData | ProductBufferStruct | Structure containing all information for the circular buffer to operate. |
| V | ControlData | CamSyncStruct | Structure containing all information to allow both the CamControl and CamShiftControl to make decisions to run the cam function effectively. |
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | Action | INT | Designates this instance of this function block as one of the several activities to occur based on the registration sensor. For applications that have only one action, such as a cut or a stamp, this input can be uleft unconnected. This input is required for applications that have more than one action associated with a sensor input, such as pick and place. |

| VAR_OUTPUT | | | |
|------------|-----------|------|---|
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| V | Engage | BOOL | Set high when the externally located Y_Cam_In function block(s) must be executed. |
| V | Disengage | BOOL | Set high when the externally located Y_Cam_Out function block(s) must be executed. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

- The Engage output is to be used with a Y_CamIn function block placed external to this function block. This design allows for one or more cam slaves to be operated via the logic provided.
- The Disengage output is to be used with a Y_CamOut function block placed external to this function block. This design allows for one or more cam slaves to be operated via the logic provided.
- This function block is designed to work with the [CamShift_Control](#) function block. It waits for an initial Camshift will occur before the first Engage event should take place. If the application requires the slave to become synchronized with the master without a Camshift, simply use an R_TRIG of the CamControl.Valid to cause the CamData.Shifting bit to go high and low.

Error Description

| ErrorID | Meaning |
|-----------------------|---|
| 0 | No error. |
| 10081 | ControlData.DecisionPosition is <= 0. The position to determine when to disengage the cam cannot be less than or equal to zero. |

Example

The operation of CamControl in deciding when to engage and disengage a cam is shown in the logic analyzer illustration below. The rising edge of the CamControl.Shifting variable denotes the "first" product to be processed. First product in this implementation means the cam is disengaged, the ProductBuffer was empty, and a product arrived. Shifting starts immediately if it is the first product in the ProductBuffer. CamControl waits for the falling edge of the Shifting bit to set the CamControl.Engage output. While the cam is engaged, the CamControl block continues to monitor the product buffer for new products. When the ProductBuffer indicates that no products have arrived and the cam cycle has past the 'Decision Position,' the CamControl.Disengage output is turned on.

```

(*Initializing the ProductBufferStruct for Registration Data *)
(*=====*)
20 Products.BufferSize:=INT#20;          (* Maximum size of buffer*)
10.0000000 Products.LockoutDistance:=LREAL#10.0;  (* Looks for a new part only after conveyor has travelled LockOutDistance after previous part
0.0000000 Products.ManualOffset:=LREAL#0.0;
16.5000000 Products.ProductAwayDistance:=LREAL#16.5;  (* Distance from sensor that corresponds to last sync point on the cam profile*)
1 Products.Sensor.Bit:=UINT#1;          (* Equates to EXT1 on a Sigma-5 amplifier, see MC_TouchProbe help for details *)
14.0000000 Products.SensorDistance:=LREAL#14.0;      (* Distance from sensor to centre of sync area in cam profile *)
14.0000000 Products.SensorOffset:=REM(Products.SensorDistance,LREAL#18.0); (* 18 is the cam master cycle *)

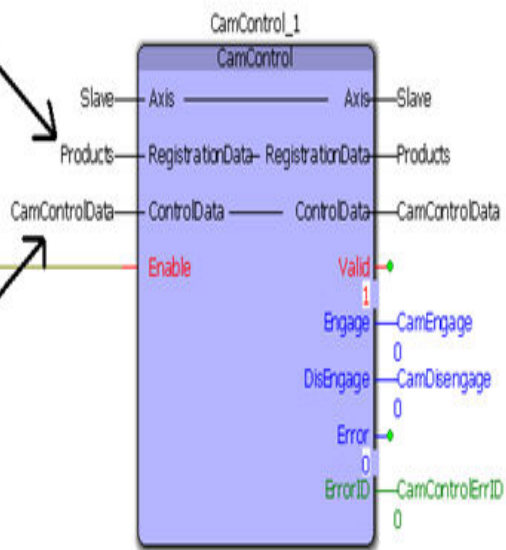
```

Variable Properties

Name: Products

Data Type: ProductBufferStruct

Usage: VAR_GLOBAL ☐ RETAIN



```

13.0000000 CamControlData.DecisionPosition := LREAL#13.0; (*Position in the cam profile where decision to cam out can be made,
9.0000000 CamControlData.EndSyncPosition := LREAL#9.0;
2 CamControlData.Mode := 2;
4.0000000 CamControlData.StartSyncPosition:= LREAL#4.0;

```

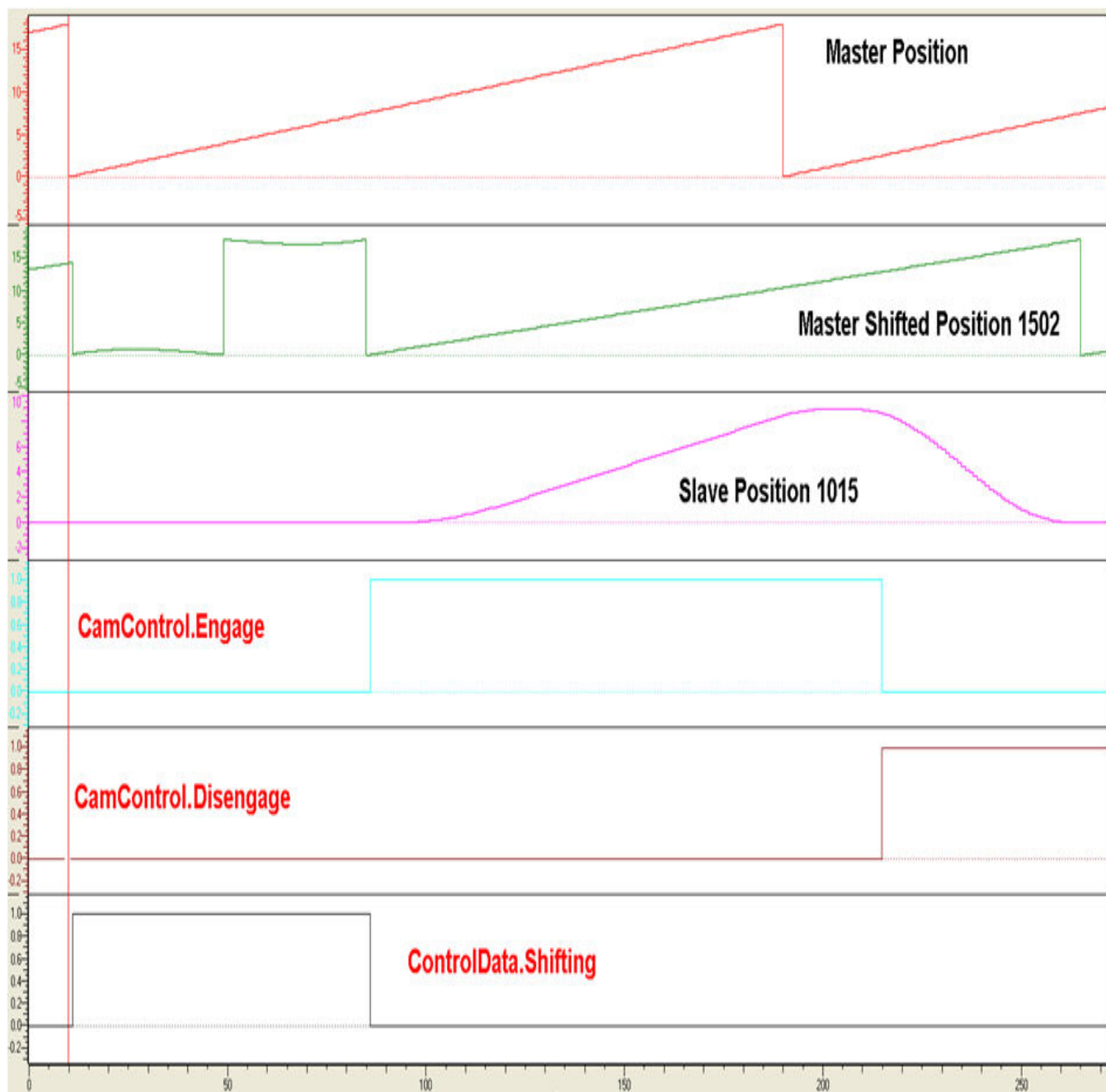
Variable Properties

Name: CamControlData

Data Type: CamSyncStruct

Usage: VAR_GLOBAL ☐ RETAIN

ControlData Shifting is updated in CamShift_Control
ControlData.Pause is updated in CamControl



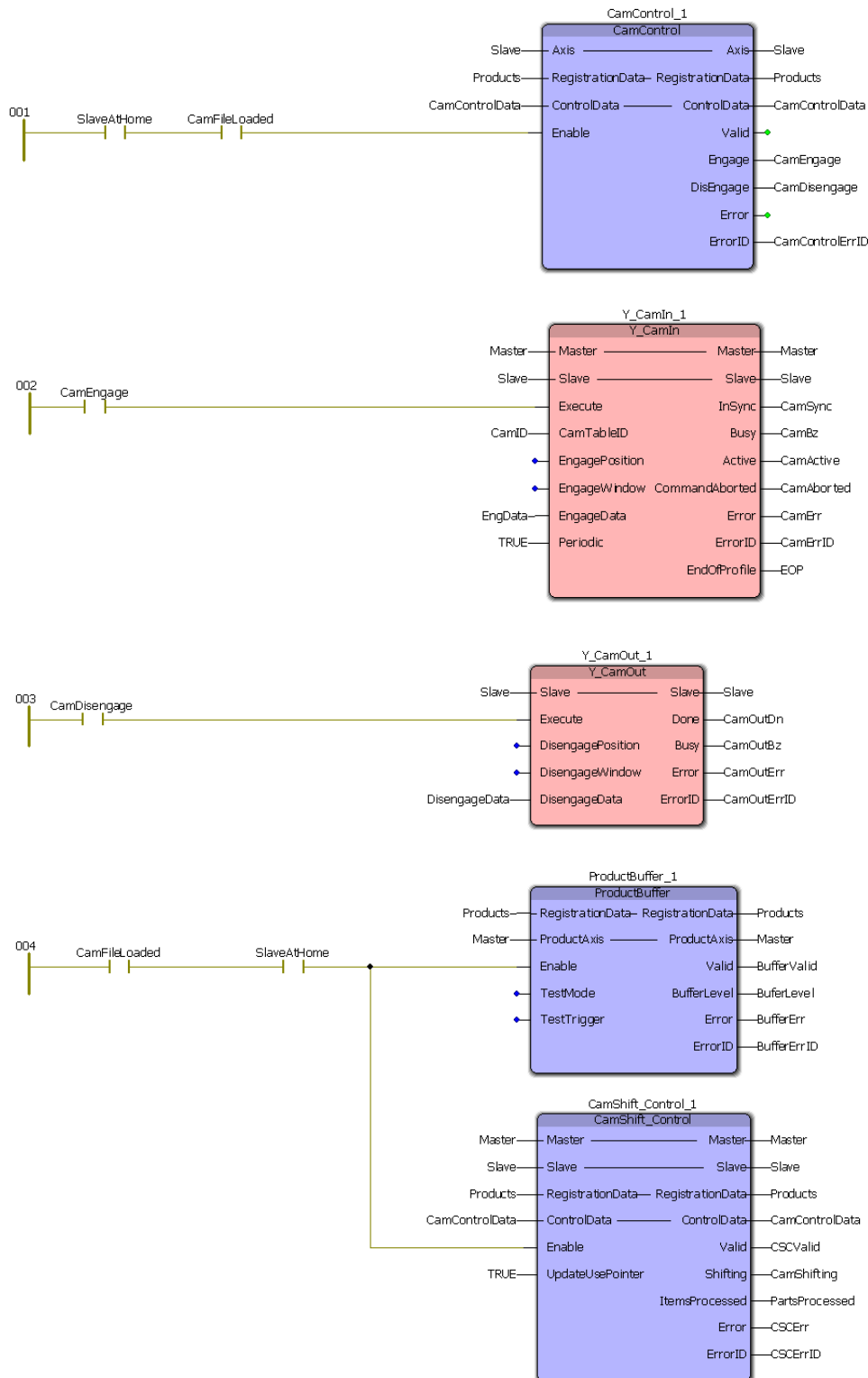
Application Example

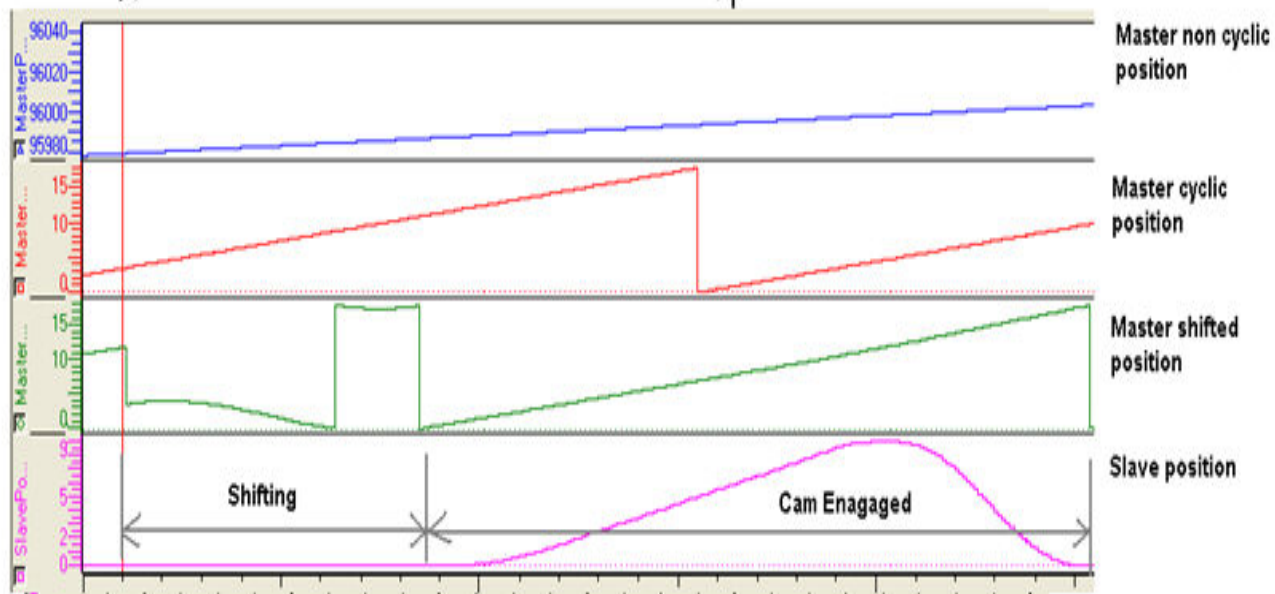
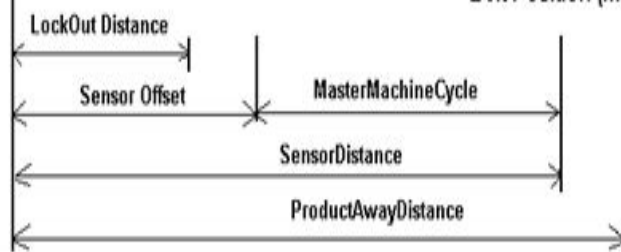
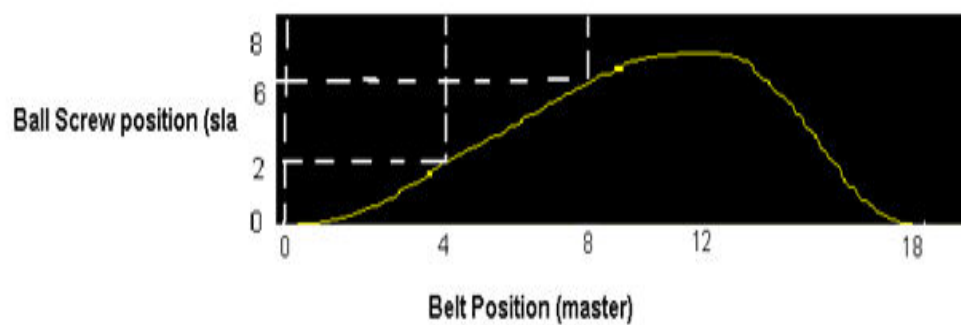
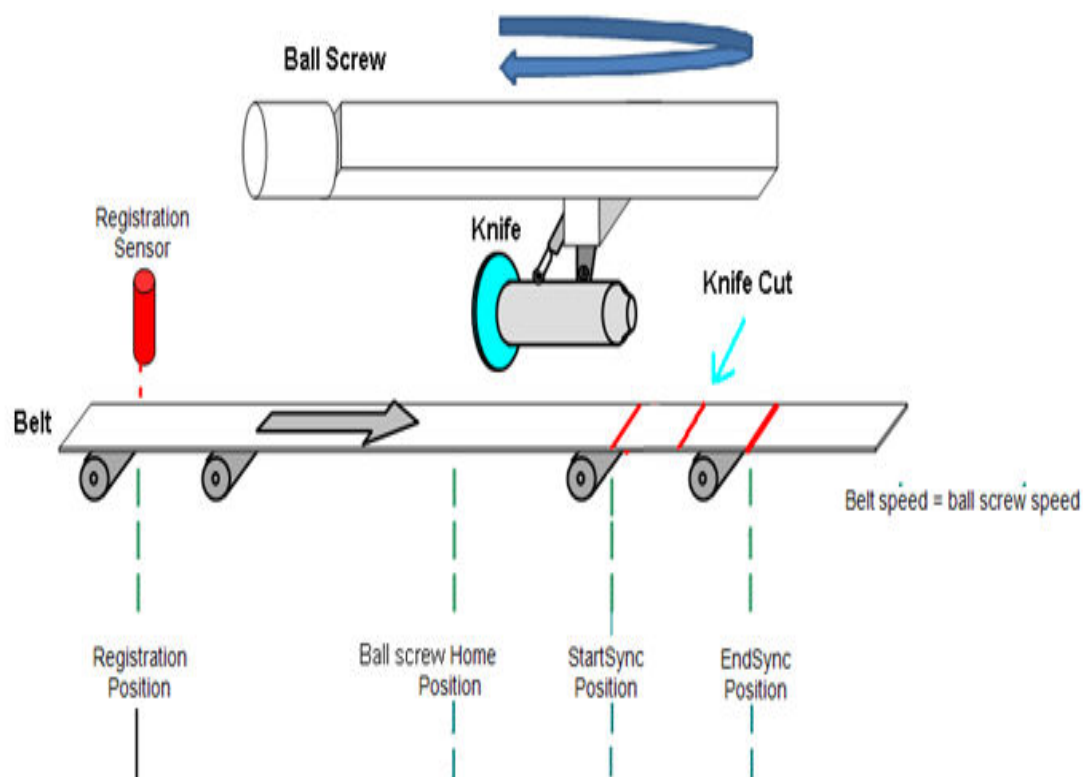
This example illustrates how the CamControl block can be applied in a linear flying shear application. In this application, the items to be cut are defective areas (knots) in a piece of wood. The code shown here performs the following actions:

1. The [ProductBuffer](#) stores the position of each defect where a cut must be made.
2. The [CamShift_Control](#) synchronizes the master (conveyor moving the wood) and slave (saw).
3. The CamControl.Engage output must be connected to Y_CamIn.Execute. (Other logic requirements may be included if necessary.)
4. Key Point: When defects are close together, the goal is to remain engaged, and use the CamShift function during the

slave (saw) retraction stroke while not in contact with the wood to re-synchronize with the next defect (or knot) to be cut.

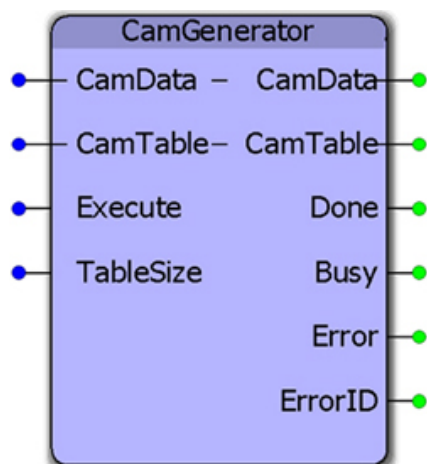
5. The CamControl.Disengage output must be connected to Y_CamOutExecute. In this application, it will cause the slave (saw) to disengage when the ProductBuffer indicates that there are no more defects to be cut.







CamGenerator



This function can calculate the information required for various master / slave motion profiles. It was designed to replicate the formulas available in Yaskawa's CamTool windows software and includes additional curve types. The CamData input is a structure of key data points required by the application, including a formula code which is used to generate a pair of master / slave data points at the resolution specified. The output CamTable is a [Y_MS_CAM_STRUCT](#) which can be downloaded to the Motion Engine using the Y_CamStructSelect function block.

Library

Cam Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|----------------------------------|--|
| VAR_IN_OUT | | | |
| V | CamData | CamSegmentStruct | This structure must be populated with the key datapoints required for the cam profile. |
| V | CamTable | Y_MS_CAM_STRUCT | Cam data structure. Can be downloaded to the motion engine using Y_CamStructSelect. |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| | | | FALSE |

| | | | | |
|-------------------|-----------|-------|--|------------|
| V | TableSize | UDINT | This value must be the same as the definition of the ARRAY size of the MS_Array_Type in the MotionInfo DataTypes folder of either the PLCopen or DataTypes Toolbox. | UDINT#2880 |
| VAR_OUTPUT | | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

- In MotionWorks IEC, certain information must be hard coded at design time, such as the size of an array. Because of this, we selected a default size of 200 for the CamSegmentArray DataType. If more segments are required, edit the Cam Toolbox's DataType definition by changing this value. There is no practical limit on the number of segments, however the IEC code uses INT datatype for array definitions associated with this function. There is also a hard coded check for the number of segments inside the CamGenerator function block. If you change the array size, also change the line that reads:

SegmentSizeError:=(CamData.LastSegment = INT#0) OR (CamData.LastSegment > INT#200).

- The default size of a Y_MS_CAM_STRUCT is defined in the PLCopen Toolbox as:

MS_Array_Type:ARRAY[0..2880] OF Y_MS_PAIR.

If your cam profile requires more than 2880 master / slave pairs, this value can be increased by editing the DataTypes Toolbox > DataTypes > MotionBlockTypes definition. When changing the value, don't forget to change the TableSize input to CamGenerator.

- The resolution specified for each point in the CamData STRUCT is resolution of the master. For example, if MasterEnd = 100.0, and the previous segment's MasterEnd = 80.0, and the Resolution = 1.0, then 20 data points will be calculated along the CurveType specified.
- See the [Cam Curve Types](#) for further details about creating cam profiles.
- See the [CamGenerator eLearning Module](#) on Yaskawa's YouTube Channel.

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 10038 | CamData.LastSegment must be greater than 0 and less than 400, or whatever value has been declared as the ARRAY size in the CTB_Types file. |
| 10039 | Cam Segment 'Resolution' cannot be zero unless the CurveType is TB_CurveType#StraightLine.. |
| 10040 | Curve Type selected in a segment is not valid. |
| 10041 | Total pairs required would exceed DataType definition for MS_Array_Type based on number of segments and resolution settings in CamData. |
| 10042 | Master must be always increasing from segment to segment. |
| 10043 | Tangent Match formula error, cannot have only one segment. |

| | |
|-----------------------|--|
| 10044 | Tangent Blend error, must have two segments, a straight line and a Tangent Blend, in either order. |
| 10077 | Cubic Spline maximum number of consecutive segments exceeded. DataType definition for the Matrix could be increased if necessary. |
| 10083 | Unsupported Cubic Spline Sequence. |
| 10089 | Bezier Error. There should be a straight line segment before and after the bezier segment. |
| 10097 | Bezier Slope Error. The slopes of the two straight lines before and after the Bezier segment should have slopes with same signs. If the slopes are positive, the slave end point should be GE slave start point. If the slopes are negative, slave end point should be LE slave start point. |

Examples

Structured text to load a [CamSegmentStruct](#):

Example 1

```

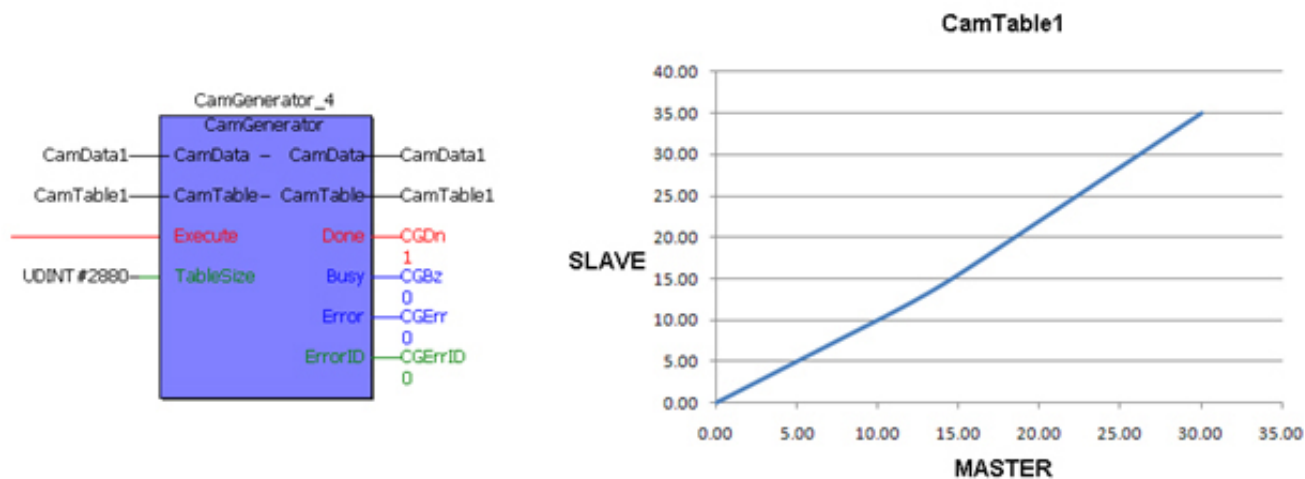
3 CamData1.LastSegment:=INT#3;
0.0000 CamData1.SlaveStart:=LREAL#0.0;

1 CamData1.CamParameters[1].CurveType:=TB_CurveType#StraightLine;
10.0000 CamData1.CamParameters[1].MasterEnd:=LREAL#10.0;
10.0000 CamData1.CamParameters[1].SlaveEnd:=LREAL#10.0;
0.5000 CamData1.CamParameters[1].Resolution:=REAL#0.5;

22 CamData1.CamParameters[2].CurveType:=TB_CurveType#TangentMatching;
20.0000 CamData1.CamParameters[2].MasterEnd:=LREAL#20.0;
22.0000 CamData1.CamParameters[2].SlaveEnd:=LREAL#22.0;
0.5000 CamData1.CamParameters[2].Resolution:=REAL#0.5;

1 CamData1.CamParameters[3].CurveType:=TB_CurveType#StraightLine;
30.0000 CamData1.CamParameters[3].MasterEnd:=LREAL#30.0;
35.0000 CamData1.CamParameters[3].SlaveEnd:=LREAL#35.0;
0.5000 CamData1.CamParameters[3].Resolution:=REAL#0.5;

```



Example 2


```

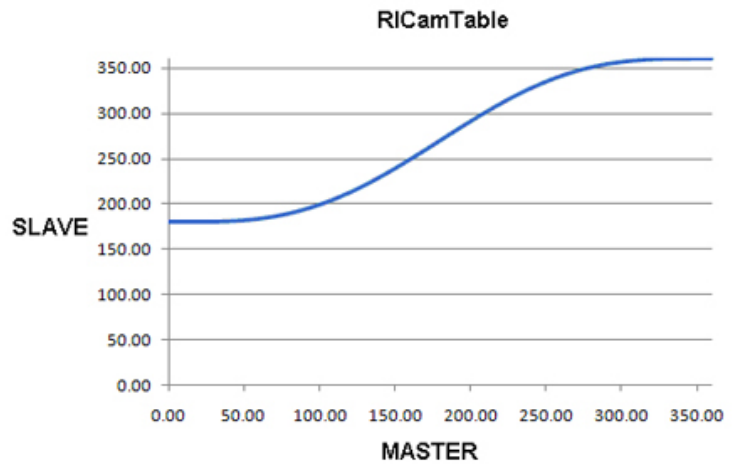
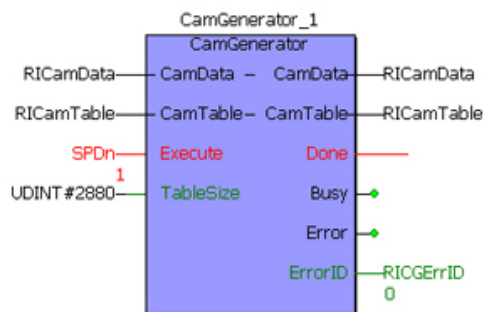
3 RICamData.LastSegment:=INT#3;
180.0000 RICamData.SlaveStart:=LREAL#180.0;

1 RICamData.CamParameters[1].CurveType:=TB_CurveType#StraightLine;
10.0000 RICamData.CamParameters[1].MasterEnd:=LREAL#10.0;
180.0000 RICamData.CamParameters[1].SlaveEnd:=LREAL#180.0;
1.0000 RICamData.CamParameters[1].Resolution:=REAL#1.0;

22 RICamData.CamParameters[2].CurveType:=TB_CurveType#TangentMatching;
350.0000 RICamData.CamParameters[2].MasterEnd:=LREAL#350.0;
350.0000 RICamData.CamParameters[2].SlaveEnd:=LREAL#350.0;
1.0000 RICamData.CamParameters[2].Resolution:=REAL#1.0;

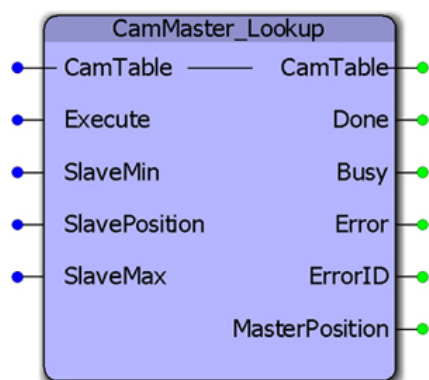
1 RICamData.CamParameters[3].CurveType:=TB_CurveType#StraightLine;
360.0000 RICamData.CamParameters[3].MasterEnd:=LREAL#360.0;
360.0000 RICamData.CamParameters[3].SlaveEnd:=LREAL#360.0;
1.0000 RICamData.CamParameters[3].Resolution:=REAL#1.0;

```





CamMaster_Lookup



This function block provides the master position given a slave position by searching the referenced CamTable. If there may be two or more master positions for the slave, as in the case of out and back slave motion, a range of slave positions can be specified to limit the search for the corresponding master position. This function block is useful for E-Stop recovery routines.

Library

Cam Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|---------------|---------------------------------|--|
| VAR_IN_OUT | | | |
| B | CamTable | Y_MS_CAM_STRUCT | Cam data structure |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| V | SlaveMin | LREAL | The smallest slave position to include when searching for the master. |
| V | SlavePosition | LREAL | The current slave position. |
| B | SlaveMax | LREAL | The largest slave position to include when searching for the master. |
| VAR_OUTPUT | | | |

| | | | |
|---|----------------|-------|--|
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |
| B | MasterPosition | LREAL | The master position which corresponds to the SlavePosition. |

Notes

This function provide the exact master position that corresponds to the SlavePosition input by interpolating the CamTable. Consider the following CamTable:

| M | S |
|----|----|
| 0 | 0 |
| 10 | 0 |
| 20 | 5 |
| 30 | 10 |
| 40 | 20 |

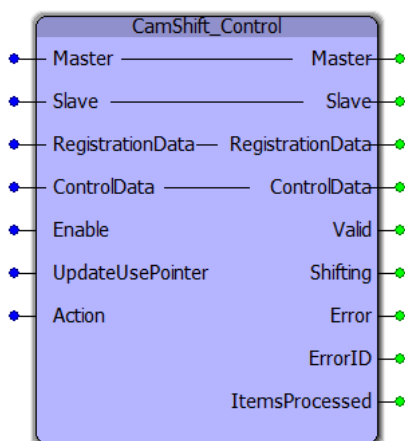
If the SlavePosition is 15, the corresponding MasterPosition is 35.

Error Description

| ErrorID | Meaning |
|-----------------------|---|
| 0 | No error. |
| 10045 | SlavePosition not found in Y_MS_CAM_STRUCT. |



CamShift_Control



The CamShift_Control block manages cam shifting for applications that buffer random products such as Linear Flying Shear or Random Rotary Placer/Knife/Drill, etc. The purpose is to re synchronize the slave for each item or product arriving on the master axis.

Library

Cam Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|------------------|-------------------------------------|---|
| VAR_IN_OUT | | | |
| B | Master | AXIS_REF | A logical reference to the master axis |
| B | Slave | AXIS_REF | A logical reference to the slave axis |
| V | RegistrationData | ProductBufferStruct | Structure containing all information for the circular buffer to operate. |
| V | ControlData | CamSyncStruct | Structure containing all information about the cam profile that will be used to calculate and implement cam shifts |
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | UpdateUsePointer | BOOL | RegistrationData.UsePointer will be updated when a product has been processed only if this input is TRUE. If more than one slave follow the master, only the last slave must update the UsePointer. |

| | | | | |
|-------------------|----------------|-------|--|--------|
| V | Action | INT | Designates this instance of this function block as one of the several activities to occur based on the registration sensor. For applications that have only one action, such as a cut or a stamp, this input can be left unconnected. This input is required for applications that have more than one action associated with a sensor input, such as pick and place. | INT #1 |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| V | Shifting | BOOL | Set high if the function block is active and Y_CamShift is Busy. | |
| V | ItemsProcessed | UDINT | Provides a count of the number of products processed since this function was enabled. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

- This function block includes a Y_CamShift block, and will execute shifts at the appropriate position based on data provided by the user via the ControlData structure.
- The shifted master position is available by reading slave axis parameter 1502.
- This function block requires the [ProductBuffer](#) function block from the PLCopen Toolbox and the CamControl block from the Cam Toolbox. These three blocks work together to provide cam engage/disengage control as well as cam shifting (synchronization) logic.
- The 'Shifting' bit is held high when a Y_CamShift is in progress.
- The CamShift_Control block uses data from RegistrationData and ControlData to make decisions on when to shift the master position and by how much to shift the position. The user must provide valid data in the RegistrationData and ControlData structures.
- In cases where multiple slaves are synchronized to a single master, the slaves can share the same ProductBuffer. Set the last slave (last CamShift_Control function block) to update the UsePointer for the ProductBuffer.

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 11050 | Cam correction (shift/offset) has been aborted by another function block. |
| 10082 | Mode Error. ControlData.Mode can only be 1 (one way cam) or 2 (two way cam). |

Code Example

The role of CamShift_Control in master / slave synchronization for each product is illustrated below.

```

(*Initializing the ProductBufferStruct for Registration Data *)
(*=====*)
20 Products.BufferSize:=INT#20; (* Maximum size of buffer*)
10.0000000 Products.LockoutDistance:=LREAL#10.0; (* Looks for a new part only after conveyor has travelled LockOutDistance after previous part
0.0000000 Products.ManualOffset:=LREAL#0.0;
16.5000000 Products.ProductAwayDistance:=LREAL#16.5; (* Distance from sensor that corresponds to last sync point on the cam profile*)
1 Products.Sensor.Bit:=UINT#1; (* Equates to EXT1 on a Sigma-5 amplifier, see MC_TouchProbe help for details *)
14.0000000 Products.SensorDistance:=LREAL#14.0; (* Distance from sensor to centre of sync area in cam profile *)
14.0000000 Products.SensorOffset:=REN(Products.SensorDistance.LREAL#18.0); (* 18 is the cam master cycle *)

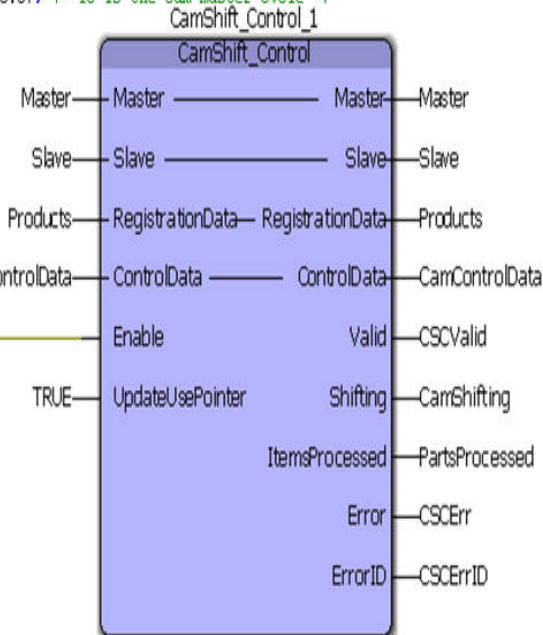
```

Variable Properties

Name:
Products
Data Type:
ProductBufferStruct
Usage:
VAR_GLOBAL ☐ RETAIN

001

SlaveAtHome CamFileLoaded



```

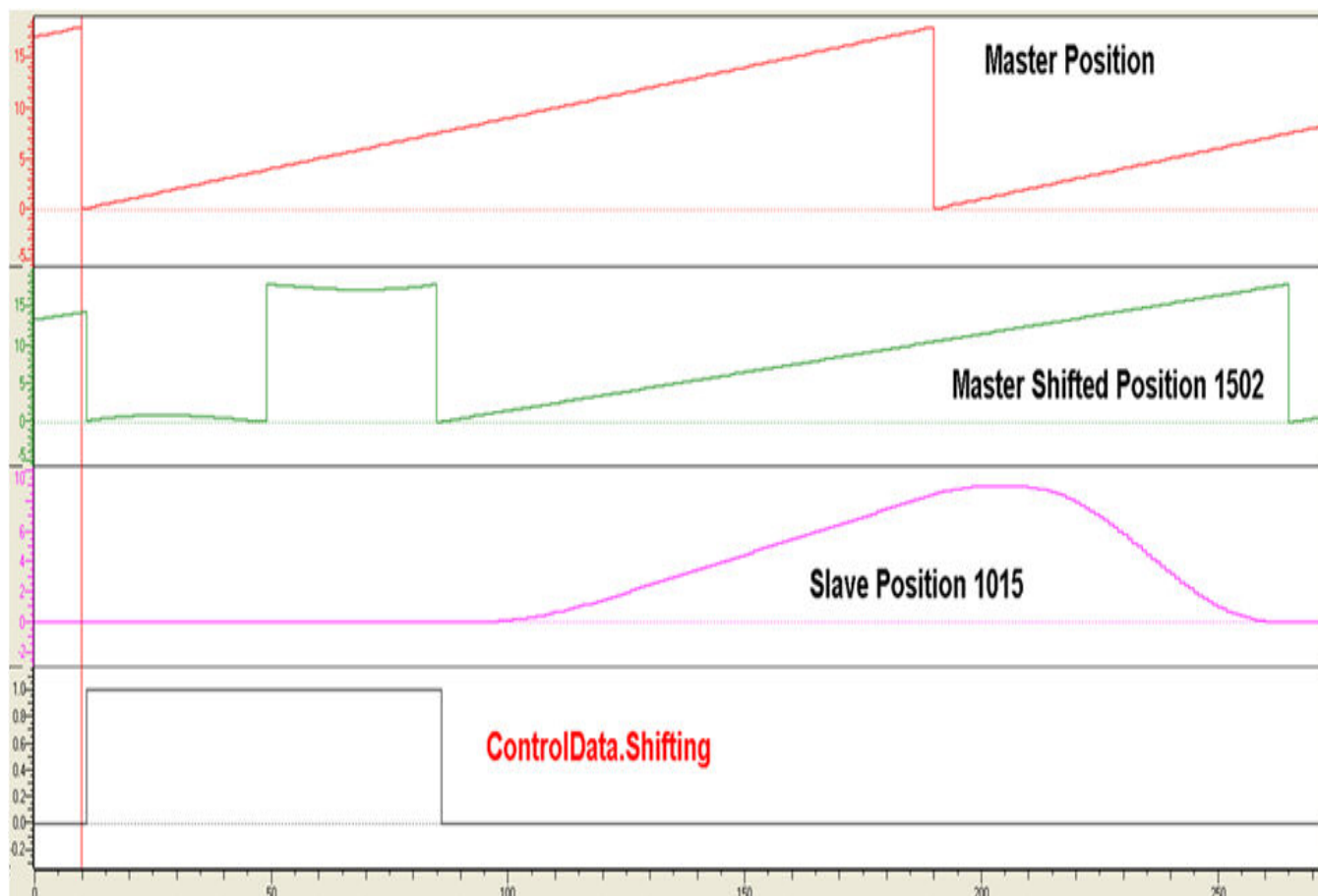
13.0000000 CamControlData.DecisionPosition := LREAL#13.0; (*Position in the cam profile where decision to cam out can be made,
9.0000000 CamControlData.EndSyncPosition := LREAL#9.0;
2 CamControlData.Mode := 2;
4.0000000 CamControlData.StartSyncPosition:= LREAL#4.0;

```

Variable Properties

Name:
CamControlData
Data Type:
CamSyncStruct
Usage:
VAR_GLOBAL ☐ RETAIN

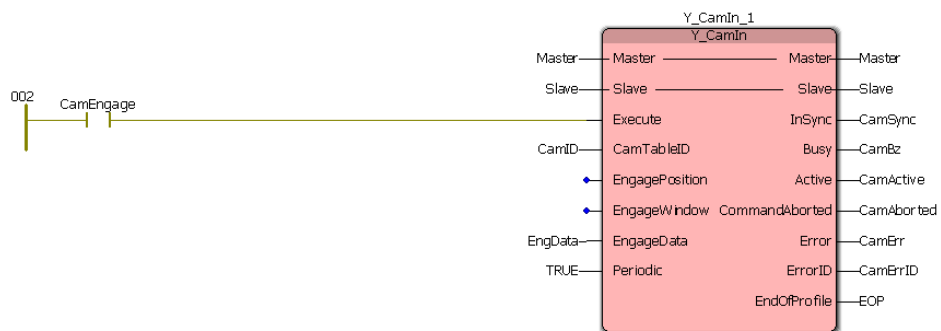
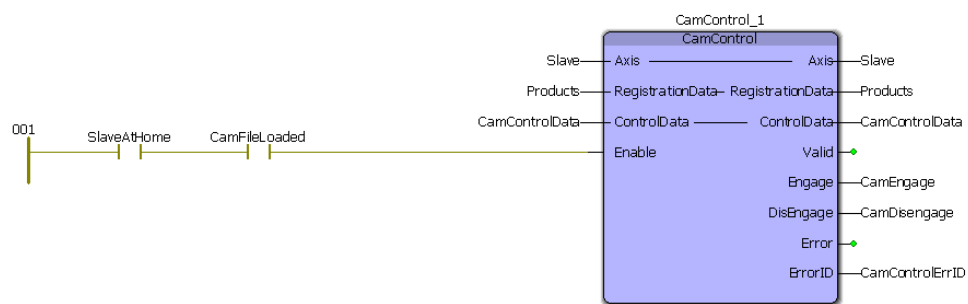
ControlData.Shifting is updated in CamShift_Control
ControlData.Pause is updated in CamControl

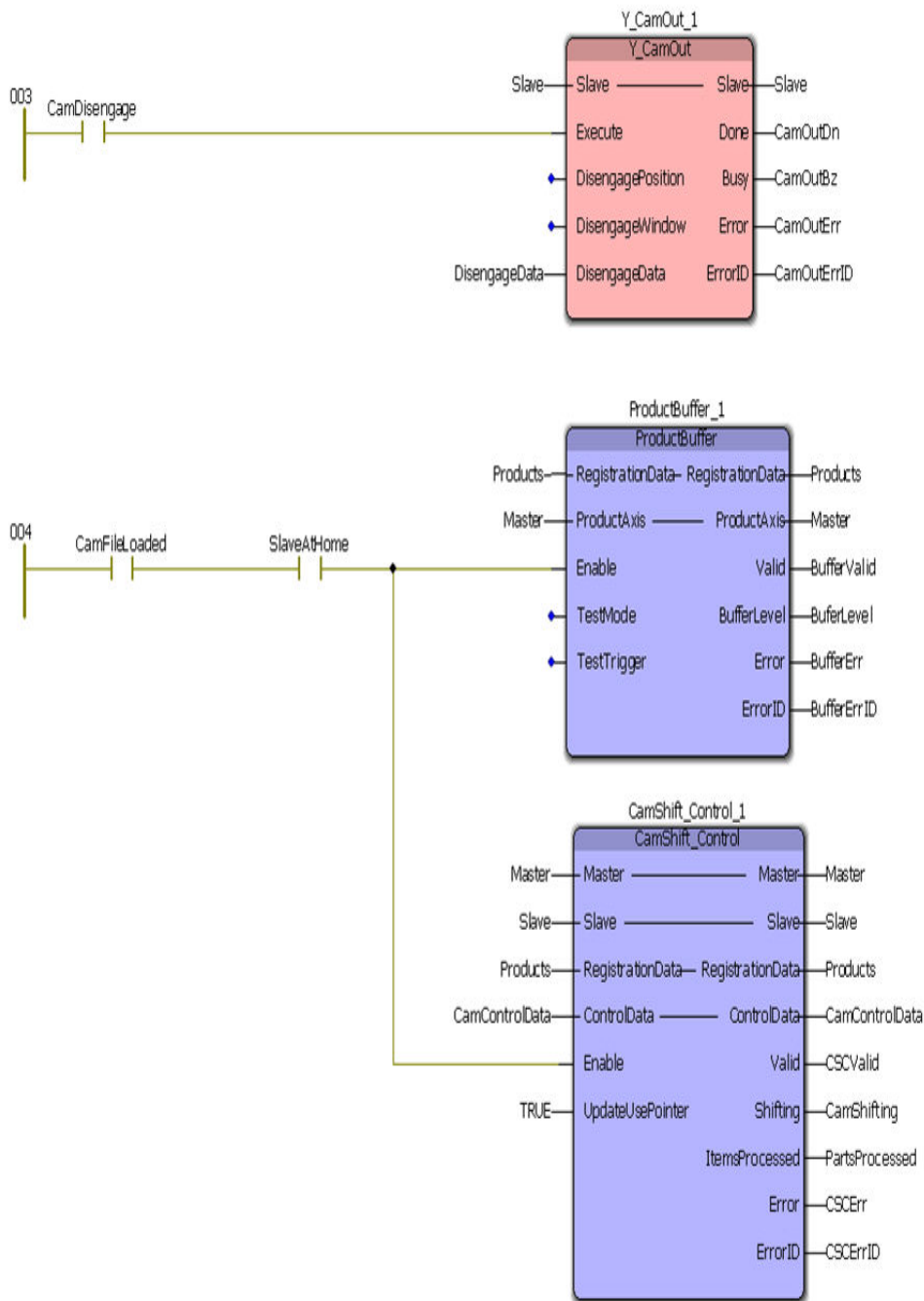


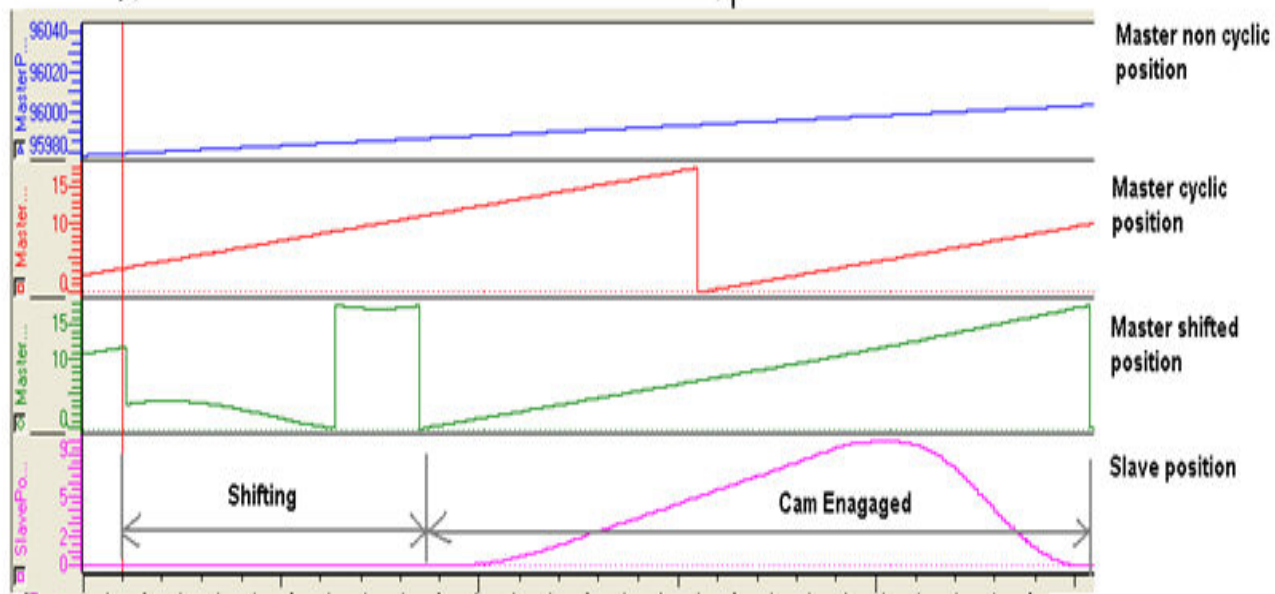
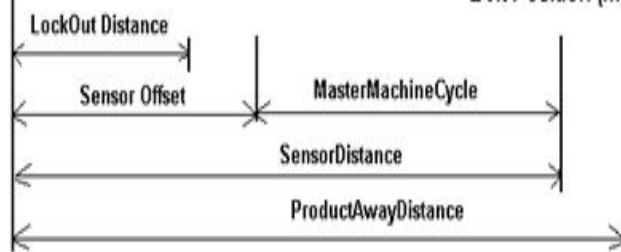
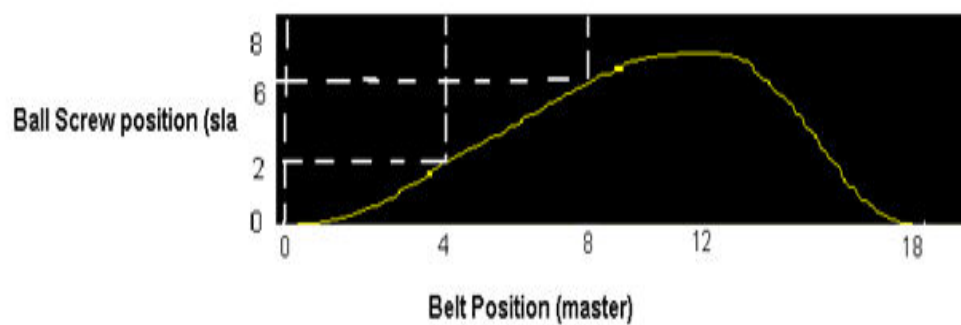
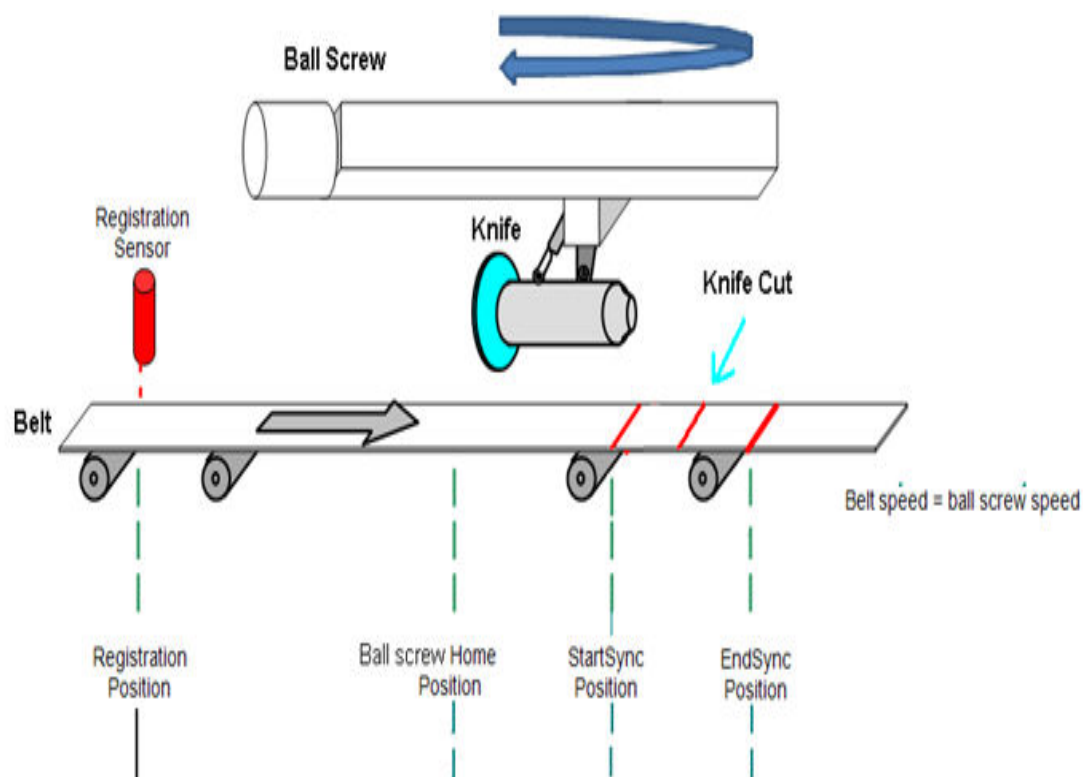
Application Example

This example illustrates how the CamControl block can be applied in a linear flying shear application. In this application, the items to be cut are defective areas (knots) in a piece of wood. The code shown here performs the following actions:

1. The [ProductBuffer](#) stores the position of each defect where a cut must be made.
2. The [CamShift_Control](#) synchronizes the master (conveyor moving the wood) and slave (saw).
3. The CamControl.Engage output must be connected to Y_CamIn.Execute. (Other logic requirements may be included if necessary.)
4. Key Point: When defects are close together, the goal is to remain engaged, and use the CamShift function during the slave (saw) retraction stroke while not in contact with the wood to re-synchronize with the next defect (or knot) to be cut.
5. The CamControl.Disengage output must be connected to Y_CamOutExecute. In this application, it will cause the slave (saw) to disengage when the [ProductBuffer](#) indicates that there are no more defects to be cut.

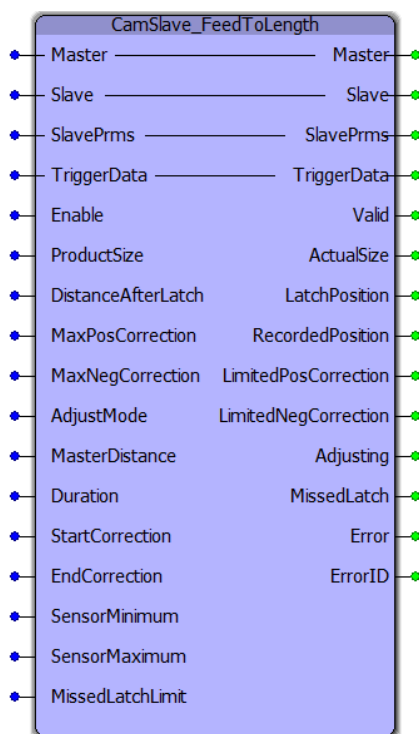








CamSlave_FeedToLength



CamSlave_FeedToLength was designed for use with camming applications that index a slave axis forward in one direction, and require on the fly adjustments of the actual index length based on a sensor input that occurs while the slave is moving. The sensor input is on the slave axis.

Library

Cam Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-------------|-------------------------------------|--|
| VAR_IN_OUT | | | |
| B | Master | AXIS_REF | A logical reference to the master axis. |
| B | Slave | AXIS_REF | A logical reference to the slave axis. |
| V | SlavePrms | AxisParameterStruct | User Defined DataType declared in the PLCopen Toolbox. |
| E | TriggerData | TRIGGER_REF | Reference to the trigger signal source.. Refer to the PLCopen Plus Function Block Manual for more details. |

| VAR_INPUT | | | | Default |
|------------|----------------------|-------|--|---|
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. | FALSE |
| V | ProductSize | LREAL | This value must be the same as the total one way index of the cam profile for this slave. | LREAL#0.0 |
| V | DistanceAfterLatch | LREAL | The desired additional travel distance after the registration mark is detected | LREAL#0.0 |
| V | MaxPosCorrection | LREAL | Limits the amount of positive correction that can be applied. | |
| V | MaxNegCorrection | LREAL | Limits the amount of negative correction that can be applied. | |
| V | AdjustMode | INT | An ENUM for TIME or range of master correction, with the following values: | |
| V | MasterDistance | LREAL | Relative amount the master will travel (in cam master units) from when the function block first executes until the correction is complete. Only used if AdjustMode = Y_AdjustMode#Master-Distance. | |
| V | Duration | LREAL | Time of the correction used if AdjustMode is set for TIME mode | |
| V | StartCorrection | LREAL | Earliest master position where the correction can begin. | LREAL#0.0 |
| V | FinishCorrection | LREAL | Latest master position where the correction must be completed. | LREAL#0.0 |
| V | SensorMinimum | LREAL | The earliest slave position where a sensor position is valid for correction. | LREAL#0.0 |
| V | SensorMaximum | LREAL | The latest slave position where a sensor position is valid for correction. | LREAL#0.0 (function block defaults to ProductSize if unconnected.) |
| V | MissedLatchLimit | UINT | The number of consecutive DefaultDistances allowed to occur without seeing a registration mark in the window, and not cause an Error. Valid registration marks will reset the internal counter. | UINT#0 (interpreted as infinite) |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| V | ActualSize | LREAL | The actual indexed distance. | |
| V | LatchPosition | LREAL | The slave's position in the CamTable when the latch occurred. | |
| B | RecordedPosition | LREAL | The slaves latch position as reported by MC_TouchProbe. | |
| V | LimitedPosCorrection | BOOL | Indicates that the MaxPosCorrection is limiting the required correction. | |
| V | LimitedNegCorrection | BOOL | Indicates that the MaxNegCorrection is limiting the required correction. | |
| V | Adjusting | BOOL | Indicates that an adjustment is currently taking place (Busy output of Y_SlaveOffset) | |
| V | MissedLatch | BOOL | Indicates that a latch was detected, but it was outside of the window parameters specified. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

- This function block requires that the ReadAxisParameters function block from the PLCopen toolbox is also running, preferably in the same task as CamSlaveFeedToLength.
- This function block does not support buffering of products. It is recommended to place the sensor less than 1 part length away from where the correction needs to happen.
- Functionality differences between the CamSlave_FeedToLength and [SlaveOffset_Control](#) are given in the table shown below.

| | CamSlave_FeedToLength | SlaveOffset_Control |
|---|-----------------------|------------------------|
| <i>BufferProducts (SensorDistance > 1 part length)</i> | Not supported | Supported |
| <i>Successive triggers > 2 part lengths</i> | Reports missed latch | Makes large correction |
| <i>Missed Part Indicator</i> | Supported | Not supported |
| <i>Registration within window check</i> | Supported | Not supported |
| <i>Correction limits</i> | Supported | Not Supported |

- See the [CamSlave_FeedToLength eLearning Module](#) on Yaskawa's YouTube Channel.

Missed Latch Detection feature:

There are two parts to this feature.

- 1) It will report an ErrorID 10021 if the user enters a non zero value for the MissedLatchLimit and a consecutive number of latches are not counted. (To detect a hardware failure or other problem with system such as a sensor blockage.)
- 2) If latches are detected, but are outside of the SensorMinimum and SensorMaximum range, it is not considered a missed latch in terms of counting up to the MissedLatchLimit. In this condition, the function block will pulse the MissedLatch output to indicate that no correction will be made because the latch is not in the specified area. The user can track the MissedLatch output pulses to make adjustments to the machine, or open the window for first time synchronization of the master and slave.

In Cam Toolbox v204, this function block was modified to report the RecordedPosition as a new output so that applications can use this information to re position or re home the axis after a manual operation without adding a separate MC_TouchProbe function block in the application. The function was also modified to prohibit its internal Y_SlaveOffset from executing if no cam is engaged.

Error Description

| ErrorID | Meaning |
|----------------------|--|
| 0 | No error. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4374 | Torque move prohibited while non-torque moves queued or in progress. |
| 4378 | The function block is not applicable for the external axis specified. |

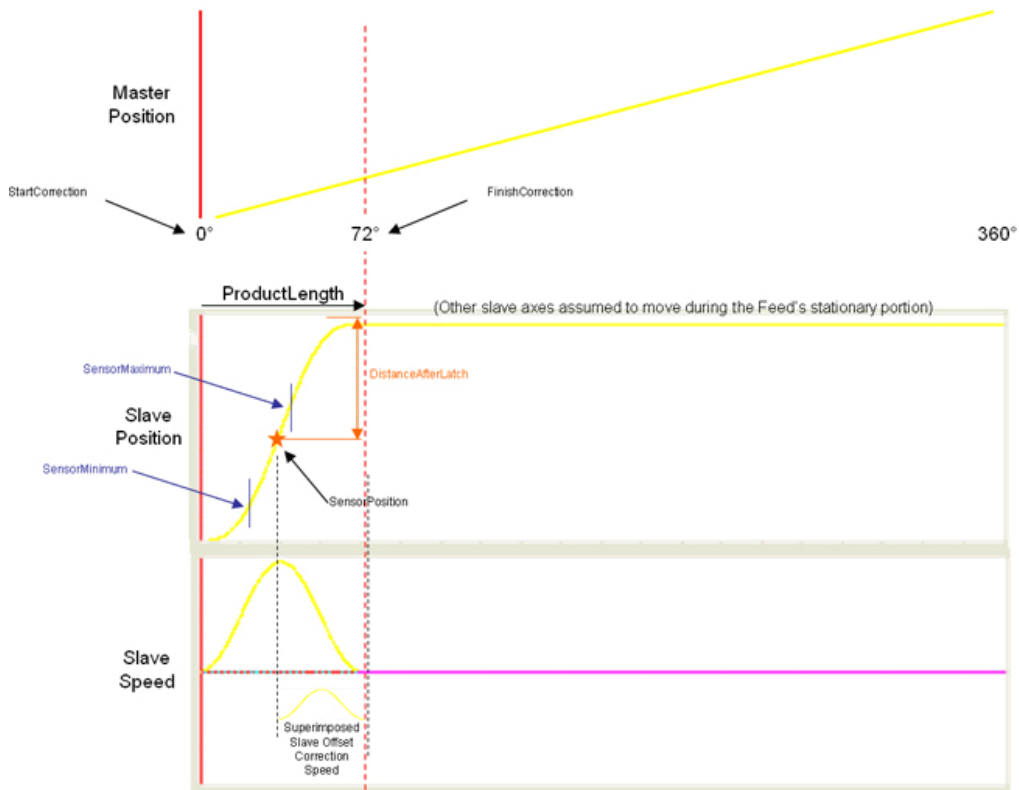
| | |
|-----------------------|--|
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4626 | The master / slave relationship is already defined. If a slave must follow a different master, use the MC_Stop block on the slave before executing the next Y_CamIn. If cascading master slaves, a maximum of two levels of cascaded master / slave relationships can be configured. |
| 4633 | Table size results in misaligned data. Refer to the help section "Internally Created Cam Data." A cam table will have a multiple of 16 bytes if created correctly. |
| 4649 | Invalid adjust mode. |
| 4657 | Distance parameter is less than or equal to zero. |
| 4663 | Specified time was less than zero. |
| 4673 | StartPosition is outside of master's range. |
| 4674 | EndPosition is outside of master's range. |
| 10020 | ProductSize cannot be less than or equal to zero. |
| 10021 | Maximum allowed consecutive missed registration marks reached. |
| 10025 | SensorMinimum must be less than SensorMaximum. |
| 10053 | DataPoint Error. |
| 10086 | MaxPosCorrection must be zero or positive, MaxNegCorrection must be or zero or negative. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |

Applications

- Label Feeder
- Punch Press
- Intermittent Form Fill and Seal

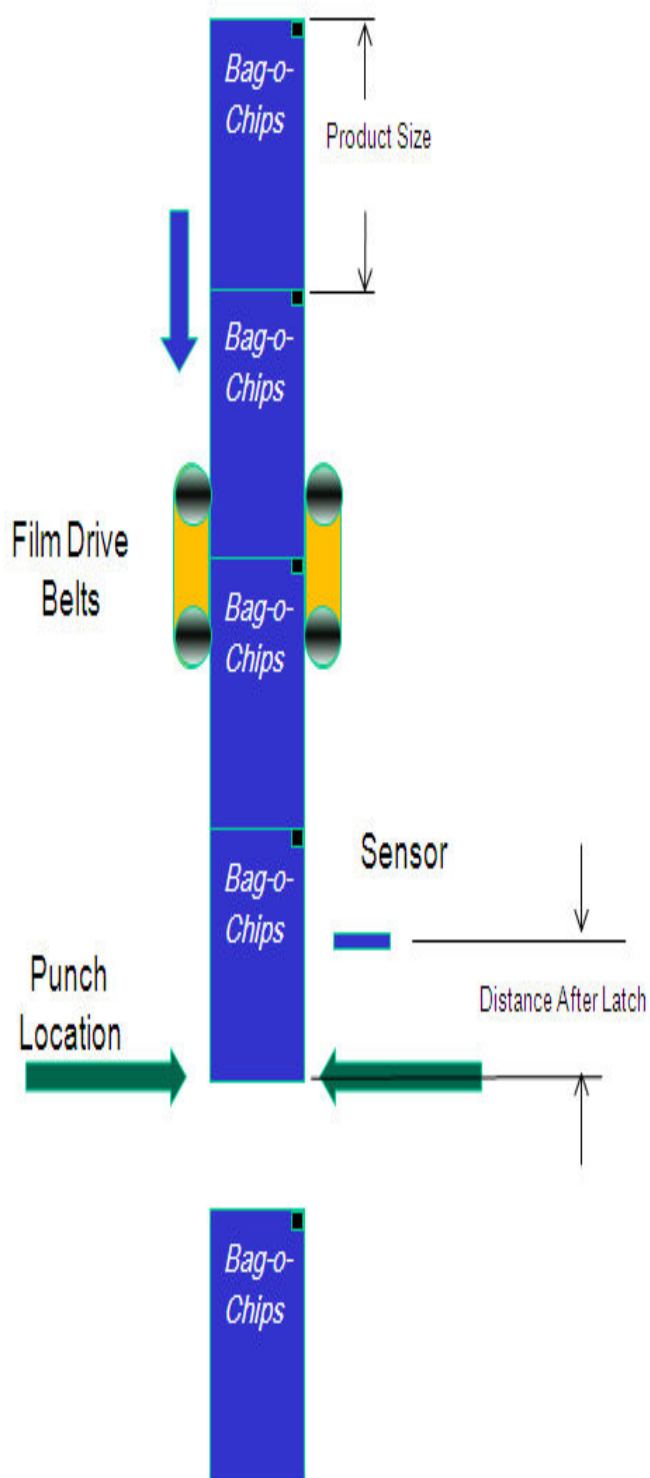
Overview of Supporting Function Blocks



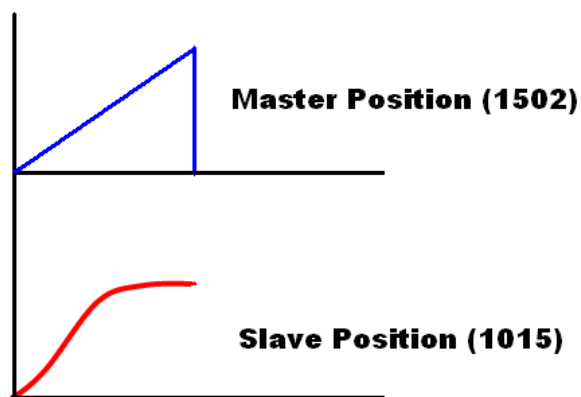


Application Example

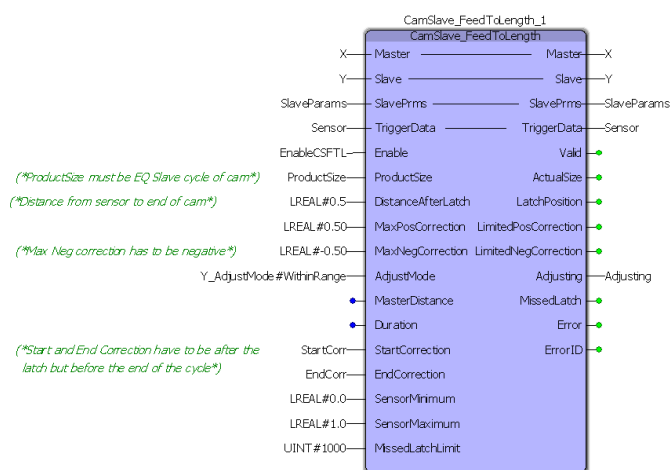
Consider a form fill and seal application as shown below. Feed belts control payout of film for the form fill and seal machine. Distance After Latch is set to align the end of bag with the cutter/punch



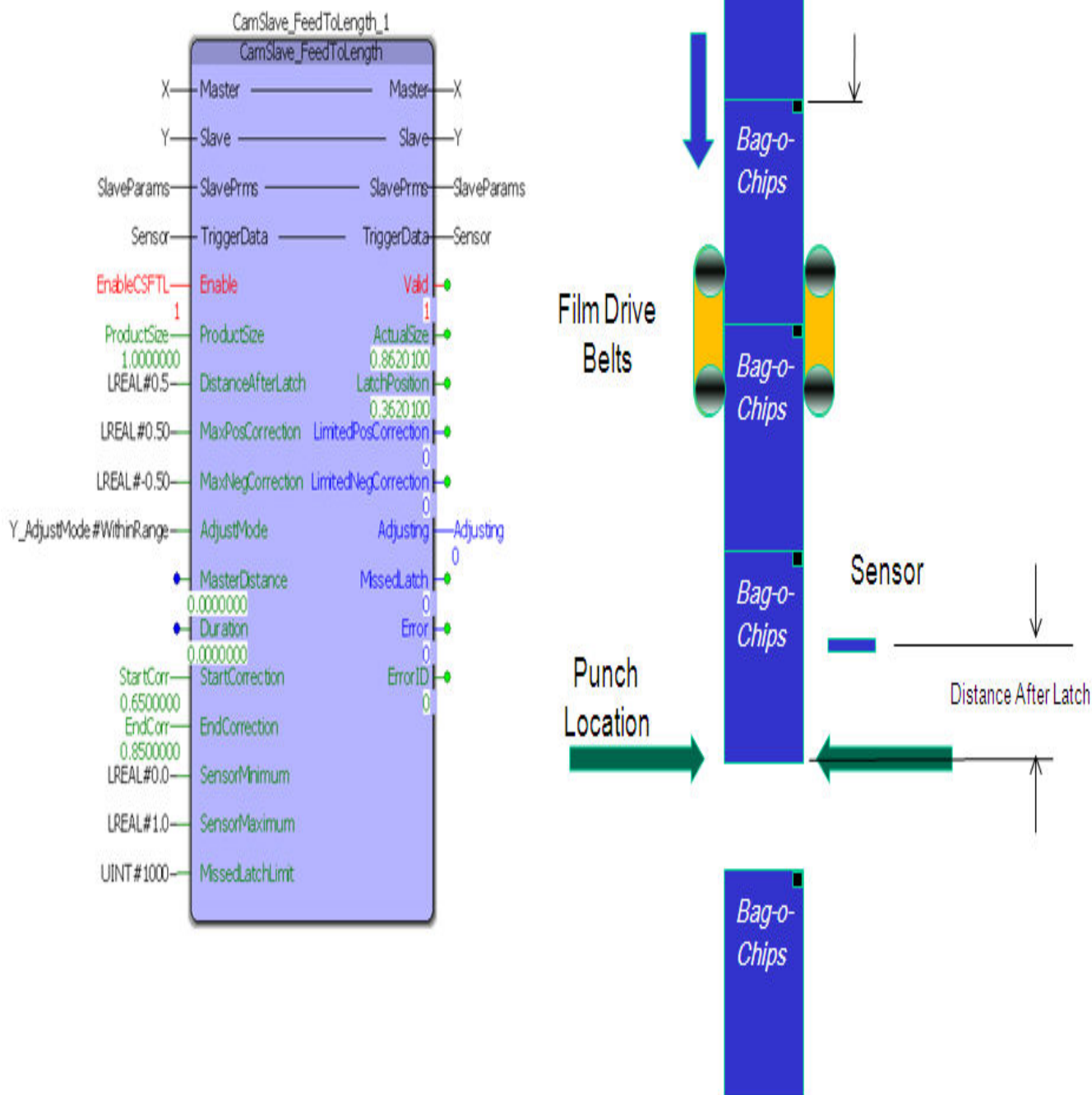
The film drive belt is the slave to a constantly running master. The nominal cam table is shown below. The master cycle is 0 - 1 units and the slave cycle is also between 0 and 1 units.



A sample screen shot of data that needs to be entered for the system described above is shown in the figure below. Care should be taken to ensure that the input parameters will generate motion that is physically achievable and desirable by the slave axis.



In the screen shot of the CamSlave_FeedToLength block shown below, the sensor detects a registration mark at 0.36201 units of the slave cycle. Assuming that the previous registration mark was captured at 0.5 units of the slave cycle, the distance between two successive registrations is 0.86201 units (0.5 + 0.36201). The actual bag length in this case is 0.86201 units.



The calculation on how much adjustment needs to be made to make the slave axis (film feed) place the film exactly at the cutter/pinch location is explained below:

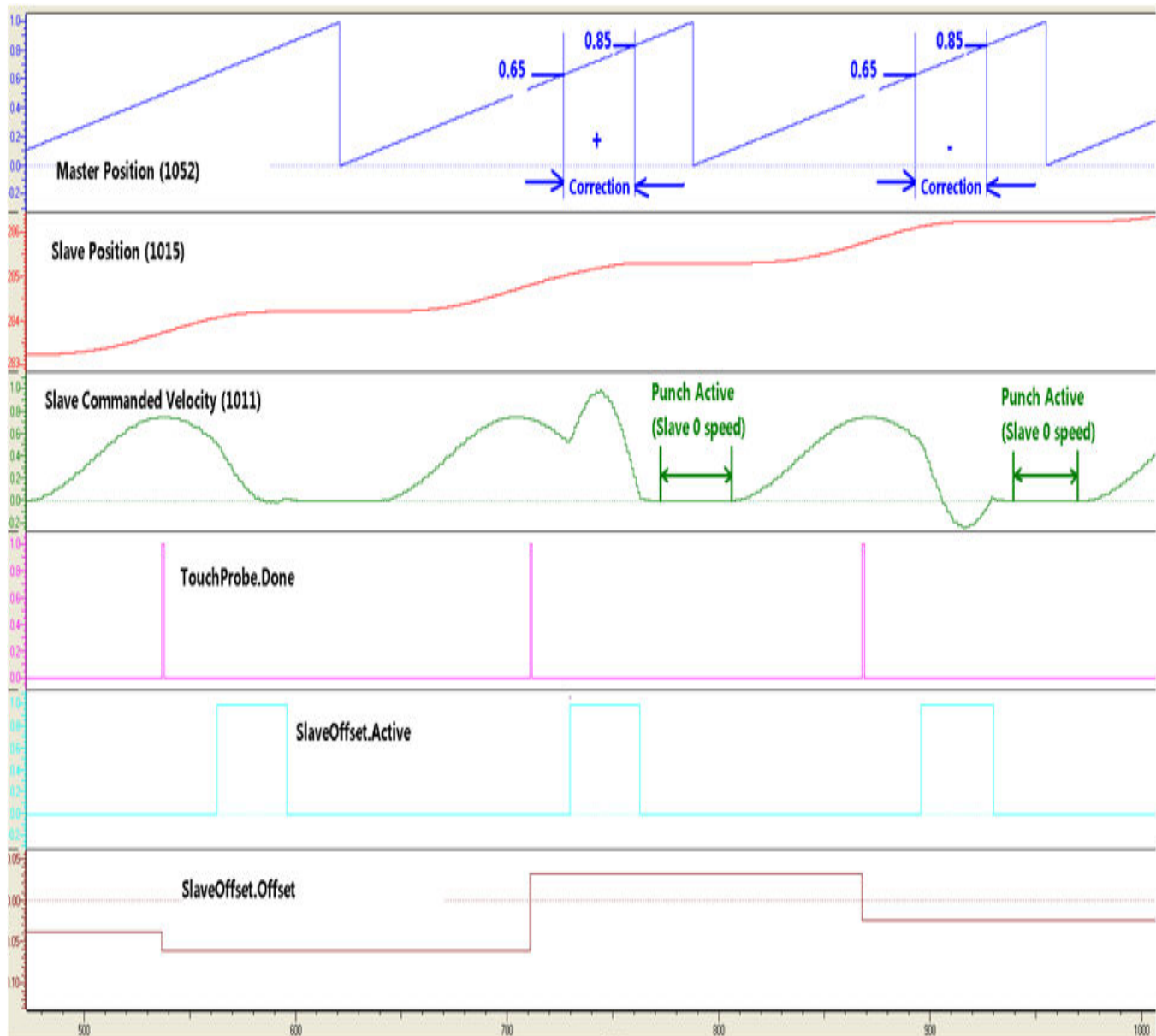
$$\text{Correction} = \text{Nominal part size (1.0)} - \text{Actual bag length (0.86201)} = -0.1379$$

This will be the amount of offset added/subtracted (for this cycle) to any previous offsets in the slave position.

A continuous sequence of short, long, short bag lengths is illustrated in the logic analyzer plots below.

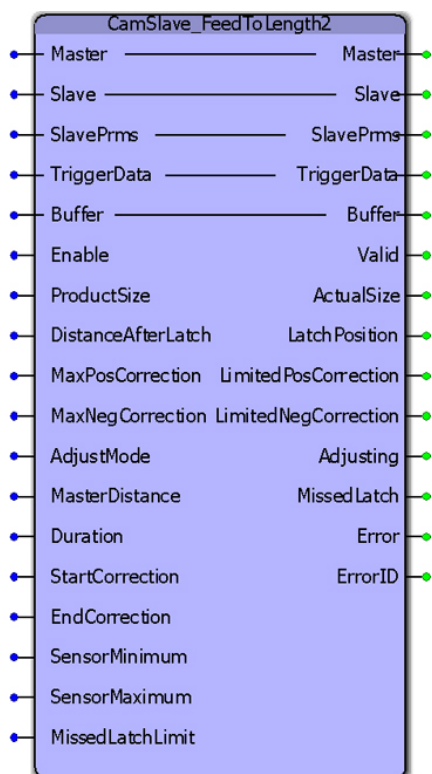
The first occurrence of TouchProbe.Done in the figure triggers a calculation that shows a short bag. A small negative offset is calculated and can be seen by the dip to negative velocity at the end of the first master cycle. The registration mark in the

middle of the second master cycle triggers a calculation that results in a long bag and a positive offset. This is seen as the spike in slave velocity between 0.65 and 0.86 units of the master cycle. The last registration mark in the figure (in the middle of the third master cycle) triggers a calculation that results in a short bag and a negative offset. This is seen as the dip in slave velocity between 0.65 and 0.86 units of the master cycle.





CamSlave_FeedToLength2



CamSlave_FeedToLength2 is an enhancement of CamSlave_FeedtoLength. The only difference is the increased performance in capturing latches that occur at higher frequency by incorporating the Y_ProbeContinuous function block. As with CamSlave_FeedtoLength, this function block was designed for use with camming applications that index a slave axis forward in one direction, and require on the fly adjustments of the actual index length based on a sensor input. The sensor input is on the slave axis.

Library

Cam Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|--------------------------|---|
| VAR_IN_OUT | | | |
| B | Master | AXIS_REF | A logical reference to the master axis. |
| B | Slave | AXIS_REF | A logical reference to the slave axis. |

| | | | |
|-------------------|----------------------|-------------------------------------|---|
| V | SlavePrms | AxisParameterStruct | User Defined DataType declared in the PLCopen Toolbox. |
| E | TriggerData | TRIGGER_REF | Reference to the trigger signal source.. Refer to PLCopen Plus Function Block Manual for more details. |
| V | Buffer | CONTINUOUS_REF | |
| VAR_INPUT | | | |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | ProductSize | LREAL | This value must be the same as the total one way index of the cam profile for this slave. |
| V | DistanceAfterLatch | LREAL | The desired additional travel distance after the registration mark is detected |
| V | MaxPosCorrection | LREAL | Limits the amount of positive correction that can be applied. |
| V | MaxNegCorrection | LREAL | Limits the amount of negative correction that can be applied. |
| V | AdjustMode | INT | An ENUM for TIME or range of master correction, with the following values: |
| V | MasterDistance | LREAL | Relative amount the master will travel (in cam master units) from when the function block first executes until the correction is complete. Only used if AdjustMode = Y_AdjustMode#MasterDistance. |
| V | Duration | LREAL | Time of the correction used if AdjustMode is set for TIME mode |
| V | StartCorrection | LREAL | Earliest master position where the correction can begin. |
| V | FinishCorrection | LREAL | Latest master position where the correction must be completed. |
| V | SensorMinimum | LREAL | The earliest slave position where a sensor position is valid for correction. |
| V | SensorMaximum | LREAL | The latest slave position where a sensor position is valid for correction. |
| V | MissedLatchLimit | UINT | The number of consecutive DefaultDistances allowed to occur without seeing a registration mark in the window, and not cause an Error. Valid registration marks will reset the internal counter. |
| VAR_OUTPUT | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| V | ActualSize | LREAL | The actual indexed distance. |
| V | LatchPosition | LREAL | The slave's position in the CamTable when the latch occurred. |
| V | LimitedPosCorrection | BOOL | Indicates that the MaxPosCorrection is limiting the required correction. |
| V | LimitedNegCorrection | BOOL | Indicates that the MaxNegCorrection is limiting the required correction. |
| V | Adjusting | BOOL | Indicates that an adjustment is currently taking place (Busy output of Y_SlaveOffset) |
| V | MissedLatch | BOOL | Indicates that a latch was detected, but it was outside of the window parameters specified. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

The slave axis must be Sigma-5 or Sigma-7 servo amplifier when using this function block.

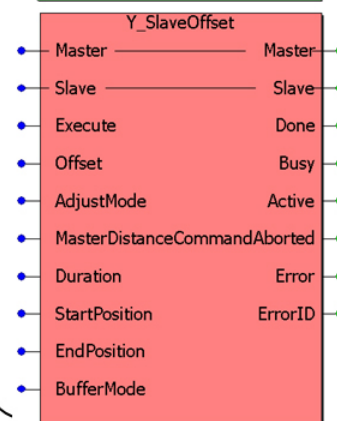
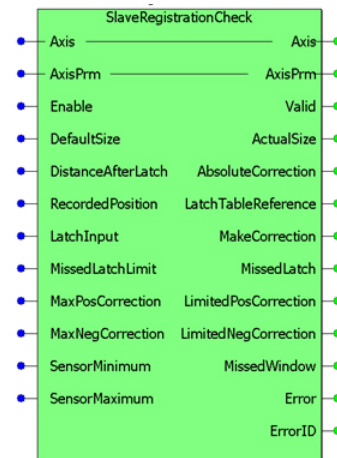
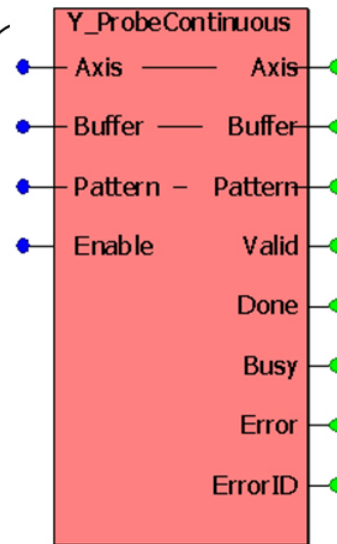
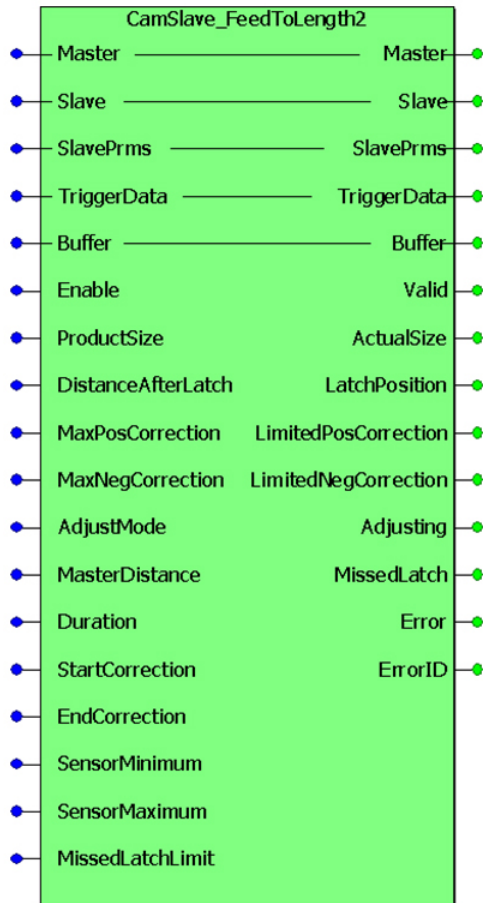
Error Description

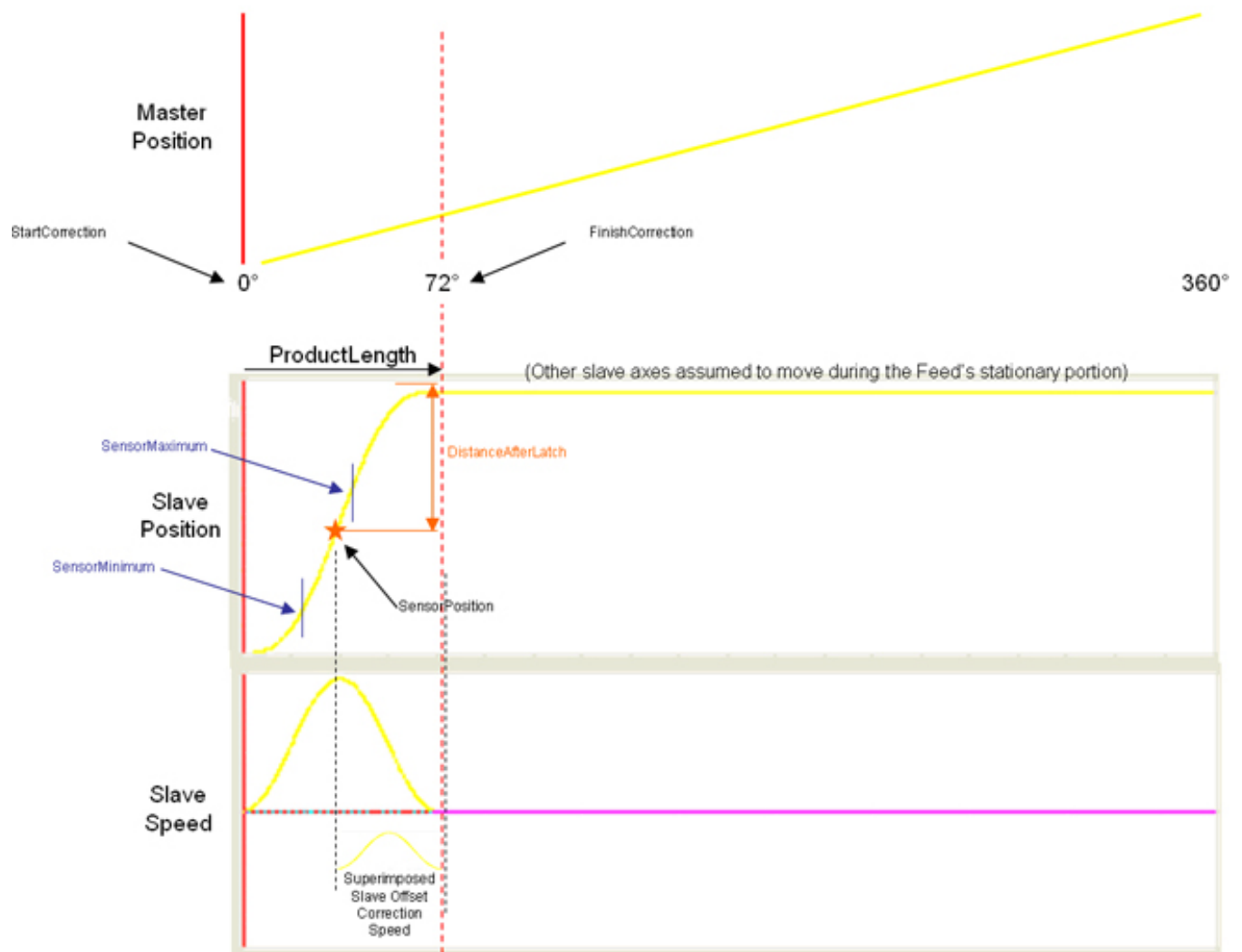
| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4374 | Torque move prohibited while non-torque moves queued or in progress. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4626 | The master / slave relationship is already defined. If a slave must follow a different master, use the MC_Stop block on the slave before executing the next Y_CamIn. If cascading master slaves, a maximum of two levels of cascaded master / slave relationships can be configured. |
| 4633 | Table size results in misaligned data. Refer to the help section "Internally Created Cam Data." A cam table will have a multiple of 16 bytes if created correctly. |
| 4649 | Invalid adjust mode. |
| 4657 | Distance parameter is less than or equal to zero. |
| 4663 | Specified time was less than zero. |
| 4673 | StartPosition is outside of master's range. |
| 4674 | EndPosition is outside of master's range. |
| 10020 | ProductSize cannot be less than or equal to zero. |
| 10021 | Maximum allowed consecutive missed registration marks reached. |
| 10025 | SensorMinimum must be less than SensorMaximum. |
| 10053 | DataPoint Error. |
| 10086 | MaxPosCorrection must be zero or positive, MaxNegCorrection must be or zero or negative. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |

Applications

- Label Feeder
- Punch Press

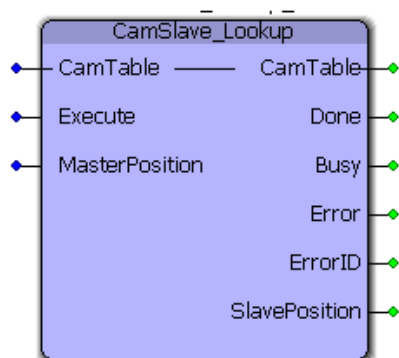
Overview of Supporting Function Blocks







CamSlave_Lookup



This function block returns the slave position corresponding to the given master position. This function block is used by [CamSlave_Recover](#).

Library

Cam Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|----------------|---------------------------------|--|
| VAR_IN_OUT | | | |
| B | CamTable | Y_MS_CAM_STRUCT | Cam data structure. |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| V | MasterPosition | LREAL | The position of the master axis for which the corresponding slave position is required. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |

| | | | |
|---|---------------|-------|--|
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |
| V | SlavePosition | LREAL | The slave position that relates to the master as described in the CamTable. |

Notes

This function provides the exact slave position that corresponds to the MasterPosition input by interpolating the CamTable. Consider the following CamTable:

| M | S |
|----|----|
| 0 | 0 |
| 10 | 0 |
| 20 | 5 |
| 30 | 10 |
| 40 | 20 |

If the MasterPosition is 15, the corresponding SlavePosition is 2.5. (50% of the value between two master points is used to determine the value 50% between the corresponding slave points.)

This function determines the equivalent slave position by looking in the CamTable only, It does not include any other cam adjustments that may have been applied using any of the Y_CamAdjust function blocks.

See the [CamSlave_Lookup eLearning Module](#) on Yaskawa's YouTube Channel.

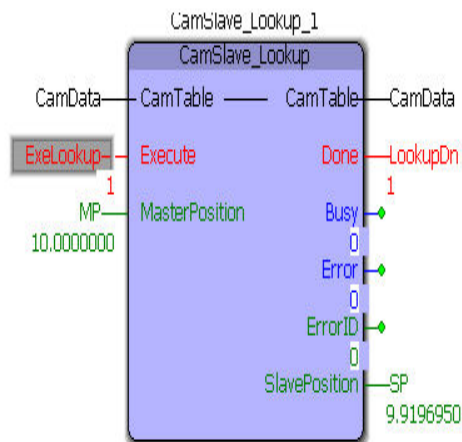
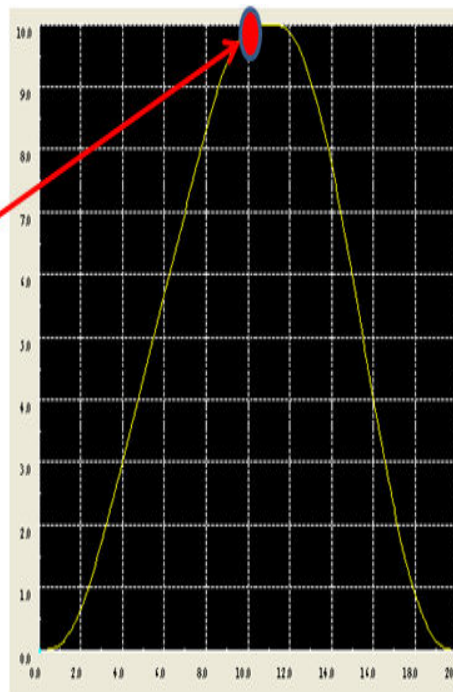
Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 10114 | Incorrect cam table size (check the CamTable.Header.Datasize). |
| 10045 | SlavePosition not found in Y_MS_CAM_STRUCT. |

Example

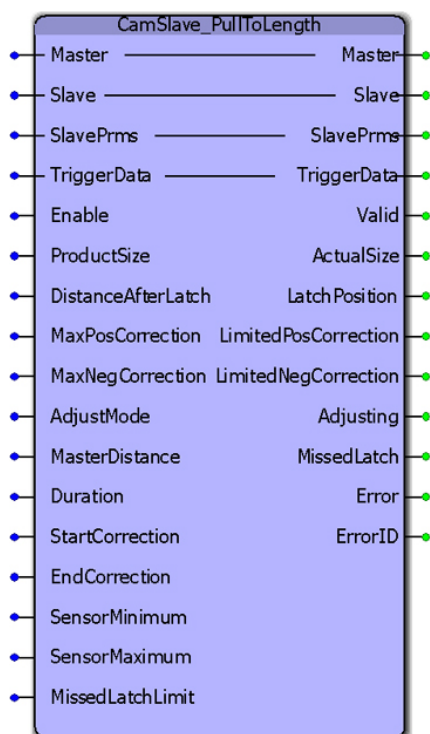
In the example shown below, the slave position corresponding to a master position of 10.0 is calculated. It can be seen that the slave position from the cam profile is 9.9196950.

| | | |
|--------|------------|--|
| [71] | | |
| Master | 9.8000000 | |
| Slave | 9.8572890 | |
| [72] | | |
| Master | 9.9000000 | |
| Slave | 9.8912510 | |
| [73] | | |
| Master | 10.0000000 | |
| Slave | 9.9196950 | |
| [74] | | |
| Master | 10.1000000 | |
| Slave | 9.9429420 | |
| [75] | | |
| Master | 10.2000000 | |
| Slave | 9.9613810 | |





CamSlave_PullToLength



CamSlave_PullToLength was designed for applications where the slave mechanism pulls material forward but the mechanism has a reciprocating stroke. This function block incorporates the ability to capture a registration mark on the material being pulled, and make on-the-fly adjustments to the stroke length by executing a Y_CamScale function block. This block has the same basic core operation as CamSlaveFeedToLength, which was designed for slaves that move in one direction but have the same requirement.

Library

Cam Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|-------------------------------------|--|
| VAR_IN_OUT | | | |
| B | Master | AXIS_REF | A logical reference to the master axis. |
| B | Slave | AXIS_REF | A logical reference to the slave axis. |
| V | SlavePrms | AxisParameterStruct | User Defined DataType declared in the PLCopen Toolbox. |

| | | | |
|------------------|--------------------|-----------------------------|---|
| E | TriggerData | TRIGGER_REF | Reference to the trigger signal source.. Refer to PLCopen Plus Function Block Manual for more details. |
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | ProductSize | LREAL | This value must be the same as the total one way index of the cam profile for this slave. |
| V | DistanceAfterLatch | LREAL | The desired additional travel distance after the registration mark is detected |
| V | MaxPosCorrection | LREAL | Limits the amount of positive correction that can be applied. |
| V | MaxNegCorrection | LREAL | Limits the amount of negative correction that can be applied. |
| V | AdjustMode | INT | <p>An ENUM for TIME or range of master correction, with the following values:</p> <p>Y_AdjustMode#MasterDistance: The adjustment starts immediately and completes when the master has travelled the specified MasterDistance.</p> <p>Y_AdjustMode#ElapsedTime: The adjustment starts immediately and completes within the specified Time.</p> <p>Y_AdjustMode#WithinRange: The adjustment starts when the master first crosses the StartPosition and completes when the master reaches the EndPosition.</p> |
| V | MasterDistance | LREAL | Relative amount the master will travel (in cam master units) from when the function block first executes until the correction is complete. Only used if AdjustMode = Y_AdjustMode#MasterDistance. |
| V | Duration | LREAL | Time of the correction used if AdjustMode is set for TIME mode |
| V | StartCorrection | LREAL | Earliest master position where the correction can begin. |
| V | FinishCorrection | LREAL | Latest master position where the correction must be completed. |
| V | SensorMinimum | LREAL | The earliest slave position where a sensor position is valid for correction. |
| V | SensorMaximum | LREAL | The latest slave position where a sensor position is valid for correction. |
| | | | LREAL#0.0 (function block SensorMaximum to ProductSize if unconnected or set to zero.) |

| | | | | |
|-------------------|----------------------|-------|---|----------------------------------|
| V | MissedLatchLimit | UINT | The number of consecutive DefaultDistances allowed to occur without seeing a registration mark in the window, and not cause an Error. Valid registration marks will reset the internal counter. | UINT#0 (interpreted as infinite) |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| V | ActualSize | LREAL | The actual indexed distance. | |
| V | LatchPosition | LREAL | The slave's position in the CamTable when the latch occurred. | |
| V | LimitedPosCorrection | BOOL | Indicates that the MaxPosCorrection is limiting the required correction. | |
| V | LimitedNegCorrection | BOOL | Indicates that the MaxNegCorrection is limiting the required correction. | |
| V | Adjusting | BOOL | Indicates that an adjustment is currently taking place (Busy output of Y_SlaveOffset) | |
| V | MissedLatch | BOOL | Indicates that a latch was detected, but it was outside of the window parameters specified. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

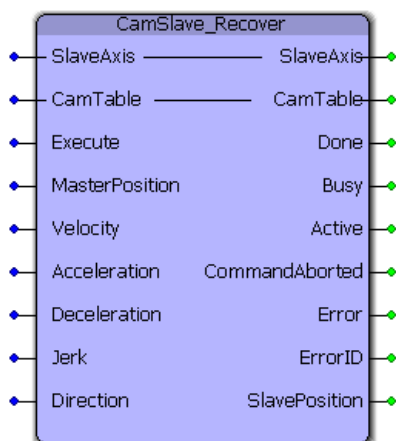
This function block is an adaptation of [CamSlave_FeedToLength](#). The main difference is that this function is designed for reciprocating slave motion, and uses the Y_CamScale function block instead of the Y_SlaveOffset function block.

Error Description

| ErrorID | Meaning |
|-----------------------|---|
| 0 | No error. |
| 10020 | ProductSize cannot be less than or equal to zero. |
| 10021 | Maximum allowed consecutive missed registration marks reached. |
| 10025 | SensorMinimum must be less than SensorMaximum. |
| 10053 | DataPoint Error. |
| 10086 | MaxPosCorrection must be zero or positive, MaxNegCorrection must be zero or negative. |



CamSlave_Recover



The CamSlave_Recover block moves a Slave back into sync with the master axis after camming was interrupted unexpectedly, such as E-Stop conditions, or alarms that disable the servo. This function block is particularly useful when resuming the cam motion from the position where it was interrupted is necessary to avoid wasting products in process, or if machine characteristics demand it, or if homing and re-starting the cycle is not feasible. The CamSlave_Recover function block can be used to bring the slave axis to the position in the cam table that corresponds to the current master axis position. Linear interpolation is performed for accuracy in case of coarse resolution between points in the cam table. Once CamSlave_Recover is Done, the camming motion can resume. This function block contains an MC_MoveAbsolute function.

Library

Cam Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|---------------------------------|--|
| VAR_IN_OUT | | | |
| B | SlaveAxis | AXIS_REF | A logical reference to the slave axis. |
| B | CamTable | Y_MS_CAM_STRUCT | Cam data structure |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |

| | | | | |
|-------------------|----------------|--------------|--|-----------|
| B | MasterPosition | LREAL | Master axis' current position. The CamSlave_ Recover function block will command the slave axis to move to the slave position corresponding to this MasterPosition value. | LREAL#0.0 |
| B | Velocity | LREAL | Velocity with which the slave axis recovers and moves to the position from the cam table corresponding to the master axis position | LREAL#0.0 |
| B | Acceleration | LREAL | Acceleration with which the slave axis recovers and moves to the position from the cam table corresponding to the master axis position | LREAL#0.0 |
| B | Deceleration | LREAL | Deceleration with which the slave axis recovers and moves to the position from the cam table corresponding to the master axis position | LREAL#0.0 |
| E | Jerk | LREAL | <i>Not supported; reserved for future use. Value of the jerk in [user units / second^3].</i> | LREAL#0.0 |
| B | Direction | MC_Direction | The position of the slave axis for which the corresponding master position is required. | LREAL#0.0 |
| VAR_OUTPUT | | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |
| B | Active | BOOL | For buffered modes, this output is set high at the moment the block takes control of the axis. For non buffered modes, the outputs busy and active have the same value | |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |
| V | SlavePosition | LREAL | Slave position in the cam profile that corresponds to the MasterPosition input to the function block | |

Notes

After CamSlave_ Recover is done, in most cases, the slave will be at a position different from the home position or dwell position. Care should be taken before re-engaging the slave to the master axis. Engage Position and Engage Data inputs on the Y_CamIn block should be verified to make sure that they are set correctly. Incorrect engage position and or engage method can cause abrupt motion on the slave axis.

Recommended steps to recover from a cam cycle interruption

- 1) Clear all alarms after an E-Stop.
- 2) Enable the slave.
- 3) Verify the MasterPosition input is the position of the master axis to where the slave must to move to re-synchronize the cam operation.
- 3) Execute CamSlave_ Recover with valid inputs.
- 4) Once CamSlave_ Recover.Done is TRUE, the slave is in position to continue the cam motion immediately.
- 5) Change the Y_CamIn.EngagePosition to the current master position. Set Y_CamIn.EngageData.SlaveAbsolute:= TRUE.
- 6) Execute Y_Camin. The cam will engage and when the master axis starts motion, the slave will move in synchronization with the master.

See the [CamSlave_ Recover eLearning Module](#) on Yaskawa's YouTube Channel.

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4658 | Velocity parameter is less than or equal to zero. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4642 | Direction does not correspond to a valid enumeration value. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 10113 | Incorrect cam table size (check the CamTable.Header.datasize) |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |

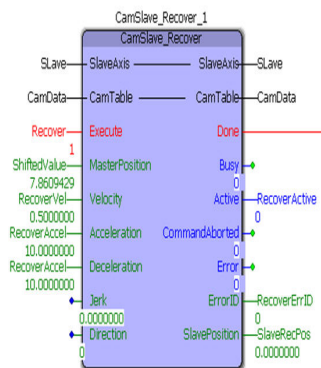
Example

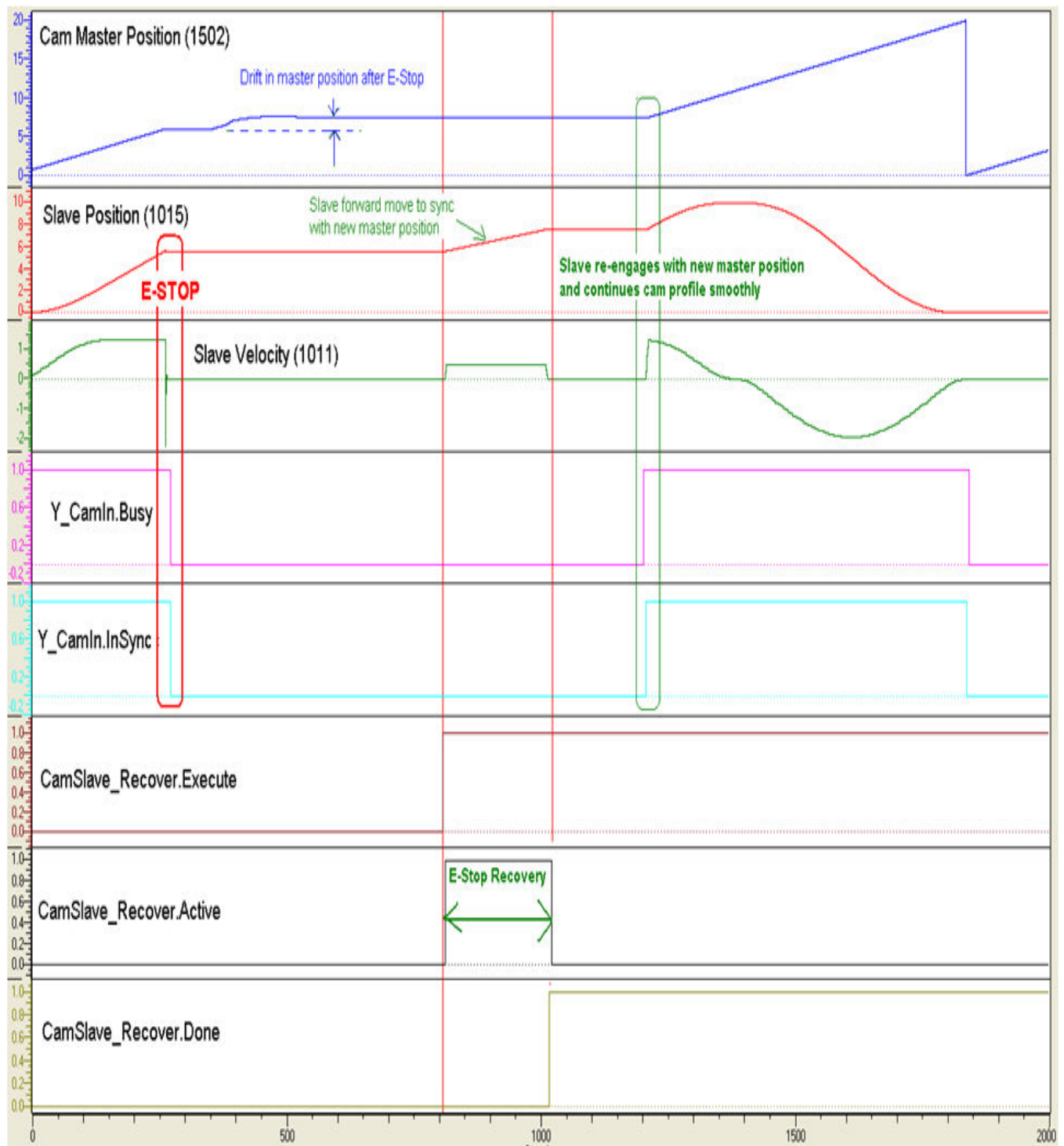
E-Stops can result in the instantaneous loss of control of the axes. Manually clearing debris or scrap from the machine and adjustments after E-Stops and alarms can cause a change in motor position, all resulting in a de synchronization of the master and slave.

The example given below illustrates how the CamSlave_Recover block can solve E-Stop recovery issues. The logic analyzer plot shows the axes when the E-Stop occurred. At this point, the Y_CamIn outputs InSync and Busy change to FALSE. A slight drift in the master axis position can be seen after the E-Stop. This can be due to axis inertia, or because of adjustments made to the machine. The CamSlave_Recover block is executed to physically move the slave to the position that corresponds to the master's current position as determined by looking in the CamTable.

The distance that the slave axis traverses in this process can be seen in the illustration. Once the CamSlave_Recover is Done, the slave can be re-engaged with the master using Y_Camin.

Important: In this recovery condition, the 'EngagePosition' must be set to the master axis' current position and the EngageData.SlaveAbsolute=TRUE must be applied.

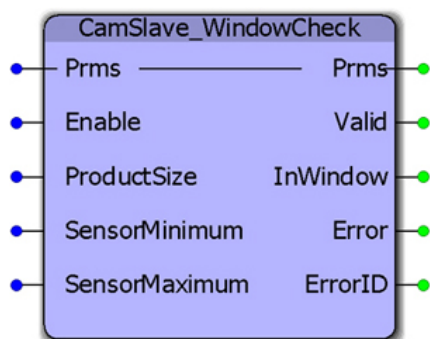




| | | |
|--------------|-----------|----------------|
| ⊞ [41] | | |
| Master | 5.0000000 | |
| Slave | 4.3333330 | E-Stop |
| ⊞ [42] | | |
| Master | 6.0000000 | Master: 5.97 |
| Slave | 5.6666670 | Slave : 5.61 |
| ⊞ [43] | | |
| Master | 7.0000000 | |
| Slave | 7.0000000 | |
| ⊞ [44] | | |
| Master | 7.1000000 | |
| Slave | 7.1333060 | |
| ⊞ [45] | | |
| Master | 7.2000000 | |
| Slave | 7.2664440 | |
| ⊞ [46] | | |
| Master | 7.3000000 | |
| Slave | 7.3992430 | |
| ⊞ [47] | | |
| Master | 7.4000000 | |
| Slave | 7.5315240 | |
| ⊞ [48] | | |
| Master | 7.5000000 | |
| Slave | 7.6630960 | |
| ⊞ [49] | | |
| Master | 7.6000000 | |
| Slave | 7.7937530 | |
| ⊞ [50] | | |
| Master | 7.7000000 | |
| Slave | 7.9232730 | |
| ⊞ [51] | | |
| Master | 7.8000000 | After recovery |
| Slave | 8.0514140 | |
| ⊞ [52] | | |
| Master | 7.9000000 | Master: 7.8609 |
| Slave | 8.1779140 | Slave : 8.1285 |
| ⊞ [53] | | |
| Master | 8.0000000 | |
| Slave | 8.3024920 | |



CamSlave_WindowCheck



This function block is used by the CamSlave_FeedToLength function blocks to determine when the MC_TouchProbe output is valid and should be used for correction. It compares the CamTableOutput parameter 1520 to the SensorMinimum and SensorMaximum, not the actual slave feedback.

Library

Cam Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|---------------|-------------------------------------|---|
| VAR_IN_OUT | | | |
| V | Prms | AxisParameterStruct | User Defined DataType declared in the PLCopen Toolbox. |
| VAR_INPUT | | | |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | ProductSize | LREAL | This value must be the same as the total one way index of the cam profile for this slave. |
| V | SensorMinimum | LREAL | The earliest slave position where a sensor position is valid for correction. |
| V | SensorMaximum | LREAL | The latest slave position where a sensor position is valid for correction. |
| VAR_OUTPUT | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| V | InWindow | BOOL | Indicates the slave output |

| | | | |
|---|---------|------|---|
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

If SensorMinimum and SensorMaximum are both zero, this function does not check for a window and reports InWindow as TRUE.

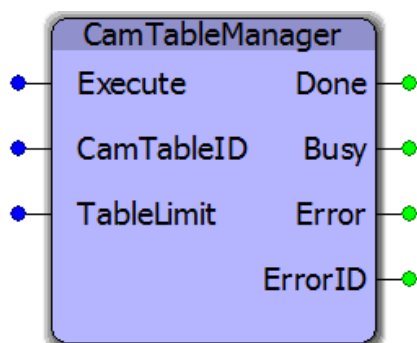
For the most accurate WindowCheck, this function block must be in a fast application task. Since this function is used by CamSlave_WindowCheck, that block also should be used in a fast (high priority)

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 10025 | SensorMinimum must be less than SensorMaximum. |



CamTableManager



This function block serves as a FIFO buffer for CamTableID's. Each time a new CamTableID is created, it will delete the memory allocated to the oldest CamTable by using the Y_RemoveCamTable function block from the PLCOpenPlus firmware library. This function block is used to clean up memory in applications which build cam tables on the fly. A circular buffer of four cam tables is maintained in the CamTableManager. When the function block is executed a fifth time, it releases the memory area of the oldest cam table ID. The controller can allocate this memory area for new cam tables or application code.

Library

Cam Toolbox

Parameters

| * | Parameter | Data Type | Description | |
|-------------------|------------|-----------|--|----------------|
| VAR_INPUT | | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. | FALSE |
| V | CamTableID | UINT | The most recent CamTableID create by Y_CamFileSelect or Y_CamStructSelect. | UINT #0 |
| V | TableLimit | UINT | The number of cam tables to leave in memory before they are removed. | UINT #5 |
| VAR_OUTPUT | | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |

| | | | |
|---|---------|------|---|
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

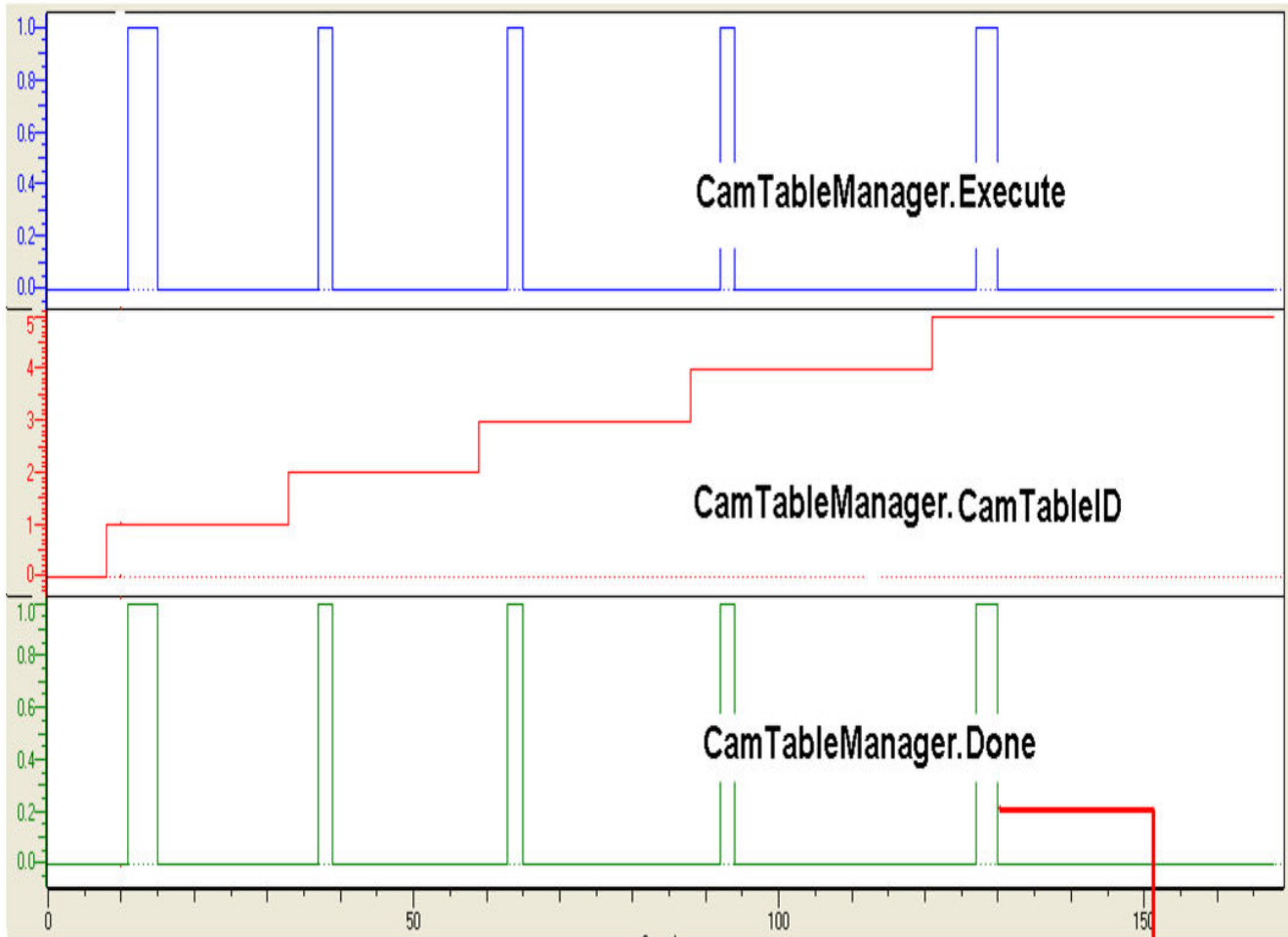
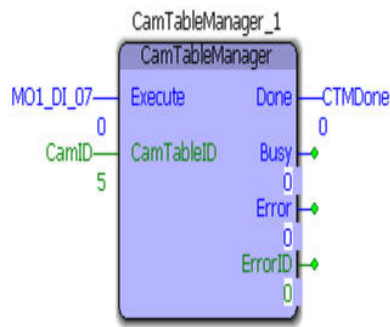
- This function block is unnecessary in applications which use a single, static cam table, or when there are several cams but once they are created, they are used permanently and not recalculated. There is capacity in the controller memory for dozens of cam tables. CamTableManager prevents the situation where a machine has been continuously running for weeks and enough cams were created that the memory becomes exhausted.
- Even though the memory for cam tables has been released, the Y_CamStructSelect function block will continue to allocate a new (increasing) CamTableID.
- See the [CamTableManager eLearning Module](#) on Yaskawa's YouTube Channel.

Error Description

| ErrorID | Meaning |
|----------------------|---|
| 0 | No error. |
| 4887 | CamTableID does not refer to a valid cam table. |

Example 1

An example of using the CamTableManager is shown below. On the fifth execute of the CamTableManager block, the memory for the oldest CamTable ID gets released. In the example shown below, the memory for CamID 1 gets released. The next execution of the CamTableManager will release the memory for CamID 2.



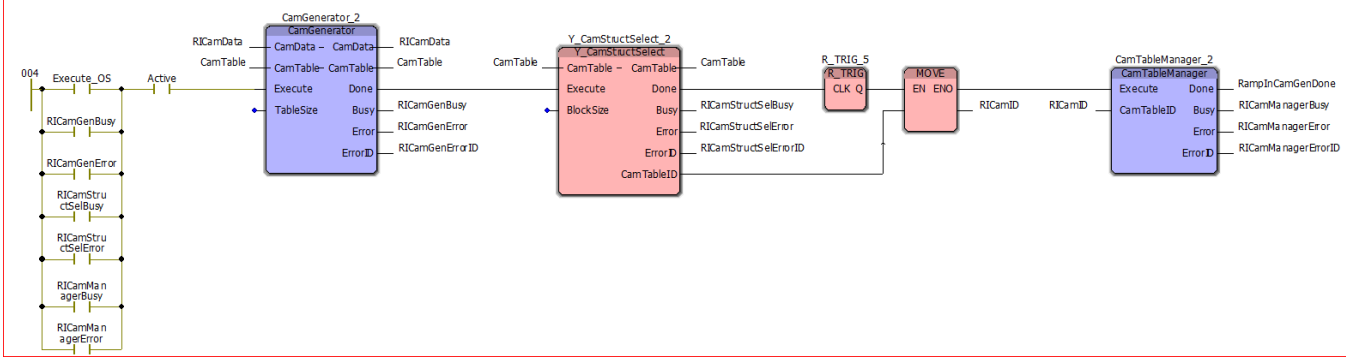
Watch Window

| Variable | Value | De |
|-----------|-------|----|
| CamTables | | |
| [0] | 1 | |
| [1] | 2 | |
| [2] | 3 | |
| [3] | 4 | |
| [4] | 5 | |

Watch 1 Watch 2 Watch 3 Watch 4 W

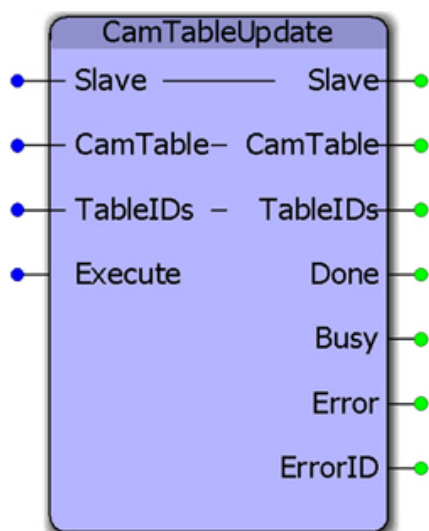
Memory for Cam ID 1 gets cleared

Application Example





CamTableUpdate



This function block aids with cam file management when on the fly changes to the table data are required. It supports two tables: one which may be actively running in the motion engine, and one that may be recalculated and transferred to the motion engine. It contains the Y_CamStructSelect and Y_WriteCamTable function blocks.

Library

Cam Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|---------------------------------|--|
| VAR_IN_OUT | | | |
| B | Slave | AXIS_REF | A logical reference to the slave axis |
| B | CamTable | Y_MS_CAM_STRUCT | Cam data structure |
| V | TableIDs | TableIDStruct | Contains an Active and Inactive TableID |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| VAR_OUTPUT | | | |

| | | | |
|---|---------|------|---|
| B | Done | BOOL | Set high when the commanded action has been completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when execute goes low. |
| B | Busy | BOOL | Set high upon the rising edge of the 'Execute' or 'Enable' input, and reset if Done, CommandAborted, or Error is true. |
| B | Error | BOOL | Set high if error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | BOOL | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

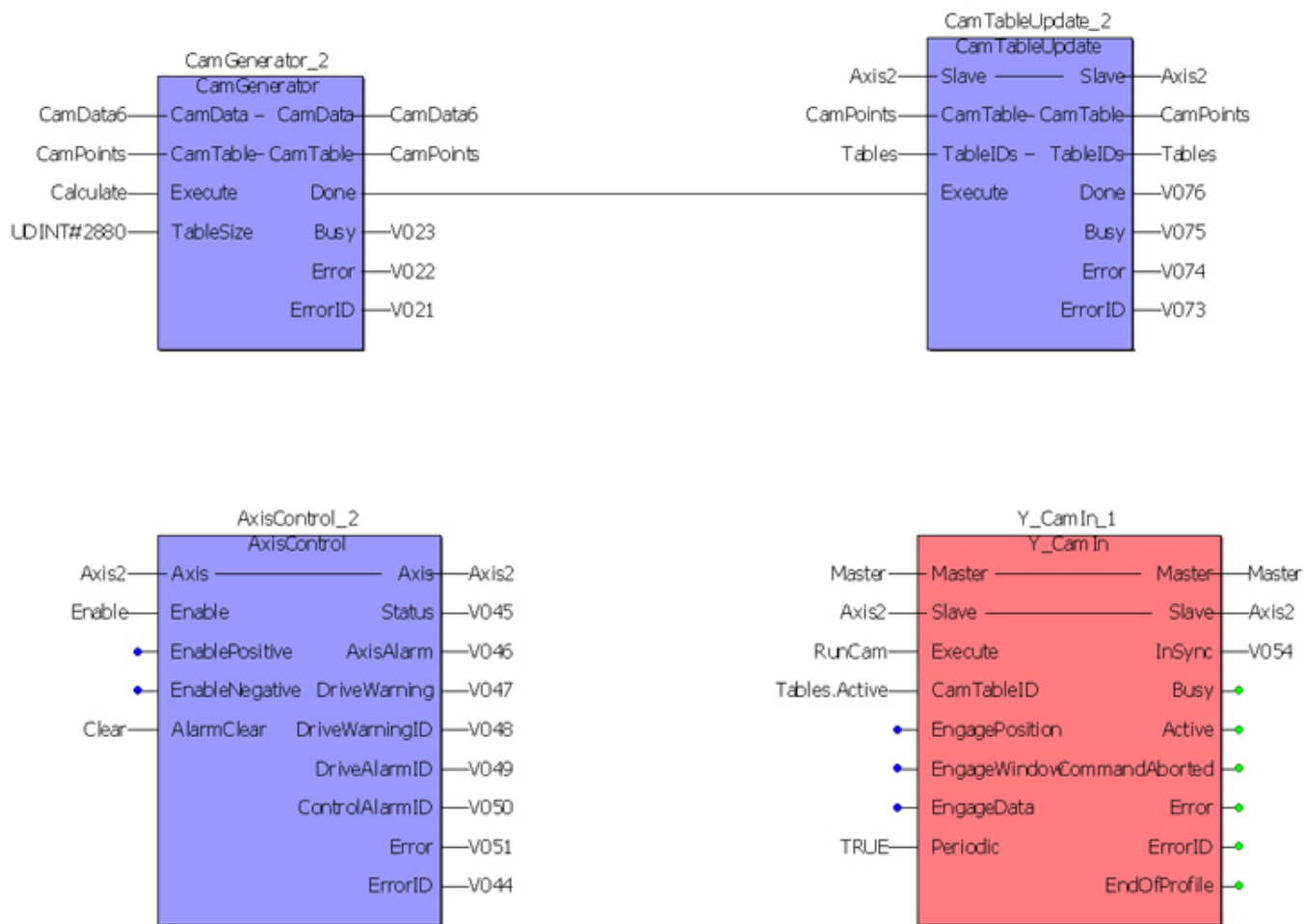
- If both TableIDs in the TableIDs input are zero, then this block automatically uses Y_CamStructSelect to send the first CamTable and obtain the CamTableID.
- If the event causing the cam tables to update is fired too frequently, this block limits the cam table transfer and swap by holding in a Busy state while the previous table transferred is still waiting to become the active table. In this way, it helps to stage the table swapping so that the application does not resort to writing over an active table, which can cause the slave to jump.

Error Description

| ErrorID | Meaning |
|----------------------|---|
| 0 | No error. |
| 4377 | File reading already in progress. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4387 | Already copying cam data (If Execute transition to TRUE while Busy = TRUE). |
| 4633 | Table size results in misaligned data. Refer to the help section "Internally Created Cam Data." A cam table will have a multiple of 16 bytes if created correctly. |
| 4634 | Buffer size results in misaligned data |
| 4635 | Table type is not supported. |
| 4636 | Invalid start index. |
| 4637 | Invalid end index. |
| 4885 | Invalid header for the cam file (missing # of rows, #of columns, or feed-forward velocity flag). You must first populate the TableType and DataSize in the Y_MS_CAM_STRUCT before executing the function. |
| 4887 | CamTableID does not refer to a valid cam table. |

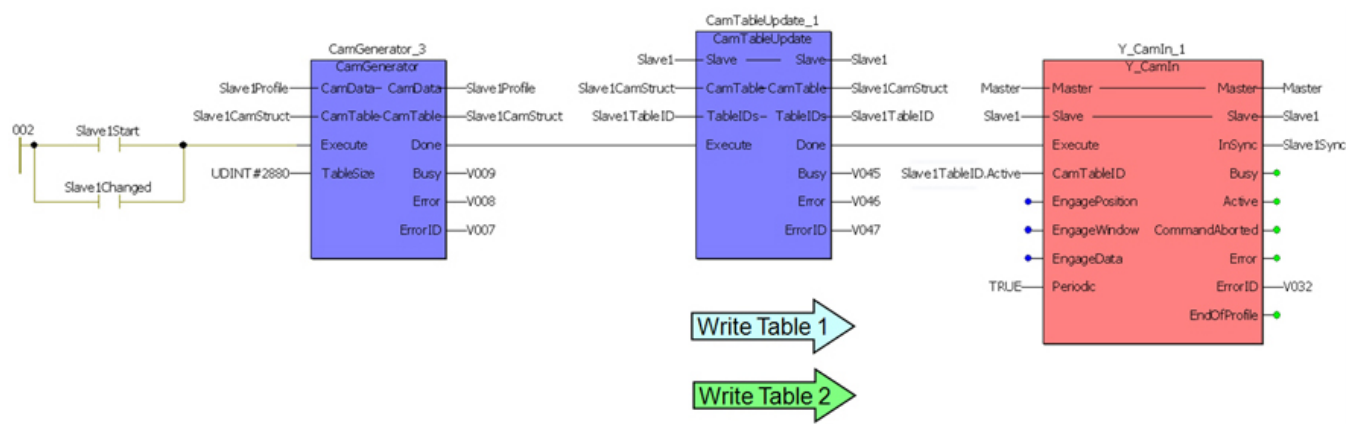
Example 1:

In this example, assume that some event has occurred which triggers the need for a new cam table to be generated using CamGenerator. CamGenerator in turn fires CamTableUpdate to send the new CamTable to the motion engine. CamTableUpdate manages the active and inactive TableIDs, which can then be used with Y_CamIn. The Table.Active variable will contain the TableID of the last table transferred, so the next time the rising edge of Y_CamIn is triggered, the new table will be used. This can be done while camming is currently engaged.



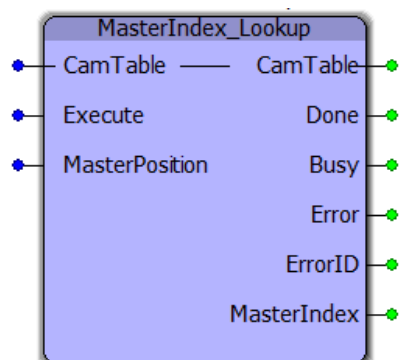
Example 2: Using Two Cam Tables

- One will be actively running the motion
- One will be "on deck" to take new changes





MasterIndex_Lookup



This function block returns the array index value corresponding to the given master position.

Library

Cam Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|----------------|---------------------------------|--|
| VAR_IN_OUT | | | |
| B | CamTable | Y_MS_CAM_STRUCT | Cam data structure |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| V | MasterPosition | LREAL | The position of the master axis for which the index in the cam table is required. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |

| | | | |
|---|-------------|-------|--|
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |
| V | MasterIndex | UDINT | The array index corresponding to the master axis position in the Y_MS_CAM_STRUCT structure. |

Notes

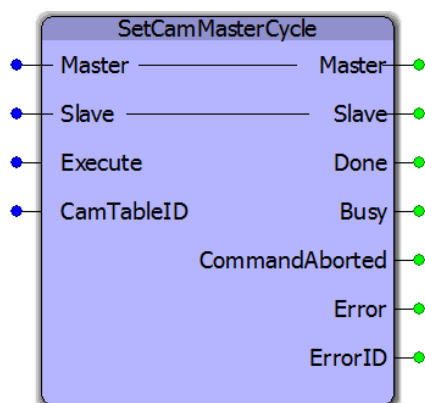
- The MasterPosition input should be a value between the maximum and minimum values of the master's position profile for the index value to be valid.

Error Description

| ErrorID | Meaning |
|-------------------|-----------|
| 0 | No error. |



SetCamMasterCycle



This function block prepares the motion engine with the cam table data so that cam adjustments involving blocks like Y_CamShift can be executed before Y_CamIn is executed. This is necessary for applications where calculations that involve the cam master cycle (parameter 1512) or cam master shifted cyclic position (parameter 1502) must be made before the Y_CamIn function block is executed.

Parameters

| * | Parameter | Data Type | Description | |
|------------|----------------|-----------|--|---------|
| VAR_IN_OUT | | | | |
| B | Master | AXIS_REF | A logical reference to the master axis. | |
| B | Slave | AXIS_REF | A logical reference to the slave axis. | |
| VAR_INPUT | | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. | FALSE |
| B | CamTableID | UINT | A reference to the cam memory in the motion engine. | UINT #0 |
| VAR_OUTPUT | | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. | |

| | | | |
|---|---------|------|---|
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

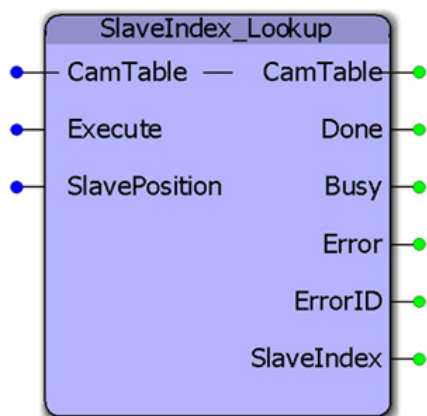
- 1) Although there will be no slave motion, the slave axis must be enabled using MC_Power before executing this function block.
- 2) A valid CamTableID must be input before executing SetCamMastercycle.

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4374 | Torque move prohibited while non-torque moves queued or in progress. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4626 | The master / slave relationship is already defined. If a slave must follow a different master, use the MC_Stop block on the slave before executing the next Y_CamIn. If cascading master slaves, a maximum of two levels of cascaded master / slave relationships can be configured. |
| 4633 | Table size results in misaligned data. Refer to the help section "Internally Created Cam Data." A cam table will have a multiple of 16 bytes if created correctly. |
| 4887 | CamTableID does not refer to a valid cam table. |
| 4891 | The slave axis can not be the same as the master axis. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 10114 | Incorrect cam table size (check the CamTable.Header.Datasize). |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |



SlaveIndex_Lookup



This function block returns the array index value corresponding to the given slave position. This function block is used by [CamMasterLookup](#) to determine the equivalent master location for a given slave position.

Library

Cam Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|---------------|---------------------------------|--|
| VAR_IN_OUT | | | |
| B | CamTable | Y_MS_CAM_STRUCT | Cam data structure |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| V | SlavePosition | LREAL | The position of the slave axis for which the corresponding master position is required. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |

| | | | |
|---|------------|-------|--|
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |
| V | SlaveIndex | UDINT | The array index of the Y_MS_CAM_STRUCT of the SlavePosition. |

Notes

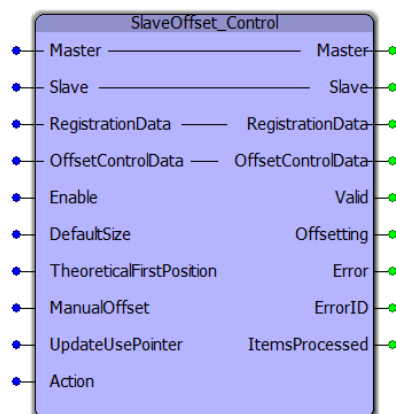
- The SlavePosition input should be a value between the maximum and minimum values of the slave's position profile for the index value to be valid.
- If the SlavePosition input is a value between two slave positions in the cam table, the SlaveIndex will return the lower index.

Error Description

| ErrorID | Meaning |
|-----------------------|---|
| 0 | No error. |
| 10045 | SlavePosition not found in Y_MS_CAM_STRUCT. |



SlaveOffset_Control



This function block makes corrections on a cammed slave axis for applications that require adjustments while the axis is in motion. Some applications, such as labeling, require on the fly adjustments based on sensor input that occurs while the label is moving. The actual pitch between consecutive labels may be different from the nominal pitch. The correction amount is the difference between the nominal part size and the actual part size measured by the sensor. In this type of application, the sensor input is wired to the slave axis.

The SlaveOffset_Control block is similar to [CamSlave_FeedToLength](#) in functionality. Both function blocks make corrections on a cammed slave axis based on sensor input. Both function blocks make corrections while the slave axis is in motion. The difference between the two blocks is that SlaveOffset_Control makes use of the [ProductBuffer](#) block while the [CamSlave_FeedToLength](#) does not. This allows the SlaveOffset_Control to buffer latched registration data. This can be used in applications where the sensor is more than one part length away from the point of action ($\text{SensorDistance} > 1 \text{ part length}$). SlaveOffset_Control lacks the window check feature, correction limit feature and missed latch limit feature available in the [CamSlave_FeedToLength](#) block.

Library

Cam Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|------------------|-------------------------------------|--|
| VAR_IN_OUT | | | |
| B | Master | AXIS_REF | A logical reference to the master axis |
| B | Slave | AXIS_REF | A logical reference to the slave axis |
| V | RegistrationData | ProductBufferStruct | Structure containing all information for the circular buffer to operate. |

| | | | |
|-------------------|--------------------------|-----------------------------------|--|
| V | OffsetControlData | SlaveOffsetStruct | Structure containing all information to calculate and implement slave offsets. |
| VAR_INPUT | | | |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | DefaultSize | LREAL | Default pitch between consecutive parts |
| V | TheoreticalFirstPosition | LREAL | Ideal absolute position of the first part that will be detected by the sensor after homing is done. |
| V | ManualOffset | LREAL | One time adjustment that can be made while the slave is in motion. A change in the manual offset value will trigger the offset value to be added to the calculated correction. |
| V | UpdateUsePointer | BOOL | RegistrationData.UsePointer will be updated when a product has been processed only if this input is TRUE. If more than one slave follows the same master as a parallel activity, only one instance of this function block must update the UsePointer. |
| V | Action | INT | Designates this instance of this function block as one of the several activities to occur based on the registration sensor. For applications that have only one action, such as a cut or a stamp, this input can be left unconnected. This input is required for applications that have more than one action associated with a sensor input, such as pick and place. |
| VAR_OUTPUT | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| V | Offsetting | BOOL | Set high if the function block is active and Y_SlaveOffset is Busy. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |
| V | ItemsProcessed | UDINT | Provides a count of the number of products processed since this function was enabled. |

Notes

- This function block includes the Y_SlaveOffset function block, and will execute Offsets at the appropriate position based on data provided by the user via the [SlaveOffsetStruct](#) structure.
- In cases where multiple slaves are synchronized to a single master, the slaves can share the same ProductBuffer . Set the last slave (last SlaveOffset_Control function block) to update the UsePointer for the ProductBuffer.
- SlaveOffset_Control provides similar functionality as [CamSlave_FeedToLength](#) as summarized in the table shown below.

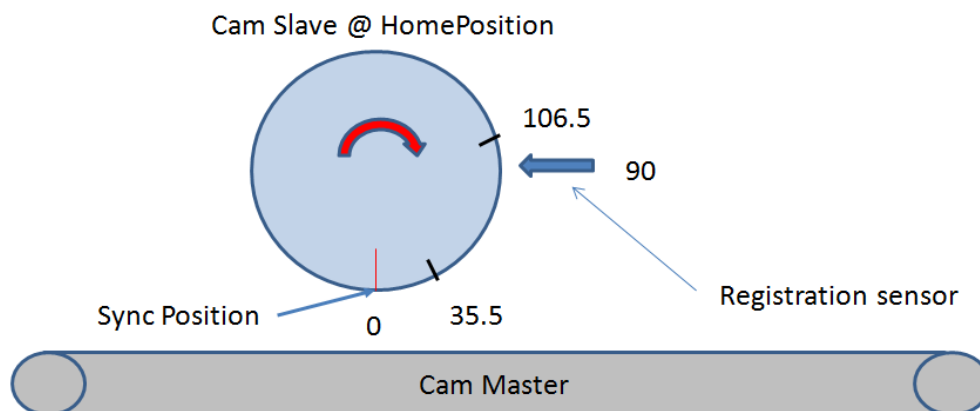
| | CamSlave_FeedToLength | SlaveOffset_Control |
|---|-----------------------|------------------------|
| <i>BufferProducts (SensorDistance > 1 part length)</i> | Not supported | Supported |
| <i>Successive triggers > 2 part lengths</i> | Reports missed latch | Makes large correction |
| <i>Missed Part Indicator</i> | Supported | Not supported |
| <i>Registration within window check</i> | Supported | Not supported |
| <i>Correction limits</i> | Supported | Not Supported |

Error Description

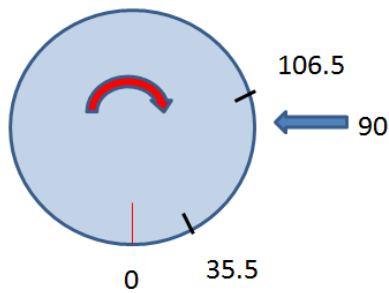
| ErrorID | Meaning |
|-----------------------|---|
| 0 | No error. |
| 11050 | Cam correction (shift/offset) has been aborted by another function block. |

Application Example 1

Consider a rotary disc cammed to a master conveyor running a one way cam in the clockwise direction as shown. The home position is defined as shown below. Product length (nominal distance between parts) on the slave is 71 degrees. The nominal cam slave travel is 71 degrees. Position 0 (bottom dead center) is the position that needs to be synchronized with the master. The sensor distance is 90 units. If the first part is at 35.5 units and if the parts are exactly at the specified nominal lengths, then the second part (first part captured by the sensor) will be at 106.5. However, the actual registered position of this part may not be 106.5. In this case, the second product will not get synchronized with the master if it runs the nominal cam of 71 units. If the second product were at 105.5 units, an offset of 1 unit will have to be made for the synchronization to be effective.



The figure below shows how to configure the SlaveOffsetStruct.

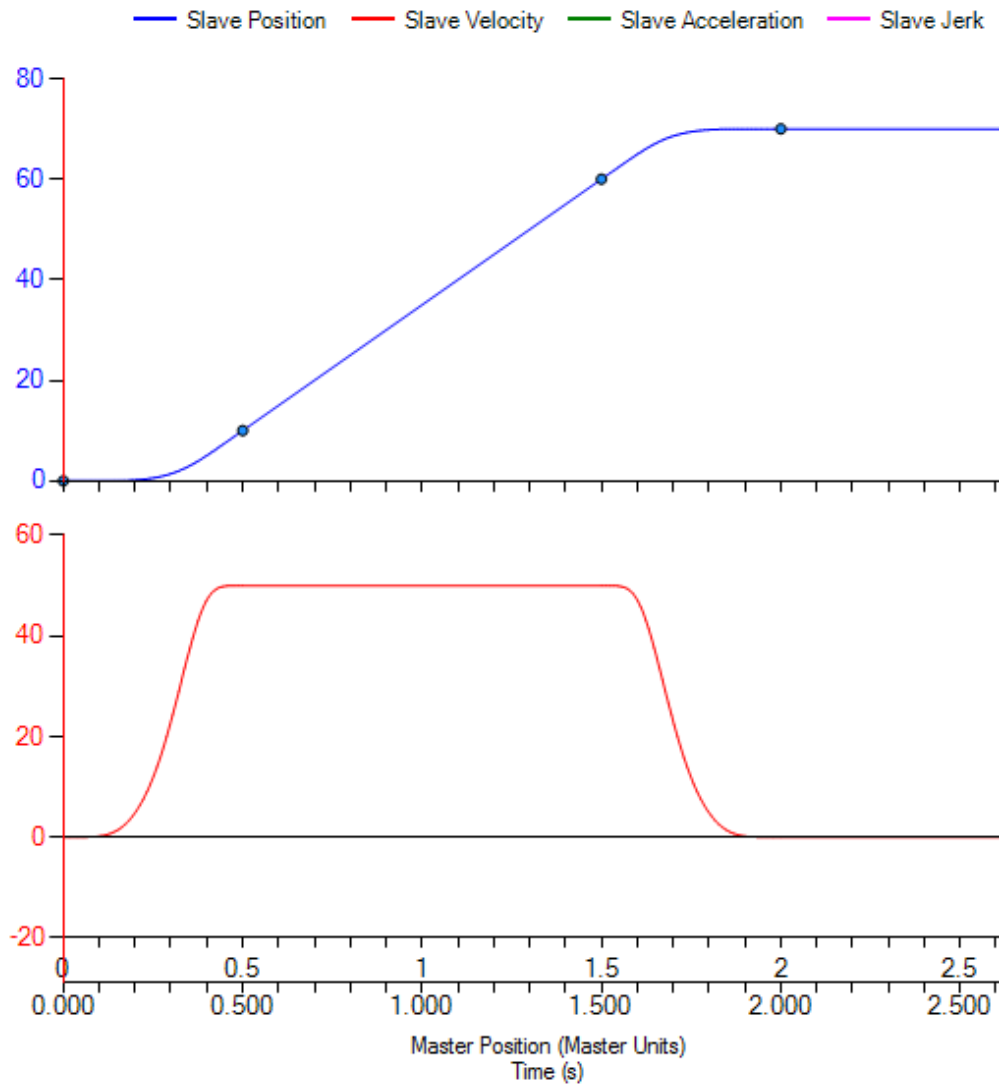


```

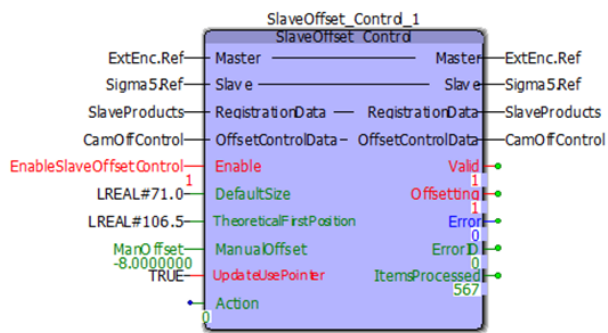
20 SlaveProducts.BufferSize := INT#20;
1 SlaveProducts.Sensor.Bit := UINT#1;
72.000000 SlaveProducts.ProductAwayDistance := LREAL#72.0;
90.000000 SlaveProducts.SensorDistance := LREAL#90.0;

0.300000 CamOffControl.StartSyncPosition := LREAL#0.3;
0.100000 CamOffControl.EndSyncPosition := LREAL#0.1;

```

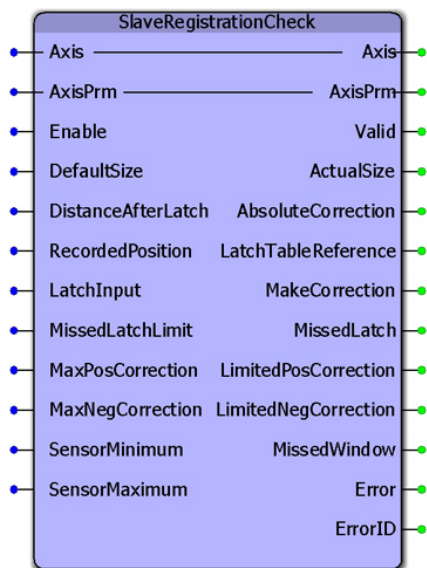


The SlaveOffset_Control block for the application described above can be set up as shown below.





SlaveRegistrationCheck



This function block was designed for use by the [CamSlave_FeedToLength](#), [CamSlave_FeedToLength2](#), and [CamSlave_PullToLength](#) function blocks. It monitors variables related to a cam slave index and fires the output "MakeCorrection" which can be connected to Y_SlaveOffset along with the AbsoluteCorrection output. The function also provides the interpolated value of the cam table output when the latch was detected.

Library

Cam Toolbox

Parameters

| * | Parameter | Data Type | Description | |
|-------------------|-------------|-------------------------------------|---|----------------|
| VAR_IN_OUT | | | | |
| B | Axis | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). | |
| B | AxisPrm | AxisParameterStruct | Structure containing all parameters available for the Slave. Populate this structure using the ReadAxisParameters function block. | |
| VAR_INPUT | | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. | FALSE |
| B | DefaultSize | LREAL | Default length of the product in user units. | LREAL#0.0 |

| | | | | |
|-------------------|----------------------|-------|---|---|
| B | DistanceAfterLatch | LREAL | The desired additional travel distance after the registration mark is detected | LREAL#0.0 |
| B | RecordedPosition | LREAL | Position where trigger event occurred in user units. In accordance with PLCopen, this output is only valid when the Done output is high. | LREAL#0.0 |
| B | LatchInput | BOOL | Typically connected to MC_TouchProbe.Done, signals the function to calculate any required correction amount. | FALSE |
| V | MissedLatchLimit | UINT | The number of consecutive DefaultDistances allowed to occur without seeing a registration mark in the window, and not cause an Error. Valid registration marks will reset the internal counter. | UINT#0 (interpreted as infinite) |
| V | MaxPosCorrection | LREAL | Limits the amount of positive correction that can be applied. | LREAL#0.0 |
| V | MaxNegCorrection | LREAL | Limits the amount of negative correction that can be applied. | LREAL#0.0 |
| V | SensorMinimum | LREAL | The earliest slave position where a sensor position is valid for correction. | LREAL#0.0 |
| V | SensorMaximum | | | LREAL#0.0 (function block sets SensorMaximum to ProductSize if unconnected or set to zero.) |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| V | ActualSize | LREAL | The actual indexed distance. | |
| V | AbsoluteCorrection | LREAL | The absolute value of the slave offset for use with Y_SlaveOffset. | |
| V | LatchTableReference | LREAL | The position of the latch corresponding to the cam table. | |
| V | MakeCorrection | BOOL | Used to signal that the correction calculation is valid. Typically used in conjunction with Y_SlaveOffset.Execute. Note: this output will pulse for one scan. | |
| V | MissedLatch | UDINT | Flag which indicates that the controller did not find a valid registration mark within the SensorMinimum and SensorMaximum positions. | |
| V | LimitedPosCorrection | BOOL | Indicates that the MaxPosCorrection is limiting the required correction. | |
| V | LimitedNegCorrection | BOOL | Indicates that the MaxNegCorrection is limiting the required correction. | |
| V | MissedWindow | BOOL | Indicates that a latch occurred, but was ignored because it was outside the range of SensorMinimum and SensorMaximum. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

- This function block determines where in the cam profile the latch occurred and compares it to the expected location to make a determination about the correction required.
- This function block also monitors the travel distance of the slave, and if the slave traveled 10% more than the ProductDistance and no valid latch was detected, a missed mark is counted. If the number of consecutive missed marks equals the MissedLatchLimit input variable, ErrorID UINT#10021 is output.
- Set MissedLatchLimit:=0 to disable monitoring for missed latches.
- Separate correction limits are provided for positive and negative to account for applications where it is not possible to make such corrections. For example, negative corrections typically cannot be applied to labeling applications because the material will become loose (slack).

Error Description

| ErrorID | Meaning |
|-----------------------|---|
| 0 | No error. |
| 4377 | File reading already in progress. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4387 | Already copying cam data (This error occurs if Execute transitions to TRUE while Busy is already TRUE). |
| 4633 | Table size results in misaligned data. Refer to the help section "Internally Created Cam Data." A cam table will have a multiple of 16 bytes if created correctly. |
| 4634 | Buffer size results in misaligned data. |
| 4635 | Table type is not supported. |
| 4636 | Invalid start index. |
| 4637 | Invalid end index. |
| 4885 | Invalid header for the cam file (missing # of rows, #of columns, or feed-forward velocity flag). You must first populate the TableType and DataSize in the Y_MS_CAM_STRUCT before executing the function. |
| 4887 | CamTableID does not refer to a valid cam table. |
| 10020 | ProductSize cannot be less than or equal to zero. |
| 10021 | Maximum allowed consecutive missed registration marks reached. |
| 10086 | MaxPosCorrection must be zero or positive, MaxNegCorrection must be or zero or negative. |

Creating Cam Tables

Toolbox Help Documentation

Help version created 1/31/2018

YASKAWA



Cam Curve Characteristics

Cam Curve does not mean a shape curve which expresses a cam profile, but rather a "motion curve" of the follower moved by the cam. A motion curve is generally shown with time on the horizontal axis and displacement on the vertical axis. The purpose of a cam is to move an object smoothly in a minimum time, without vibration and with minimum power. For this purpose, various motion curves have been developed. These curves are not only used for cam mechanisms but can also be applied to various other motions. The maximum non dimensional values such as V_m , A_m , and J_m are called the characteristic values of the cam curve. From these characteristic values and from the shapes of the acceleration curves, the general properties of the cam curves can be known.

Curve Selection

The procedure for selecting a curve is as follows:

1. Velocity V and Acceleration A are to be continuous
2. Low values of V_m and Q_m are needed in low speed and heavy load applications.
3. Low values of A_m and J_m are needed in high speed and light load applications.
4. Asymmetrical curve having the longer period of deceleration than acceleration should be used for situations when positioning accuracy is critical and residual vibration must be avoided.
5. A one-dwell curve should be used when the motion has no stop at the endpoint and must return immediately.
6. Select a curve from the modified constant velocity group when constant velocity is required in the middle part of the stroke.
7. Select a curve from the modified trapezoid group when acceleration is to be minimized.
8. The modified sine curve is recommended if there are no limitations.

Cam Curve Characteristics

Sorted by velocity

| Curve | Velocity Max | Accel Max | Accel Min | Jerk Max | Jerk Min | Inertia Torque Max | Comment |
|---|-----------------|--------------|--------------|-------------|-------------|--------------------------|---|
| No Dwell Modified Constant Velocity | 1.22 | 7.68 | 7.68 | 48.20 | -48.20 | 4.69 | Lowest Velocity |
| Modified Constant Velocity | 1.28 | 8.01 | 8.01 | 201.40 | -67.10 | 5.73 | Highest Accel |
| Simple Harmonic | 1.57 | 4.93 | 4.93 | ∞ | -15.50 | 3.88 | Lowest Inertial Torque |
| One Dwell Modified Sine | 1.66 | 5.21 | 5.21 | 65.50 | -21.80 | 4.86 | |
| One Dwell Cycloidal (m=2/3) | 1.72 | 6.75 | -4.50 | 53.00 | -53.00 | 7.53 | |
| No Dwell Modified Trapezoid | 1.72 | 4.20 | 4.20 | 26.40 | -26.40 | 5.07 | Lowest Jerk |
| One Dwell Trapezoid | 1.74 | 4.91 | 4.91 | 61.70 | -61.70 | 6.86 | |
| Modified Sine | 1.76 | 5.53 | -5.53 | 69.50 | -23.20 | 5.46 | |
| One Dwell Cycloidal (m=1) | 1.76 | 5.53 | 5.53 | 34.70 | -34.70 | 6.32 | |
| NC2 Curve | 1.79 | 5.89 | -4.21 | ∞ | -111.10 | 8.87 | |
| One Dwell Modified Trapezoid (m=1) | 1.92 | 4.44 | -4.44 | 55.80 | -55.80 | 7.11 | |
| One Dwell Modified Trapezoid (Ferguson) | 1.92 | 4.68 | -4.22 | 58.90 | -58.90 | 7.43 | |
| One Dwell Modified Trapezoid (m=2/3) | 1.94 | 5.53 | -3.68 | 69.40 | -69.40 | 8.63 | |
| Parabolic | 2.00 | 4.00 | -4.00 | ∞ | ∞ | 8.00 | Lowest Accel, Highest Jerk |
| Cycloidal | 2.00 | 6.28 | 6.28 | 39.50 | -39.50 | 8.16 | |
| Modified Trapezoid | 2.00 | 4.89 | 4.89 | 61.40 | -61.40 | 8.09 | |
| Asymmetrical Cycloidal | 2.00 | 7.85 | -5.24 | 61.70 | -61.70 | 10.20 | |
| Asymmetrical Modified Trapezoid | 2.00 | 6.11 | -4.07 | 96.00 | -96.00 | 10.11 | |
| Trapezoid | 2.18 | 6.17 | 6.17 | 77.50 | -77.50 | 10.84 | Highest Velocity, Highest Inertial Torque |

Cam Curve Characteristics

Sorted by Positive Acceleration

| Curve | Velocity Max | Accel Max | Accel Min | Jerk Max | Jerk Min | Inertia Torque Max | Comment |
|---|-----------------|--------------|--------------|-------------|-------------|--------------------------|---|
| No Dwell Modified Trapezoid | 1.72 | 4.20 | 4.20 | 26.40 | -26.40 | 5.07 | Lowest Jerk |
| One Dwell Cycloidal (m=1) | 1.76 | 5.53 | 5.53 | 34.70 | -34.70 | 6.32 | |
| Cycloidal | 2.00 | 6.28 | 6.28 | 39.50 | -39.50 | 8.16 | |
| No Dwell Modified Constant Velocity | 1.22 | 7.68 | 7.68 | 48.20 | -48.20 | 4.69 | Lowest Velocity |
| One Dwell Cycloidal (m=2/3) | 1.72 | 6.75 | -4.50 | 53.00 | -53.00 | 7.53 | |
| One Dwell Modified Trapezoid (m=1) | 1.92 | 4.44 | -4.44 | 55.80 | -55.80 | 7.11 | |
| One Dwell Modified Trapezoid (Ferguson) | 1.92 | 4.68 | -4.22 | 58.90 | -58.90 | 7.43 | |
| Modified Trapezoid | 2.00 | 4.89 | 4.89 | 61.40 | -61.40 | 8.09 | |
| One Dwell Trapezoid | 1.74 | 4.91 | 4.91 | 61.70 | -61.70 | 6.86 | |
| Asymmetrical Cycloidal | 2.00 | 7.85 | -5.24 | 61.70 | -61.70 | 10.20 | |
| One Dwell Modified Sine | 1.66 | 5.21 | 5.21 | 65.50 | -21.80 | 4.86 | |
| One Dwell Modified Trapezoid (m=2/3) | 1.94 | 5.53 | -3.68 | 69.40 | -69.40 | 8.63 | |
| Modified Sine | 1.76 | 5.53 | -5.53 | 69.50 | -23.20 | 5.46 | |
| Trapezoid | 2.18 | 6.17 | 6.17 | 77.50 | -77.50 | 10.84 | Highest Velocity, Highest Inertial Torque |
| Asymmetrical Modified Trapezoid | 2.00 | 6.11 | -4.07 | 96.00 | -96.00 | 10.11 | |
| Modified Constant Velocity | 1.28 | 8.01 | 8.01 | 201.40 | -67.10 | 5.73 | Highest Accel |
| Parabolic | 2.00 | 4.00 | -4.00 | ∞ | ∞ | 8.00 | Lowest Accel, Highest Jerk |
| Simple Harmonic | 1.57 | 4.93 | 4.93 | ∞ | -15.50 | 3.88 | Lowest Inertial Torque |
| NC2 Curve | 1.79 | 5.89 | -4.21 | ∞ | -111.10 | 8.87 | |

Cam Curve Characteristics

Sorted by Positive Jerk

| Curve | Velocity Max | Accel Max | Accel Min | Jerk Max | Jerk Min | Inertia Torque Max | Comment |
|---|-----------------|--------------|--------------|-------------|-------------|--------------------------|---|
| No Dwell Modified Trapezoid | 1.72 | 4.20 | 4.20 | 26.40 | -26.40 | 5.07 | Lowest Jerk |
| One Dwell Cycloidal (m=1) | 1.76 | 5.53 | 5.53 | 34.70 | -34.70 | 6.32 | |
| Cycloidal | 2.00 | 6.28 | 6.28 | 39.50 | -39.50 | 8.16 | Lowest Velocity |
| No Dwell Modified Constant Velocity | 1.22 | 7.68 | 7.68 | 48.20 | -48.20 | 4.69 | |
| One Dwell Cycloidal (m=2/3) | 1.72 | 6.75 | -4.50 | 53.00 | -53.00 | 7.53 | |
| One Dwell Modified Trapezoid (m=1) | 1.92 | 4.44 | -4.44 | 55.80 | -55.80 | 7.11 | |
| One Dwell Modified Trapezoid (Ferguson) | 1.92 | 4.68 | -4.22 | 58.90 | -58.90 | 7.43 | |
| Modified Trapezoid | 2.00 | 4.89 | 4.89 | 61.40 | -61.40 | 8.09 | |
| One Dwell Trapezoid | 1.74 | 4.91 | 4.91 | 61.70 | -61.70 | 6.86 | |
| Asymmetrical Cycloidal | 2.00 | 7.85 | -5.24 | 61.70 | -61.70 | 10.20 | |
| One Dwell Modified Sine | 1.66 | 5.21 | 5.21 | 65.50 | -21.80 | 4.86 | |
| One Dwell Modified Trapezoid (m=2/3) | 1.94 | 5.53 | -3.68 | 69.40 | -69.40 | 8.63 | |
| Modified Sine | 1.76 | 5.53 | -5.53 | 69.50 | -23.20 | 5.46 | Highest Velocity, Highest Inertial Torque |
| Trapezoid | 2.18 | 6.17 | 6.17 | 77.50 | -77.50 | 10.84 | |
| Asymmetrical Modified Trapezoid | 2.00 | 6.11 | -4.07 | 96.00 | -96.00 | 10.11 | Highest Accel |
| Modified Constant Velocity | 1.28 | 8.01 | 8.01 | 201.40 | -67.10 | 5.73 | |
| Parabolic | 2.00 | 4.00 | -4.00 | ∞ | ∞ | 8.00 | Lowest Accel, Highest Jerk |
| Simple Harmonic | 1.57 | 4.93 | 4.93 | ∞ | -15.50 | 3.88 | Lowest Inertial Torque |
| NC2 Curve | 1.79 | 5.89 | -4.21 | ∞ | -111.10 | 8.87 | |

Cam Curve Characteristics

Sorted by Combined Score Rank

| Curve | Velocity Max | Accel Max | Accel Min | Jerk Max | Jerk Min | Inertia Torque Max | Comment |
|---|-----------------|--------------|--------------|-------------|-------------|--------------------------|---|
| No Dwell Modified Trapezoid | 1.72 | 4.20 | 4.20 | 26.40 | -26.40 | 5.07 | Lowest Jerk |
| One Dwell Modified Trapezoid (m=1) | 1.92 | 4.44 | -4.44 | 55.80 | -55.80 | 7.11 | |
| One Dwell Cycloidal (m=1) | 1.76 | 5.53 | 5.53 | 34.70 | -34.70 | 6.32 | Lowest Velocity |
| No Dwell Modified Constant Velocity | 1.22 | 7.68 | 7.68 | 48.20 | -48.20 | 4.69 | |
| One Dwell Trapezoid | 1.74 | 4.91 | 4.91 | 61.70 | -61.70 | 6.86 | |
| One Dwell Modified Trapezoid (Ferguson) | 1.92 | 4.68 | -4.22 | 58.90 | -58.90 | 7.43 | |
| One Dwell Modified Sine | 1.66 | 5.21 | 5.21 | 65.50 | -21.80 | 4.86 | |
| One Dwell Cycloidal (m=2/3) | 1.72 | 6.75 | -4.50 | 53.00 | -53.00 | 7.53 | |
| Modified Trapezoid | 2.00 | 4.89 | 4.89 | 61.40 | -61.40 | 8.09 | Lowest Inertial Torque |
| Simple Harmonic | 1.57 | 4.93 | 4.93 | ∞ | -15.50 | 3.88 | |
| Modified Sine | 1.76 | 5.53 | -5.53 | 69.50 | -23.20 | 5.46 | Lowest Accel, Highest Jerk |
| Parabolic | 2.00 | 4.00 | -4.00 | ∞ | ∞ | 8.00 | |
| Cycloidal | 2.00 | 6.28 | 6.28 | 39.50 | -39.50 | 8.16 | |
| One Dwell Modified Trapezoid (m=2/3) | 1.94 | 5.53 | -3.68 | 69.40 | -69.40 | 8.63 | |
| Modified Constant Velocity | 1.28 | 8.01 | 8.01 | 201.40 | -67.10 | 5.73 | Highest Accel |
| NC2 Curve | 1.79 | 5.89 | -4.21 | ∞ | -111.10 | 8.87 | |
| Asymmetrical Modified Trapezoid | 2.00 | 6.11 | -4.07 | 96.00 | -96.00 | 10.11 | |
| Asymmetrical Cycloidal | 2.00 | 7.85 | -5.24 | 61.70 | -61.70 | 10.20 | |
| Trapezoid | 2.18 | 6.17 | 6.17 | 77.50 | -77.50 | 10.84 | Highest Velocity, Highest Inertial Torque |

Cam Curve Types

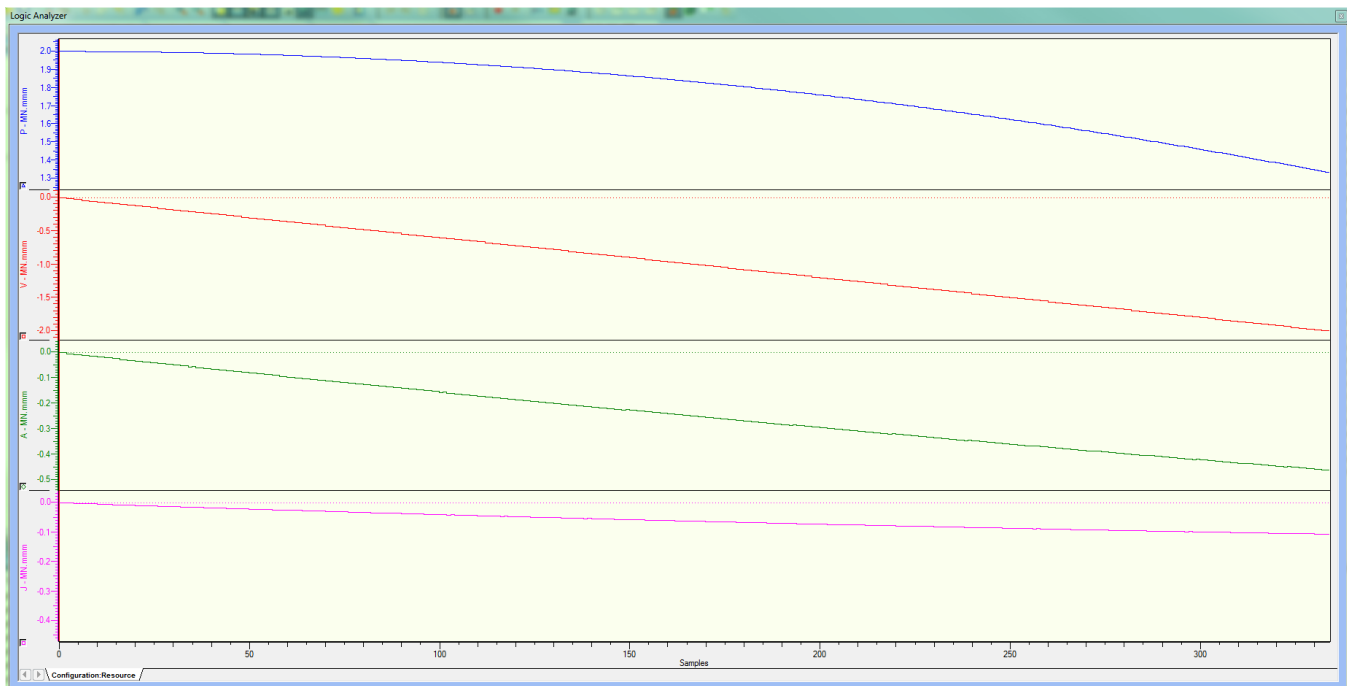
Toolbox Help Documentation
Help version created 1/31/2018

YASKAWA



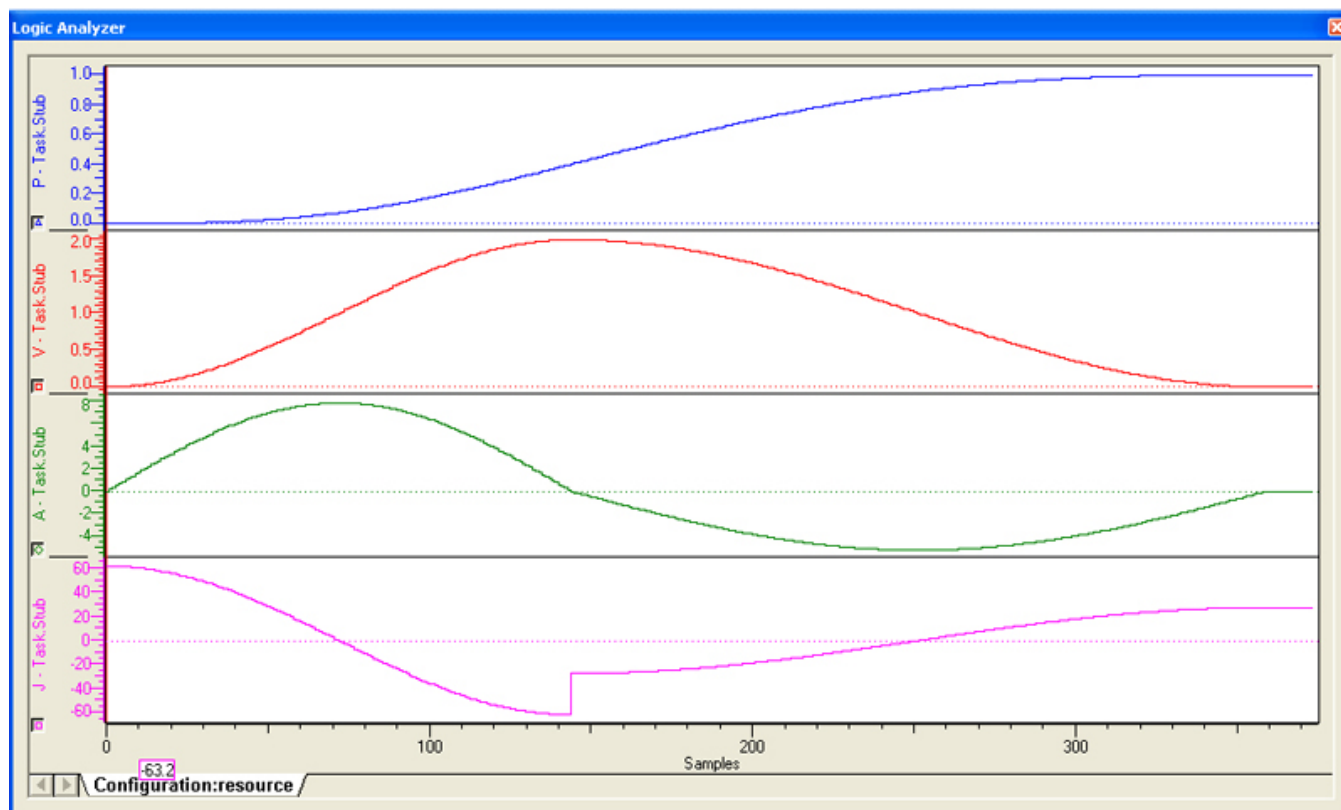
Arc

The CamSegmentStruct elements ArcRadius and ArcDirection must be declared for proper usage of this curve type.



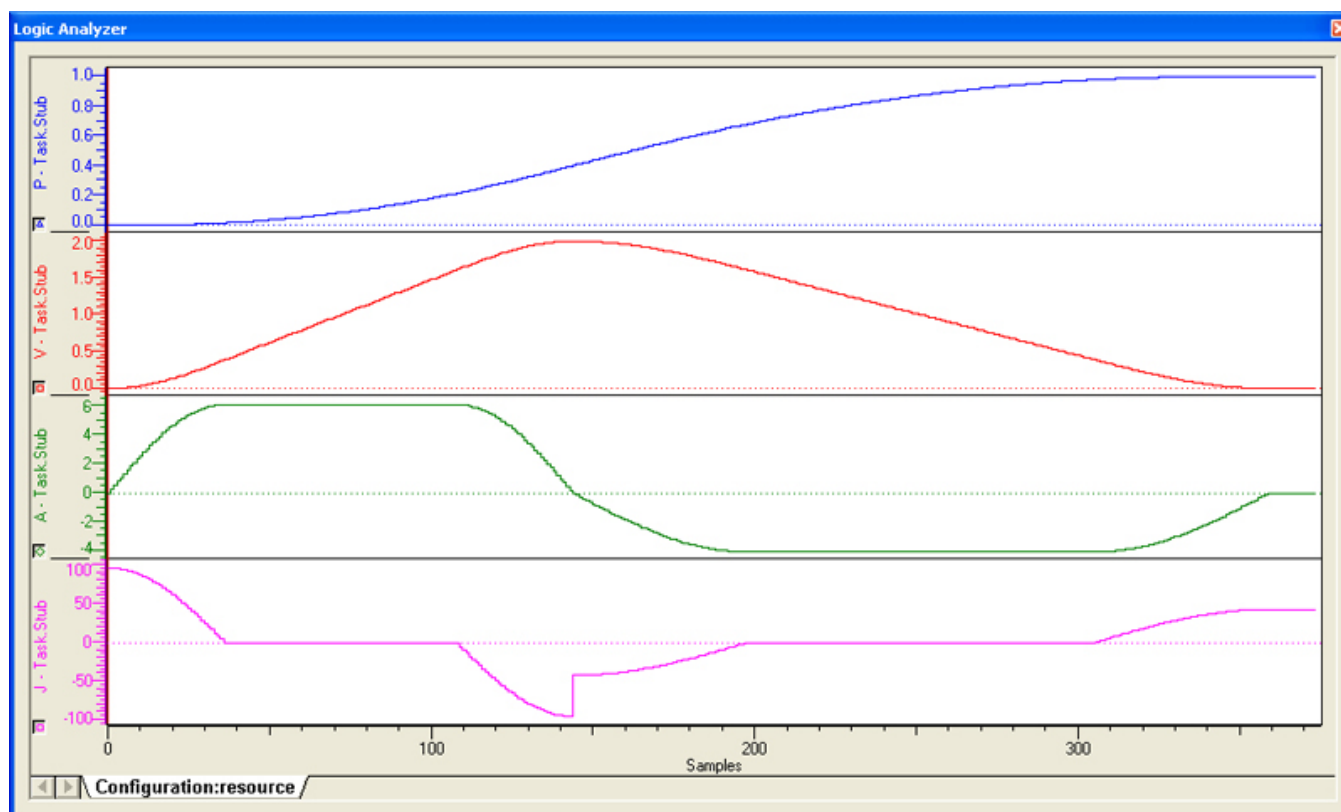


Asymmetrical Cycloidal





Asymmetrical Modified Trapezoid

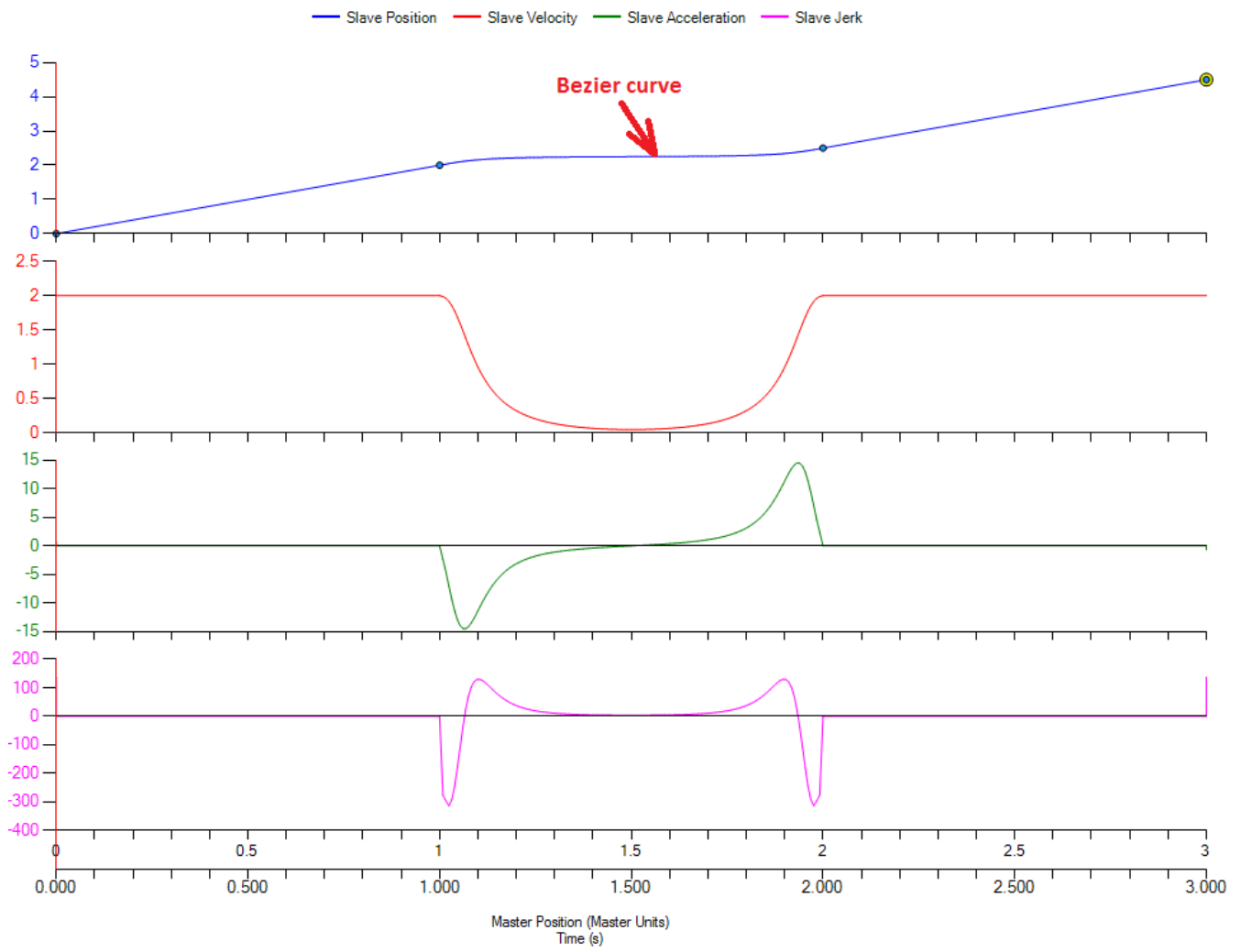




Bezier

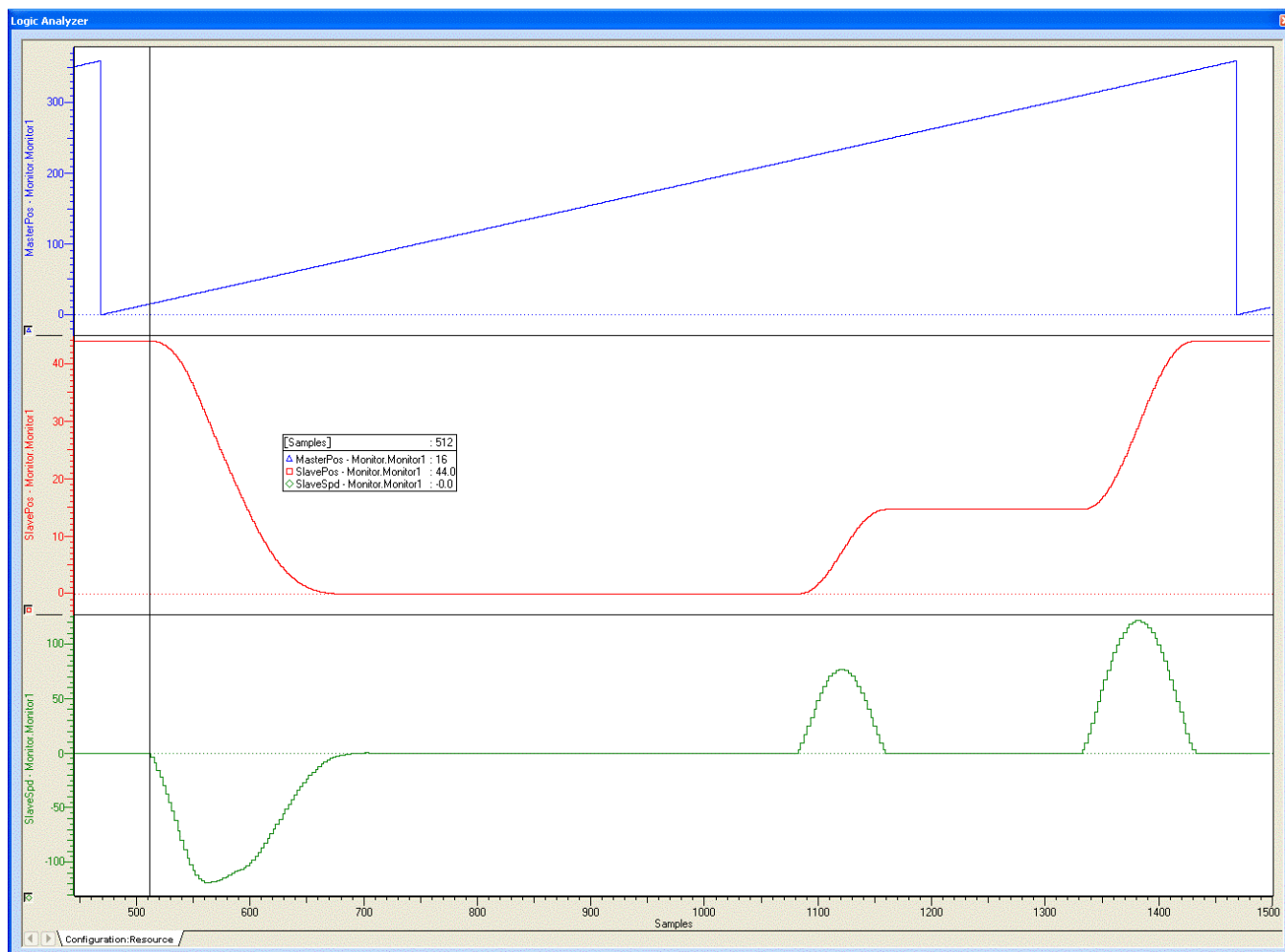
The Bezier curve type generates a non reversing bezier profile between two straight lines.

```
MyCam.SlaveStart := LREAL#0.0;  
MyCam.LastSegment := INT#3;  
MyCam.UseSplineSlope := FALSE;  
  
MyCam.CamParameters[1].CurveType := TB_CurveType#StraightLine;  
MyCam.CamParameters[1].MasterEnd := LREAL#1.0;  
MyCam.CamParameters[1].SlaveEnd := LREAL#2.0;  
MyCam.CamParameters[1].Resolution := REAL#0.0;  
  
MyCam.CamParameters[2].CurveType := TB_CurveType#Bezier;  
MyCam.CamParameters[2].MasterEnd := LREAL#2.0;  
MyCam.CamParameters[2].SlaveEnd := LREAL#2.5;  
MyCam.CamParameters[2].Resolution := REAL#0.01;  
  
MyCam.CamParameters[3].CurveType := TB_CurveType#StraightLine;  
MyCam.CamParameters[3].MasterEnd := LREAL#3.0;  
MyCam.CamParameters[3].SlaveEnd := LREAL#4.5;  
MyCam.CamParameters[3].Resolution := REAL#0.0;
```





Cubic Spline



In this example, the left or beginning portion of a motion profile was created using the cubic spline formula. The right or end portion of the cycle includes two modified sine motions.

The CamData values are shown below:

(* test cubic spline *)

Profile4.SlaveStart:=LREAL#44.0; (* The slaves initial and final position is not zero, it is 44.0 *)

seg:=INT#1;

Profile4.CamParameters[Seg].CurveType:=TB_CurveType#StraightLine;

Profile4.CamParameters[Seg].MasterEnd:=LREAL#15.0;

Profile4.CamParameters[Seg].SlaveEnd:=LREAL#44.0;

```

Profile4.CamParameters[Seg].Resolution:=REAL#0.0;

seg:=Seg + INT#1;
Profile4.CamParameters[Seg].CurveType:=TB_CurveType#CubicSpline;
Profile4.CamParameters[Seg].MasterEnd:=LREAL#17.0;
Profile4.CamParameters[Seg].SlaveEnd:=LREAL#43.9614;
Profile4.CamParameters[Seg].Resolution:=REAL#1.0;

seg:=Seg + INT#1;
Profile4.CamParameters[Seg].CurveType:=TB_CurveType#CubicSpline;
Profile4.CamParameters[Seg].MasterEnd:=LREAL#25.5;
Profile4.CamParameters[Seg].SlaveEnd:=LREAL#40.3036;
Profile4.CamParameters[Seg].Resolution:=REAL#1.0;

seg:=Seg + INT#1;
Profile4.CamParameters[Seg].CurveType:=TB_CurveType#CubicSpline;
Profile4.CamParameters[Seg].MasterEnd:=LREAL#34.0;
Profile4.CamParameters[Seg].SlaveEnd:=LREAL#30.4425;
Profile4.CamParameters[Seg].Resolution:=REAL#1.0;

seg:=Seg + INT#1;
Profile4.CamParameters[Seg].CurveType:=TB_CurveType#CubicSpline;
Profile4.CamParameters[Seg].MasterEnd:=LREAL#42.5;
Profile4.CamParameters[Seg].SlaveEnd:=LREAL#19.6003;
Profile4.CamParameters[Seg].Resolution:=REAL#1.0;

seg:=Seg + INT#1;
Profile4.CamParameters[Seg].CurveType:=TB_CurveType#CubicSpline;
Profile4.CamParameters[Seg].MasterEnd:=LREAL#43.0;
Profile4.CamParameters[Seg].SlaveEnd:=LREAL#19.0;
Profile4.CamParameters[Seg].Resolution:=REAL#1.0;

seg:=Seg + INT#1;
Profile4.CamParameters[Seg].CurveType:=TB_CurveType#CubicSpline;
Profile4.CamParameters[Seg].MasterEnd:=LREAL#51.0;
Profile4.CamParameters[Seg].SlaveEnd:=LREAL#10.0305;
Profile4.CamParameters[Seg].Resolution:=REAL#1.0;

seg:=Seg + INT#1;
Profile4.CamParameters[Seg].CurveType:=TB_CurveType#CubicSpline;
Profile4.CamParameters[Seg].MasterEnd:=LREAL#59.5;

```

Profile4.CamParameters[Seg].SlaveEnd:=LREAL#3.5477;

Profile4.CamParameters[Seg].Resolution:=REAL#1.0;

seg:=Seg + INT#1;

Profile4.CamParameters[Seg].CurveType:=TB_CurveType#CubicSpline;

Profile4.CamParameters[Seg].MasterEnd:=LREAL#68.0;

Profile4.CamParameters[Seg].SlaveEnd:=LREAL#0.6464;

Profile4.CamParameters[Seg].Resolution:=REAL#1.0;

seg:=Seg + INT#1;

Profile4.CamParameters[Seg].CurveType:=TB_CurveType#CubicSpline;

Profile4.CamParameters[Seg].MasterEnd:=LREAL#76.5;

Profile4.CamParameters[Seg].SlaveEnd:=LREAL#0.005;

Profile4.CamParameters[Seg].Resolution:=REAL#1.0;

seg:=Seg + INT#1;

Profile4.CamParameters[Seg].CurveType:=TB_CurveType#CubicSpline;

Profile4.CamParameters[Seg].MasterEnd:=LREAL#85.0;

Profile4.CamParameters[Seg].SlaveEnd:=LREAL#0.0;

Profile4.CamParameters[Seg].Resolution:=REAL#1.0;

seg:=Seg + INT#1;

Profile4.CamParameters[Seg].CurveType:=TB_CurveType#StraightLine;

Profile4.CamParameters[Seg].MasterEnd:=LREAL#220.0;

Profile4.CamParameters[Seg].SlaveEnd:=LREAL#0.0;

Profile4.CamParameters[Seg].Resolution:=REAL#0.0;

seg:=Seg + INT#1;

Profile4.CamParameters[Seg].CurveType:=TB_CurveType#ModifiedSine;

Profile4.CamParameters[Seg].MasterEnd:=LREAL#250.0;

Profile4.CamParameters[Seg].SlaveEnd:=LREAL#14.7;

Profile4.CamParameters[Seg].Resolution:=REAL#1.0;

seg:=Seg + INT#1;

Profile4.CamParameters[Seg].CurveType:=TB_CurveType#StraightLine;

Profile4.CamParameters[Seg].MasterEnd:=LREAL#310.0;

Profile4.CamParameters[Seg].SlaveEnd:=LREAL#14.7;

Profile4.CamParameters[Seg].Resolution:=REAL#1.0;

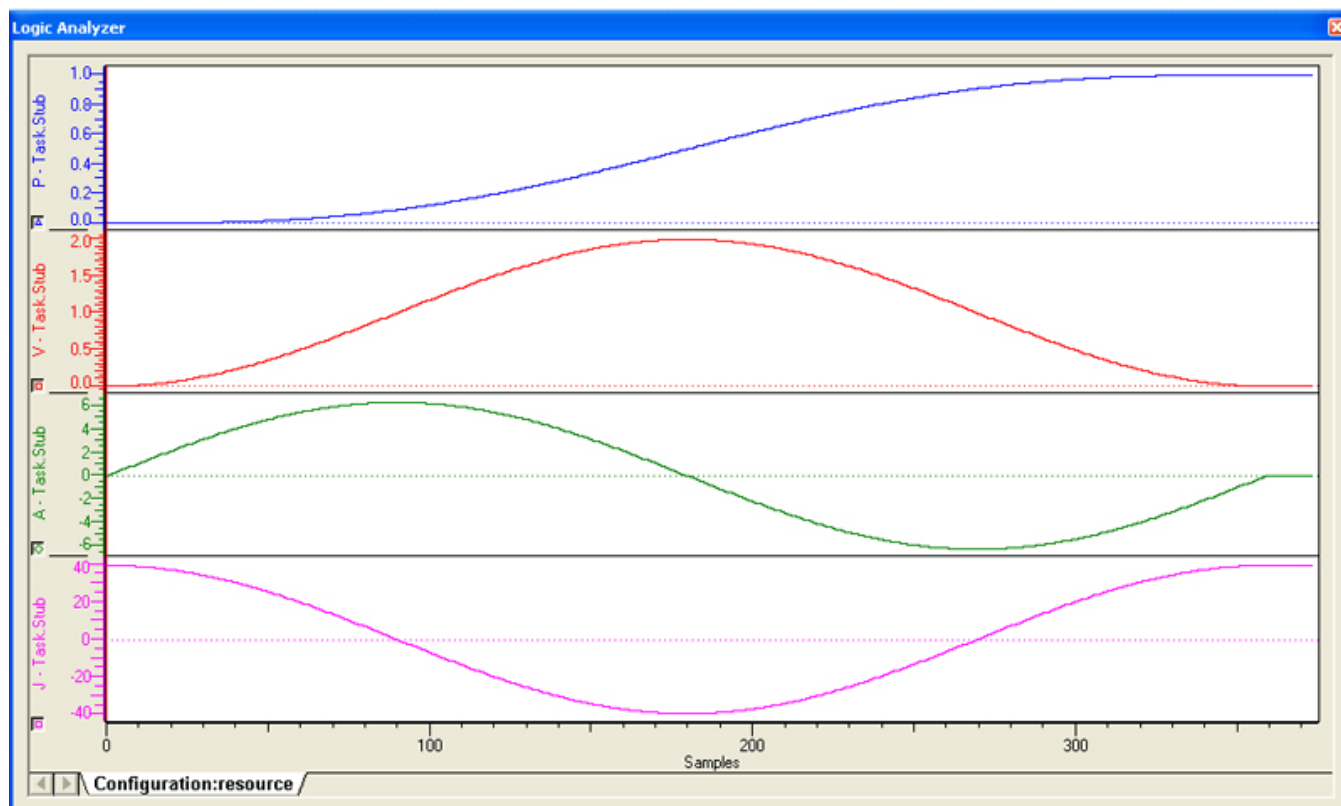
seg:=Seg + INT#1;

Profile4.CamParameters[Seg].CurveType:=TB_CurveType#ModifiedSine;

```
Profile4.CamParameters[Seg].MasterEnd:=LREAL#348.0;  
Profile4.CamParameters[Seg].SlaveEnd:=LREAL#44.0;  
Profile4.CamParameters[Seg].Resolution:=REAL#1.0;  
  
seg:=Seg + INT#1;  
Profile4.CamParameters[Seg].CurveType:=TB_CurveType#ModifiedSine;  
Profile4.CamParameters[Seg].MasterEnd:=LREAL#360.0;  
Profile4.CamParameters[Seg].SlaveEnd:=LREAL#44.0;  
Profile4.CamParameters[Seg].Resolution:=REAL#1.0;  
  
Profile4.LastSegment:=Seg;
```



Cycloidal



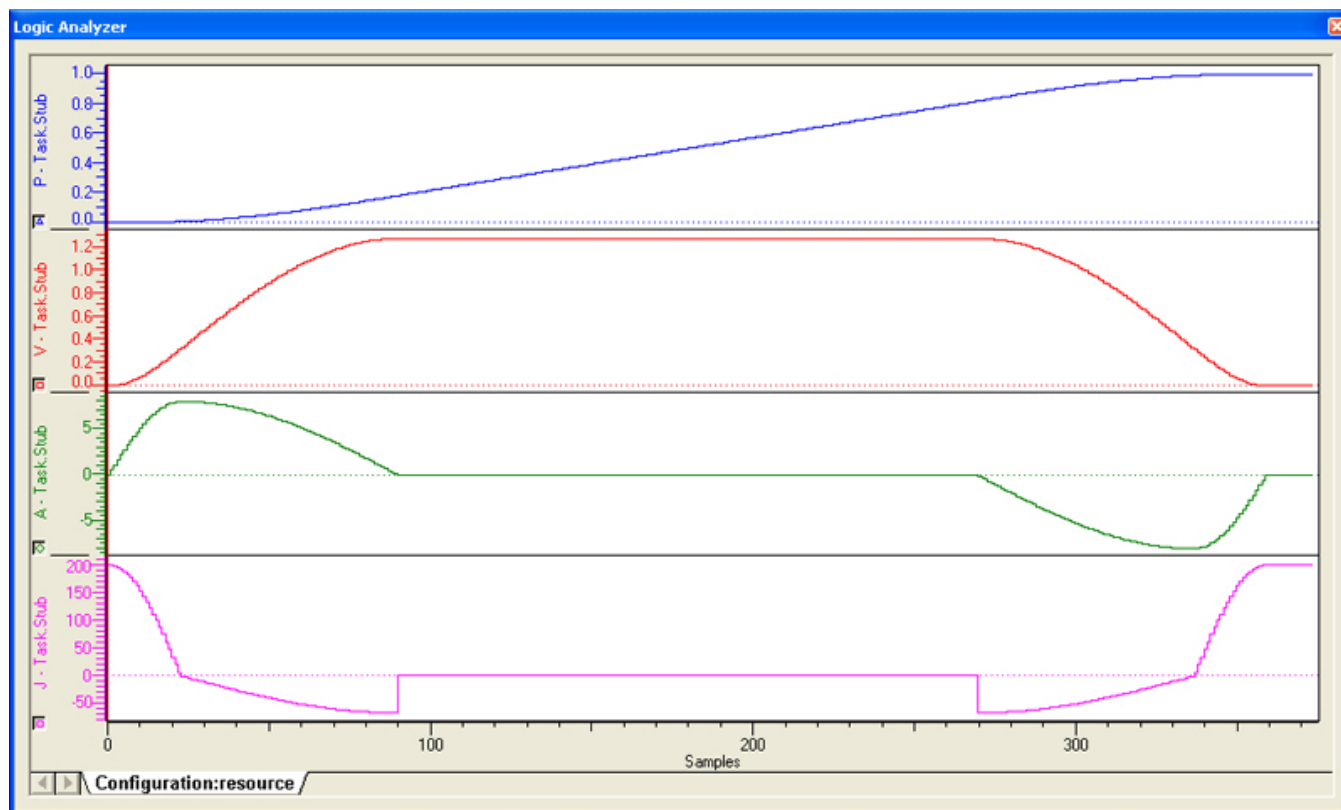


Double Harmonic

This curve type is not supported.

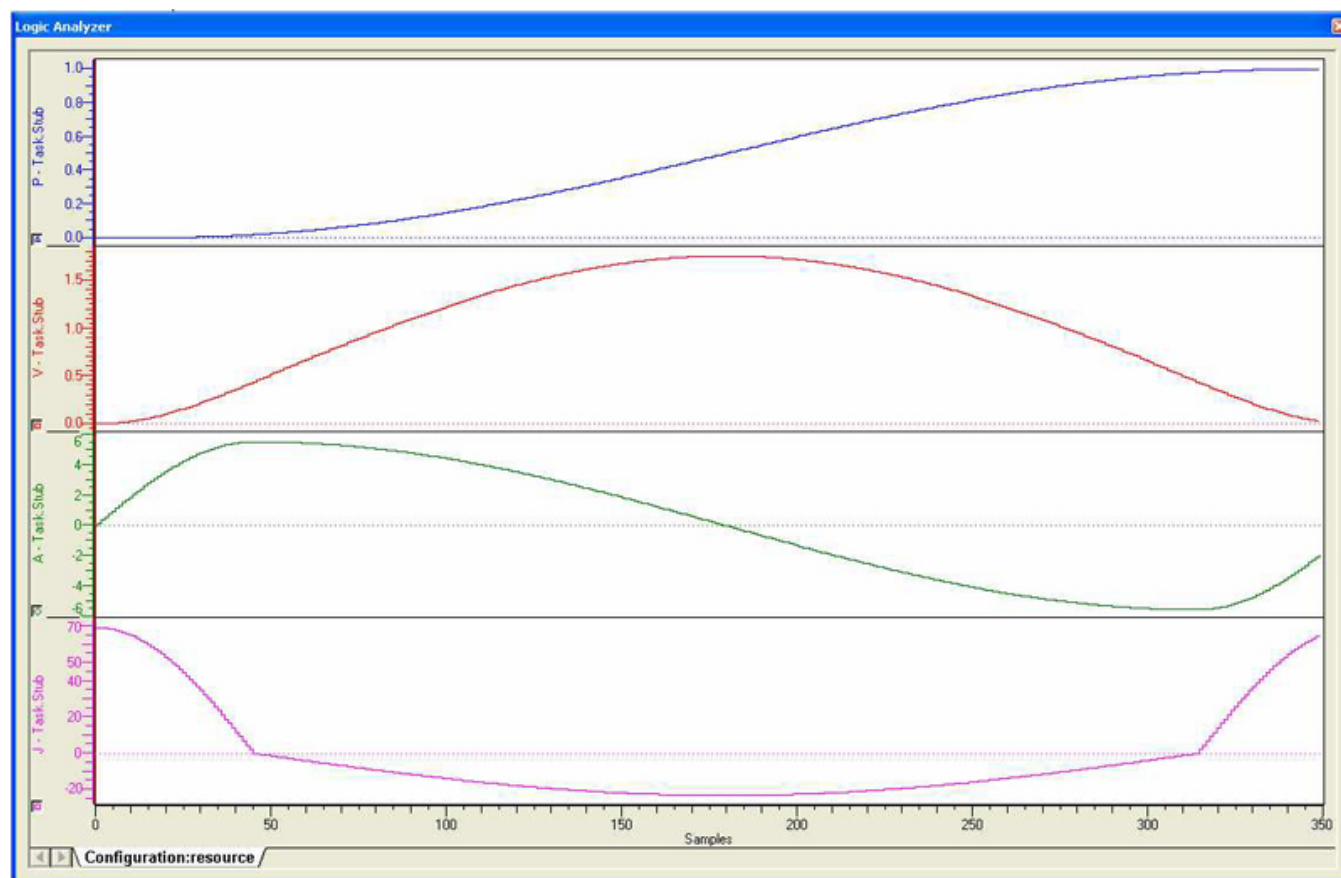


Modified Constant Velocity



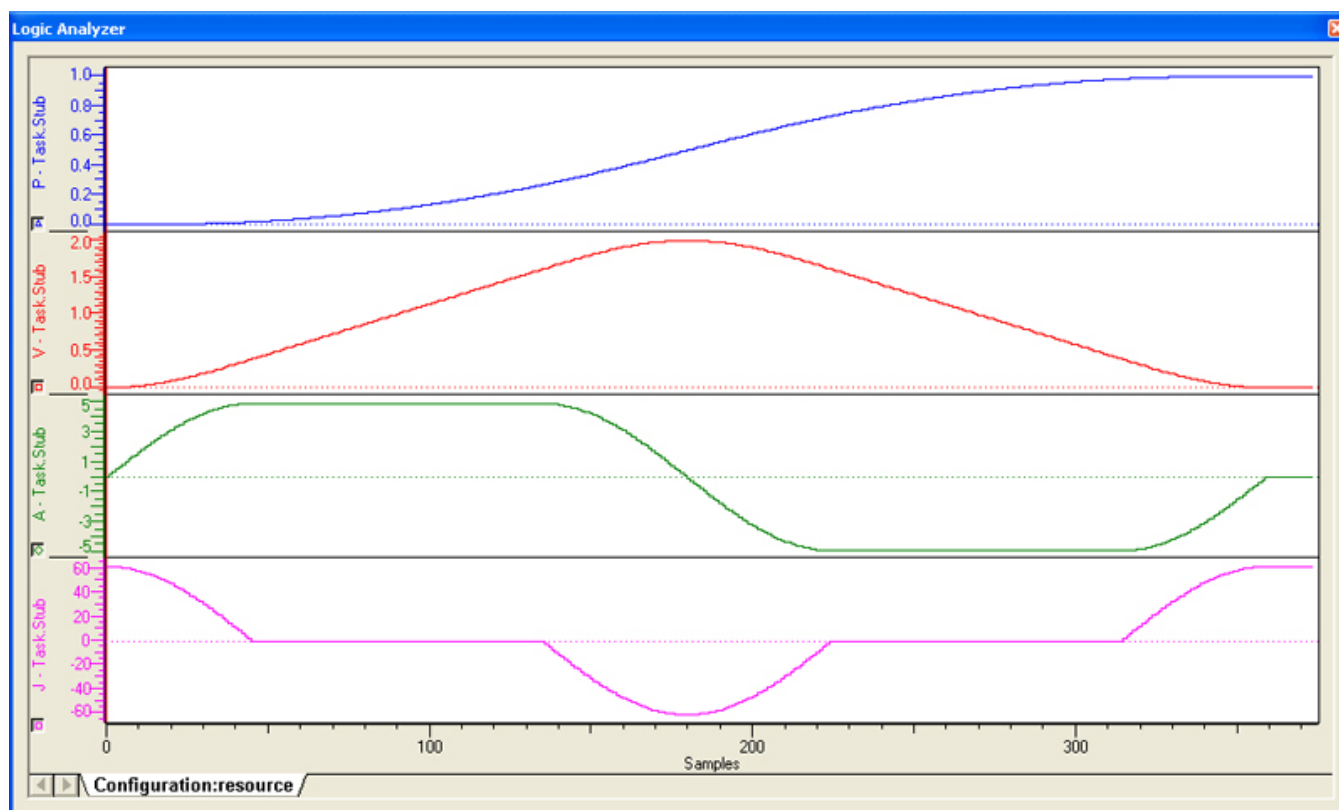


Modified Sine





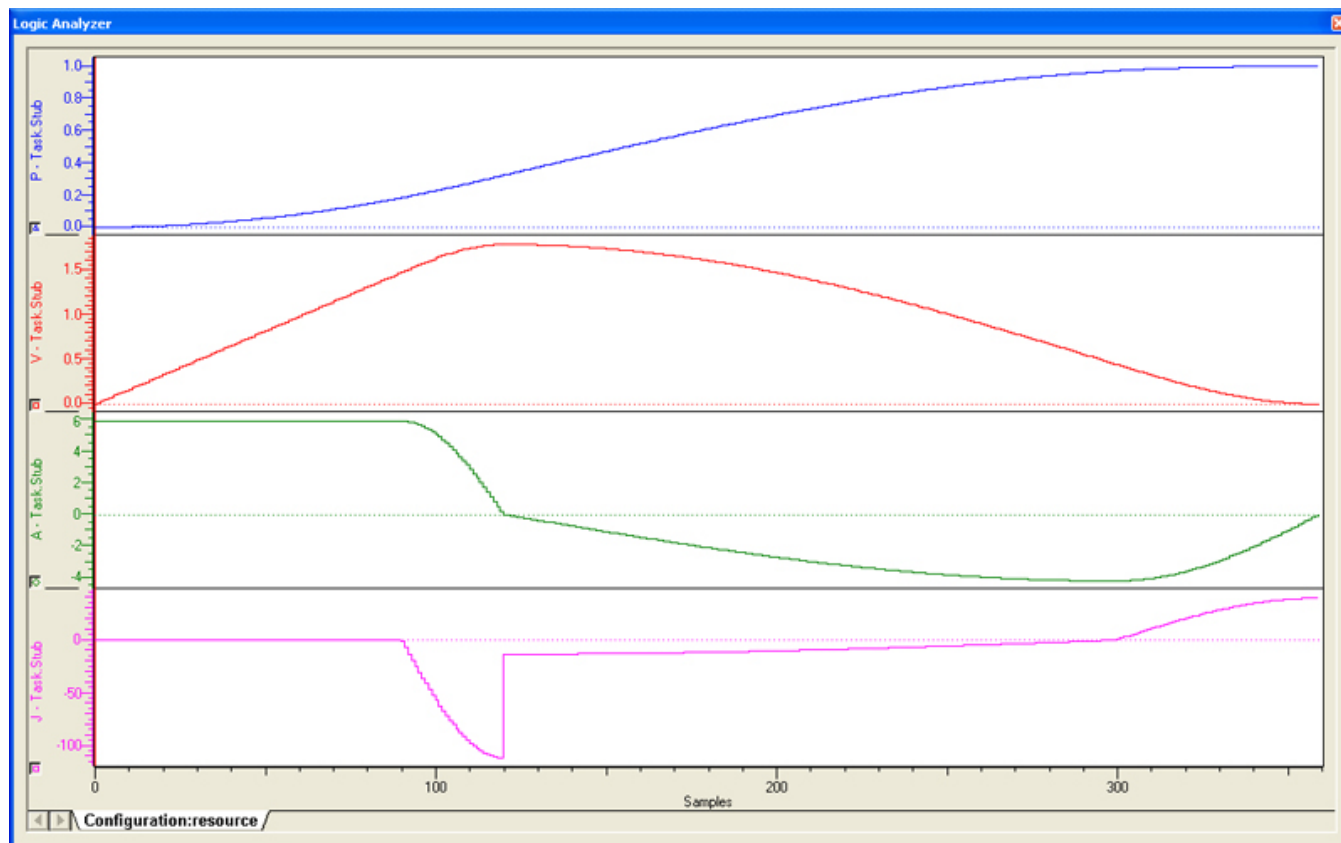
Modified Trapezoid





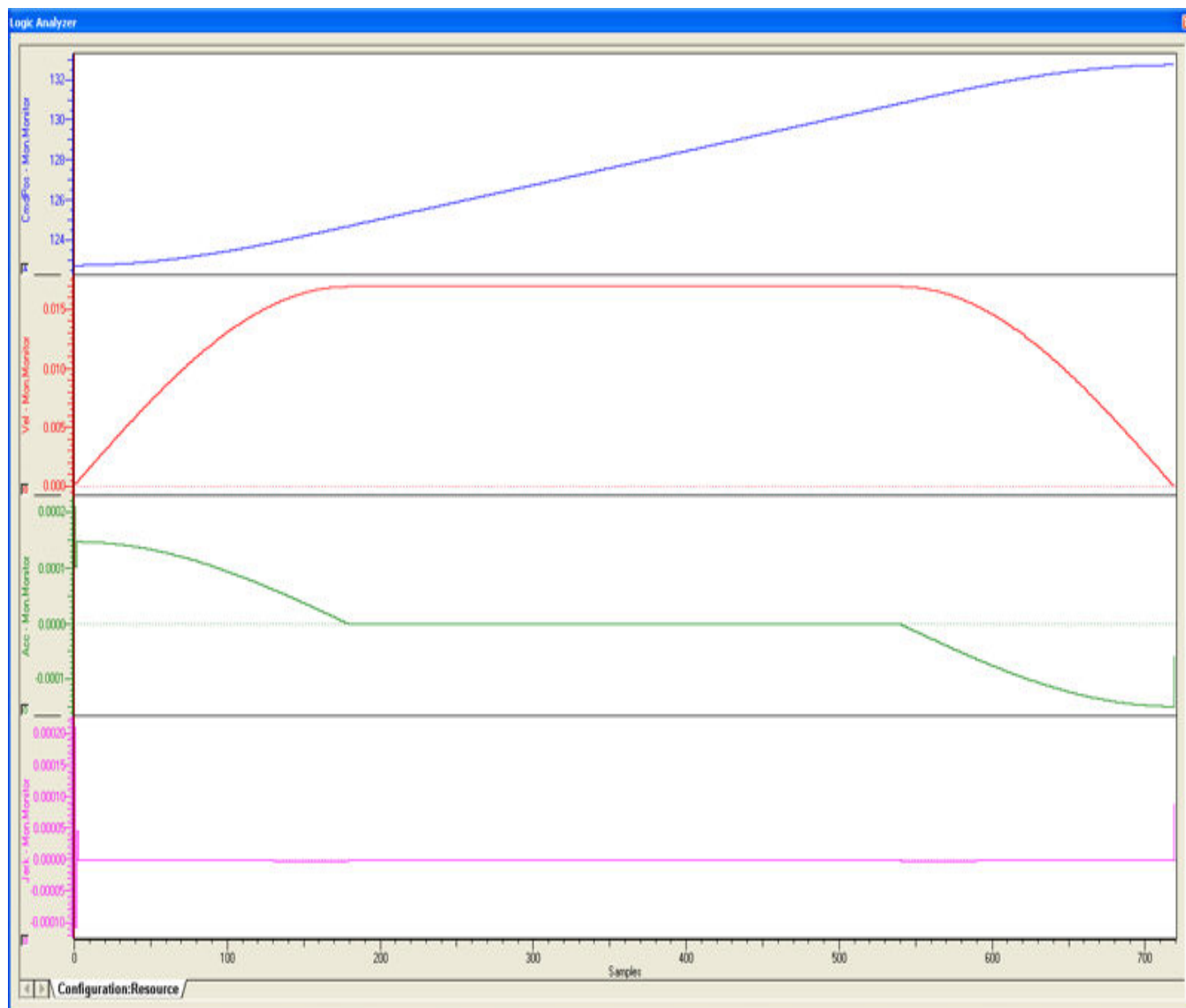
NC2 Curve

Notes: Deceleration is twice as long as acceleration, which provides the effect of restricting vibration.



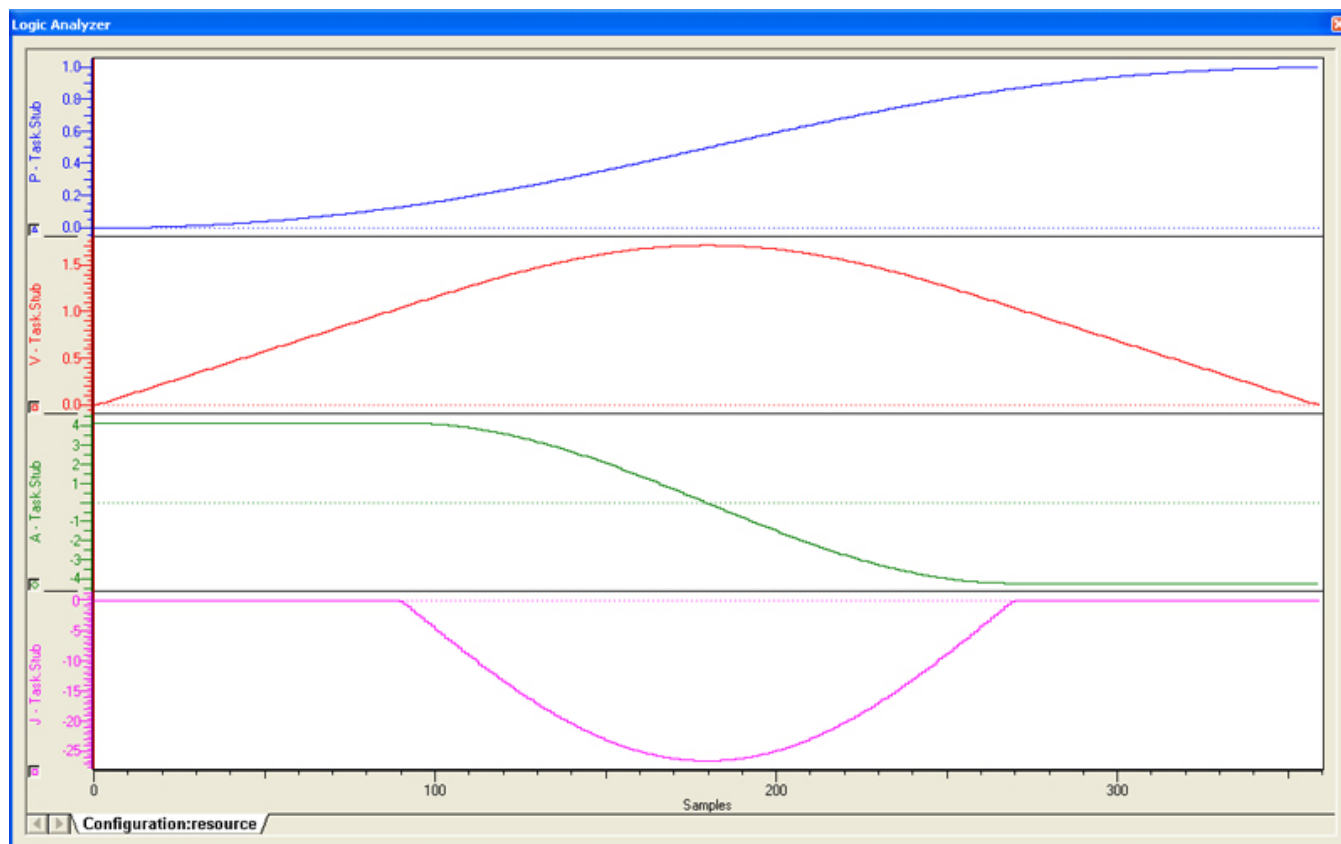


No Dwell Modified Constant Velocity



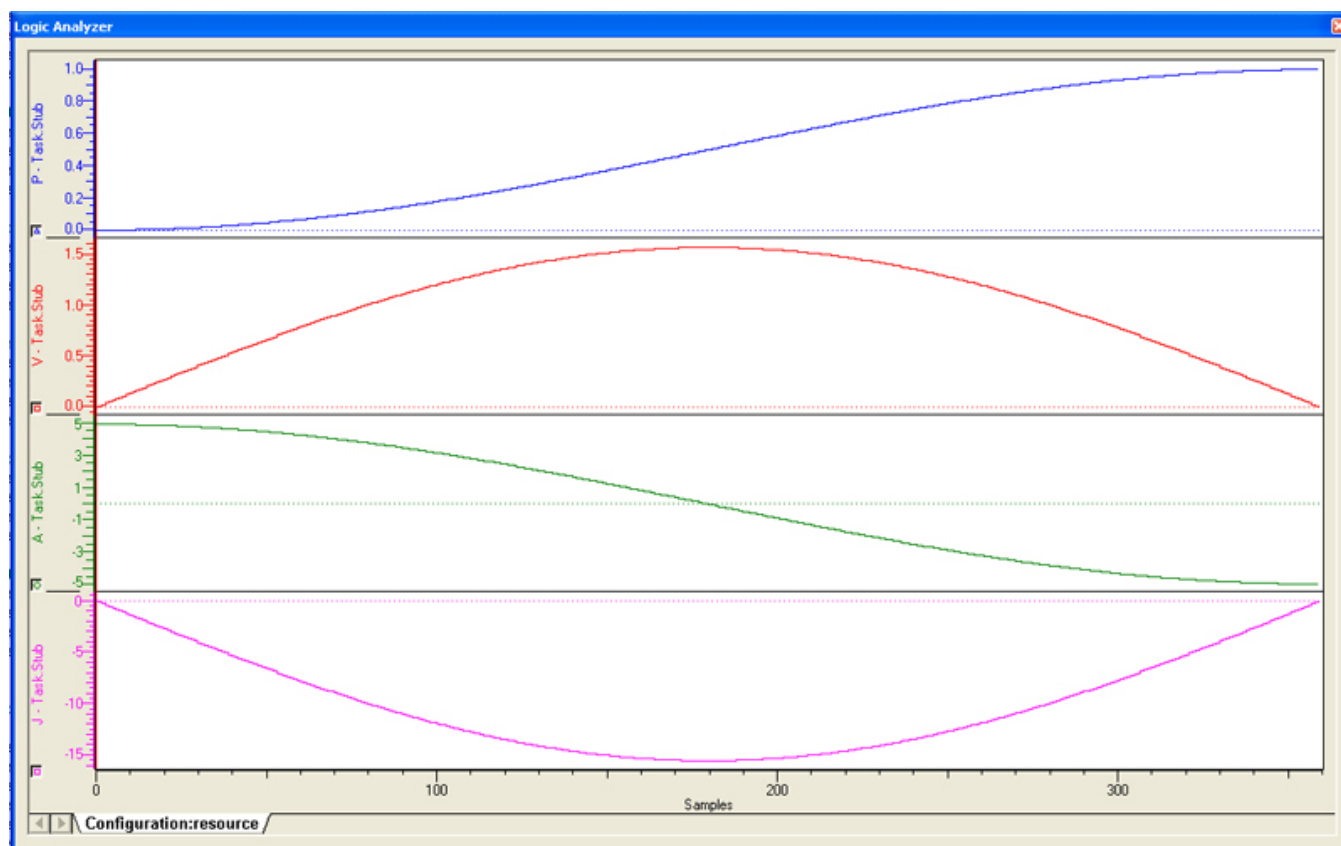


No Dwell Modified Trapezoid



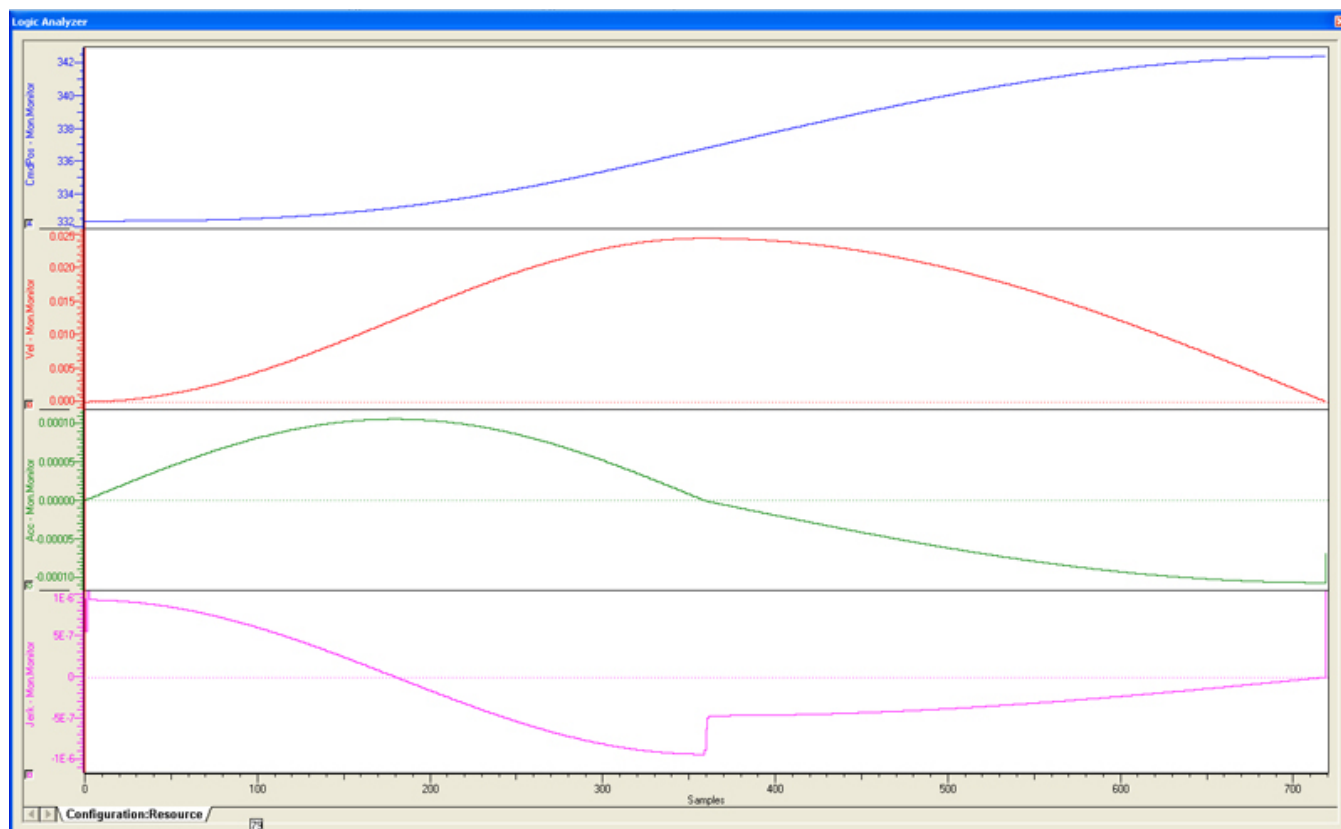


No Dwell Simple Harmonic



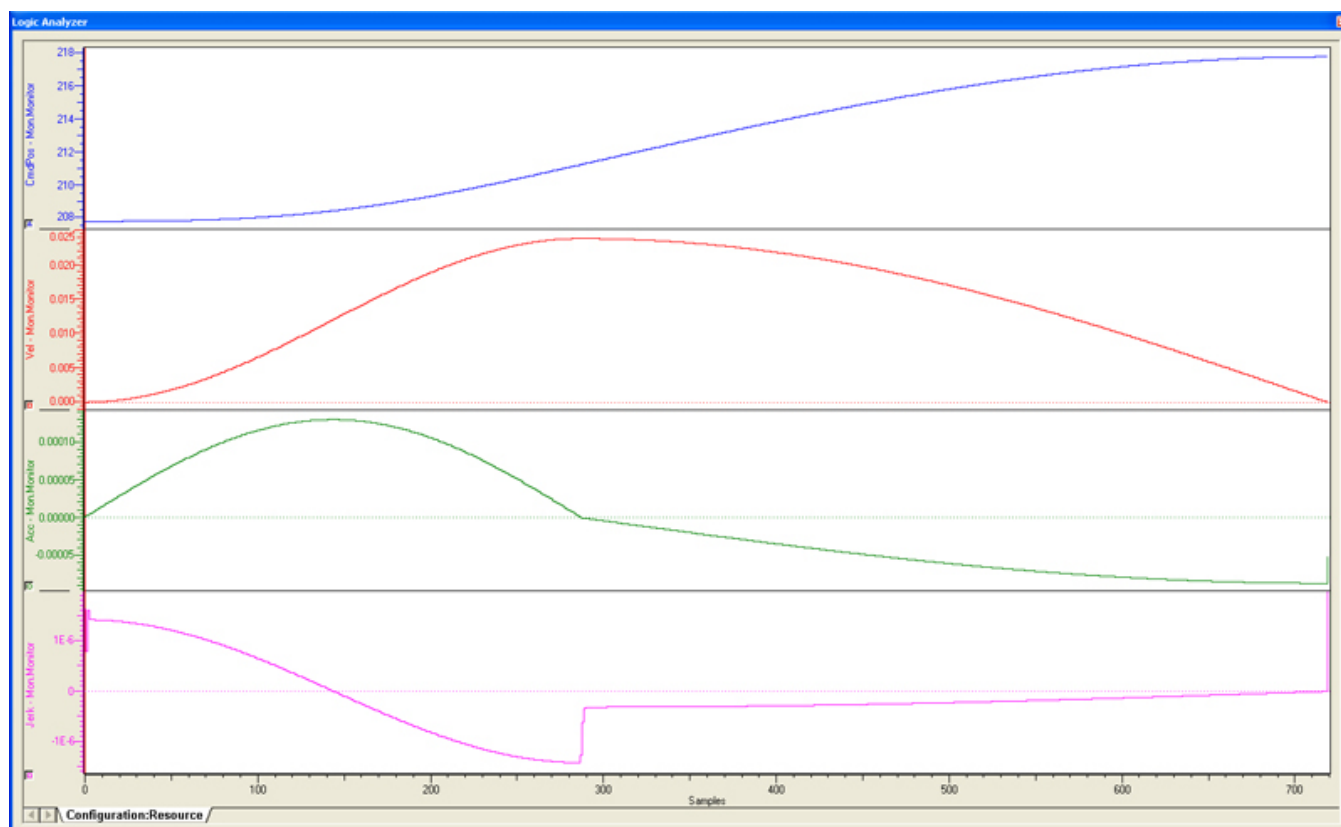


One Dwell Cycloidal_1



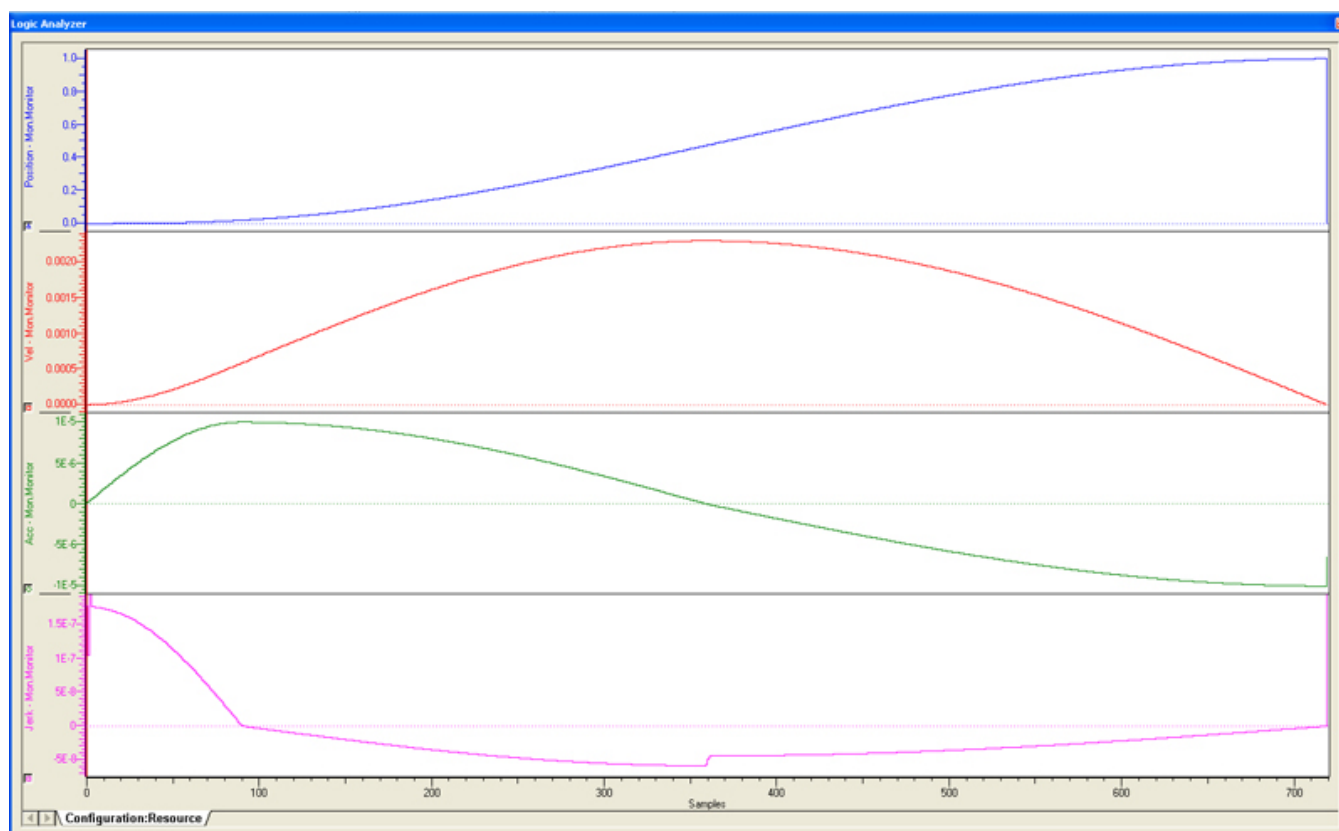


One Dwell Cycloidal_2_3



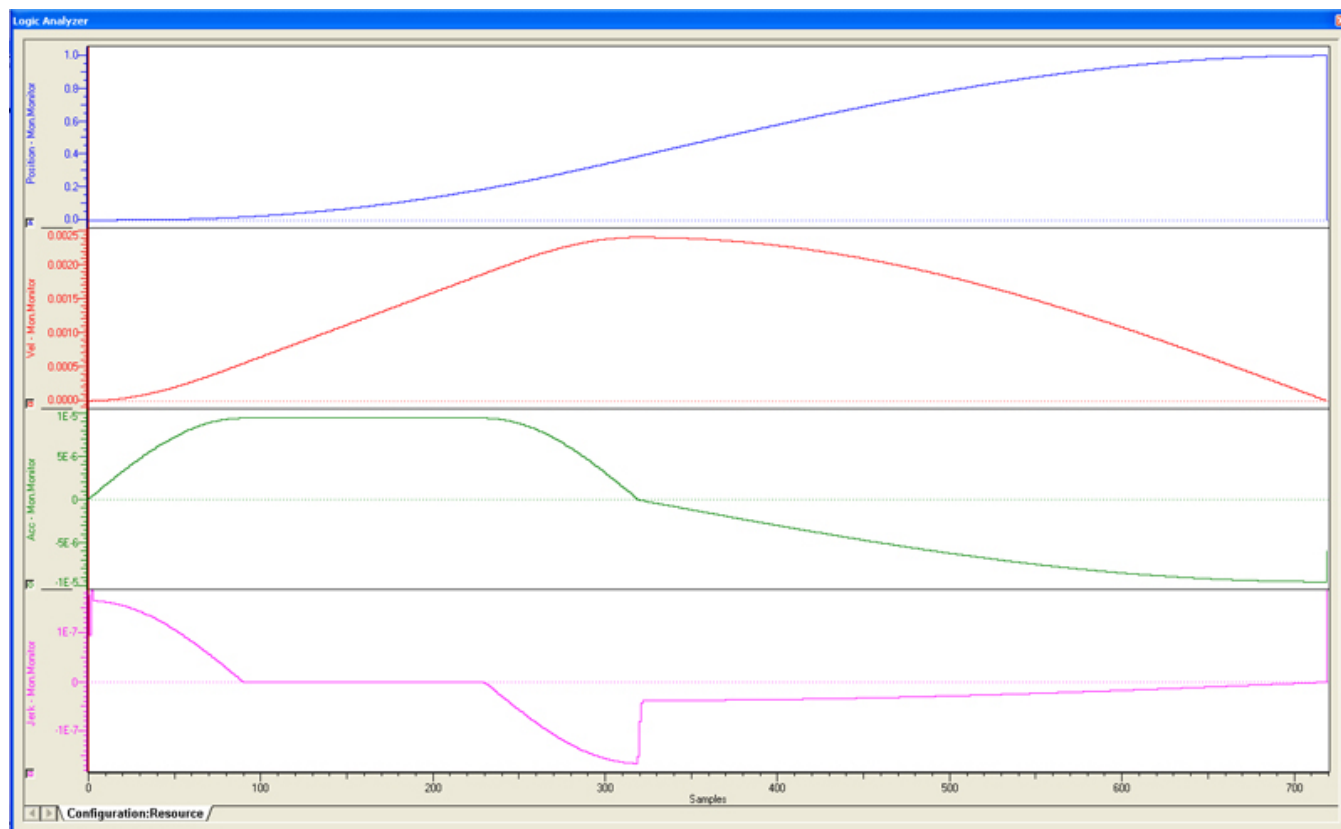


One Dwell Modified Sine



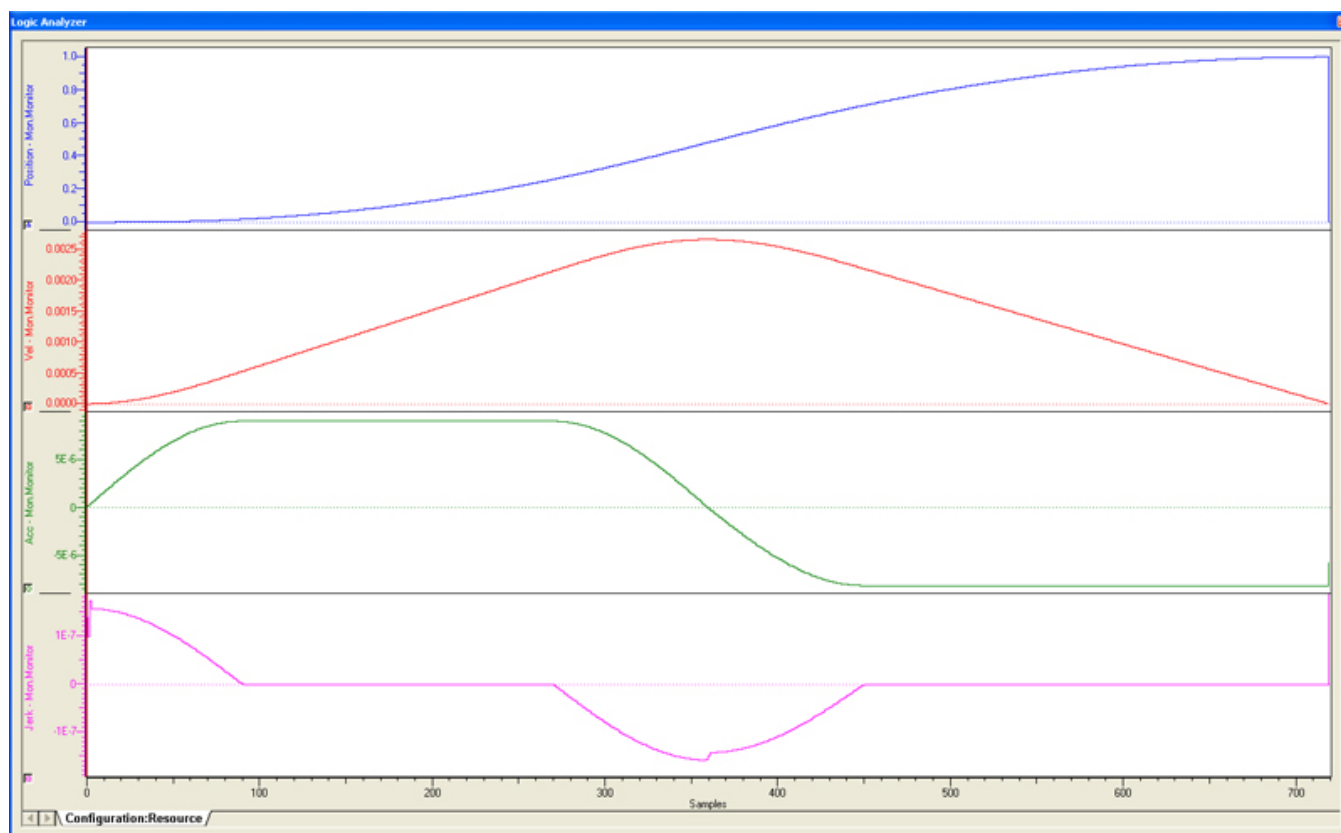


One Dwell Trapezoid



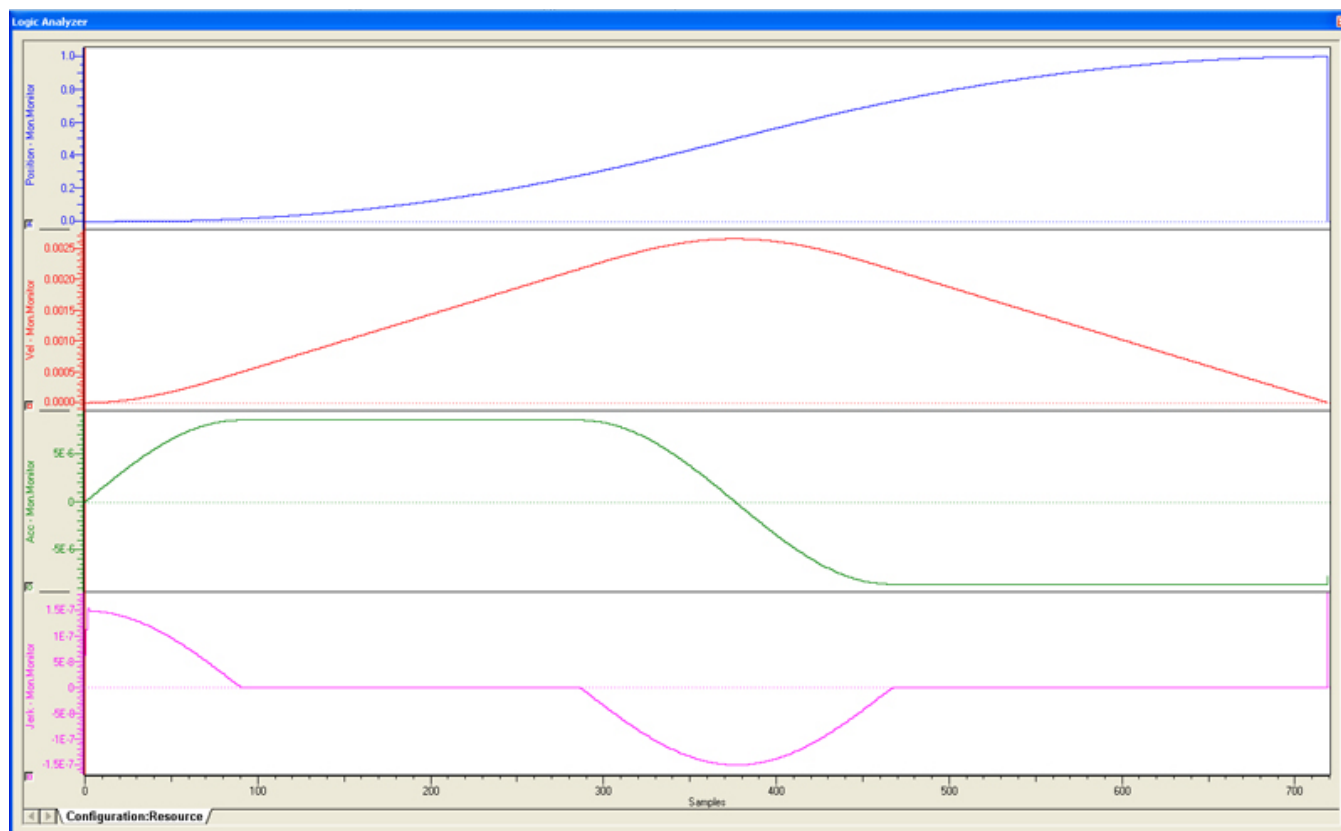


One Dwell Trapezoid



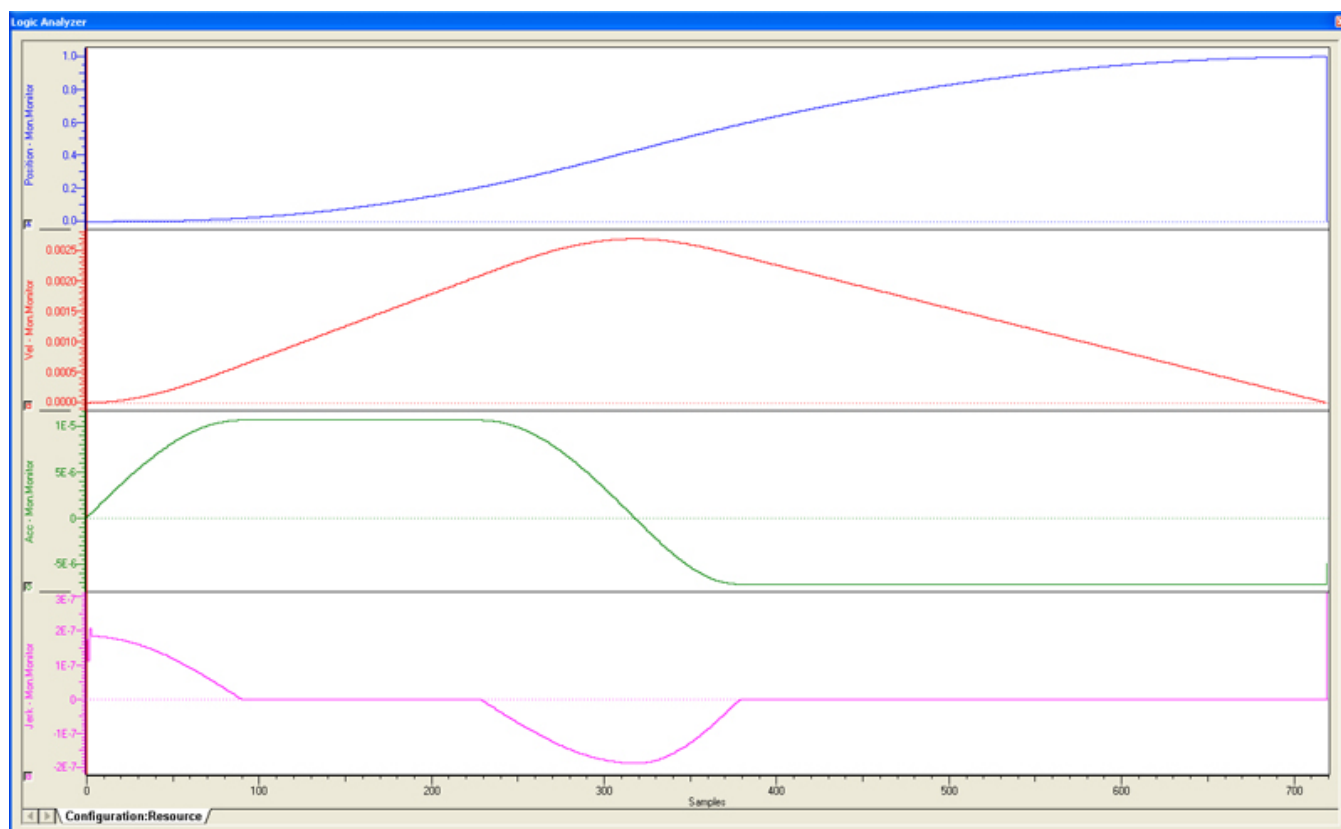


One Dwell Trapezoid_1





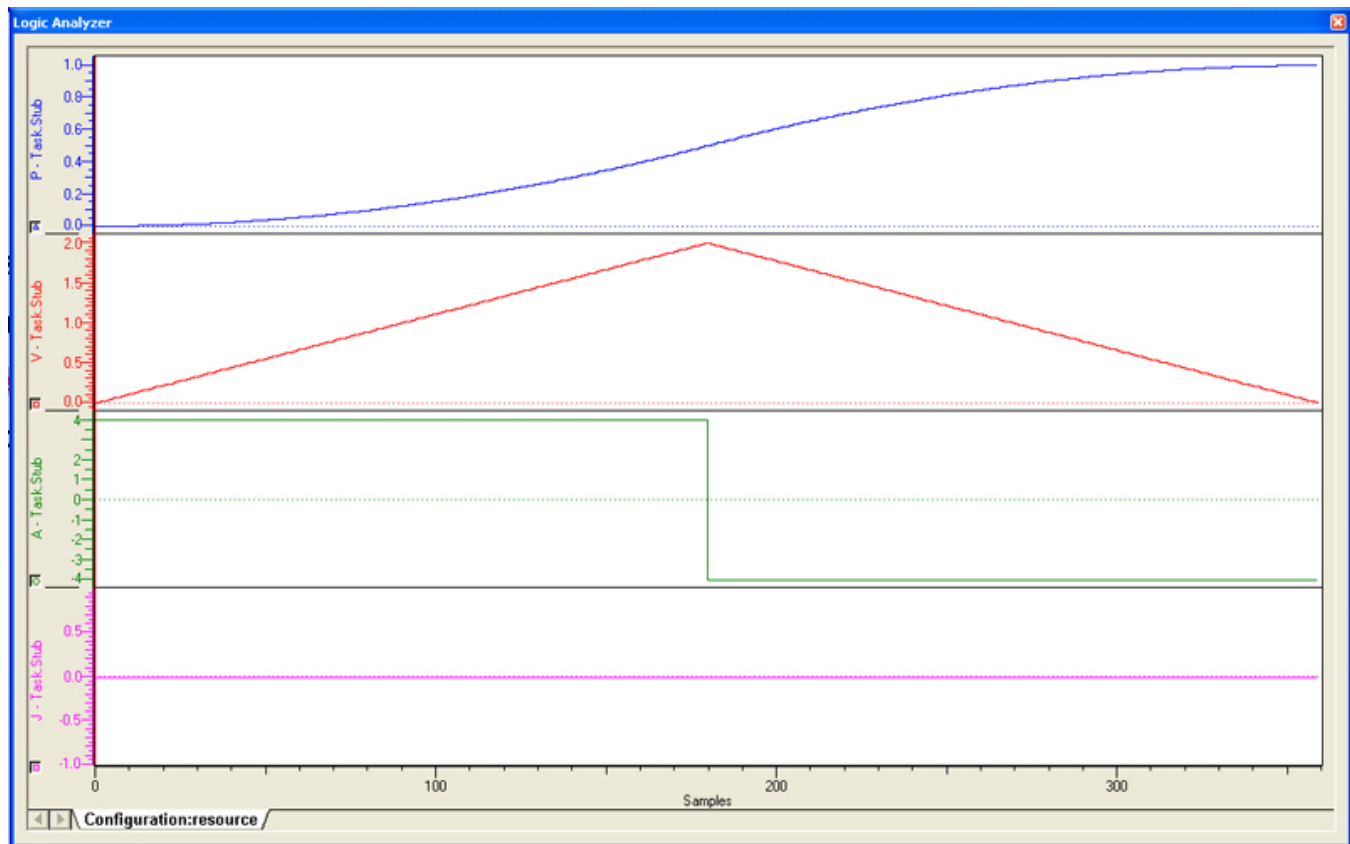
One Dwell Trapezoid_2_3





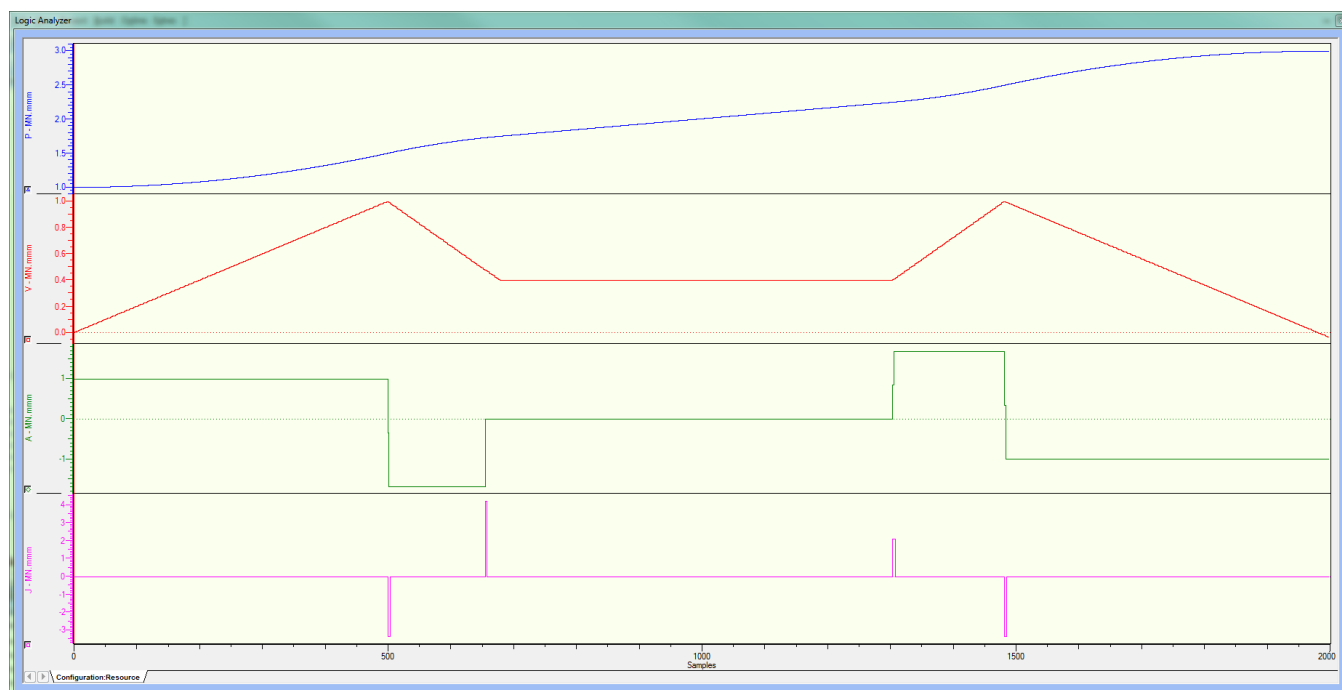
Parabolic

Designed for use as the only segment in the motion profile when a axis must be indexed. This curve has the feature that the non dimensional maximum acceleration A_m is the minimum ($A_m=4$) among all curves. Downside – Can cause vibration. Modified Trapezoid is better.





ParabolicVelocityBlend





Reverse Double Harmonic

This curve type is not supported.



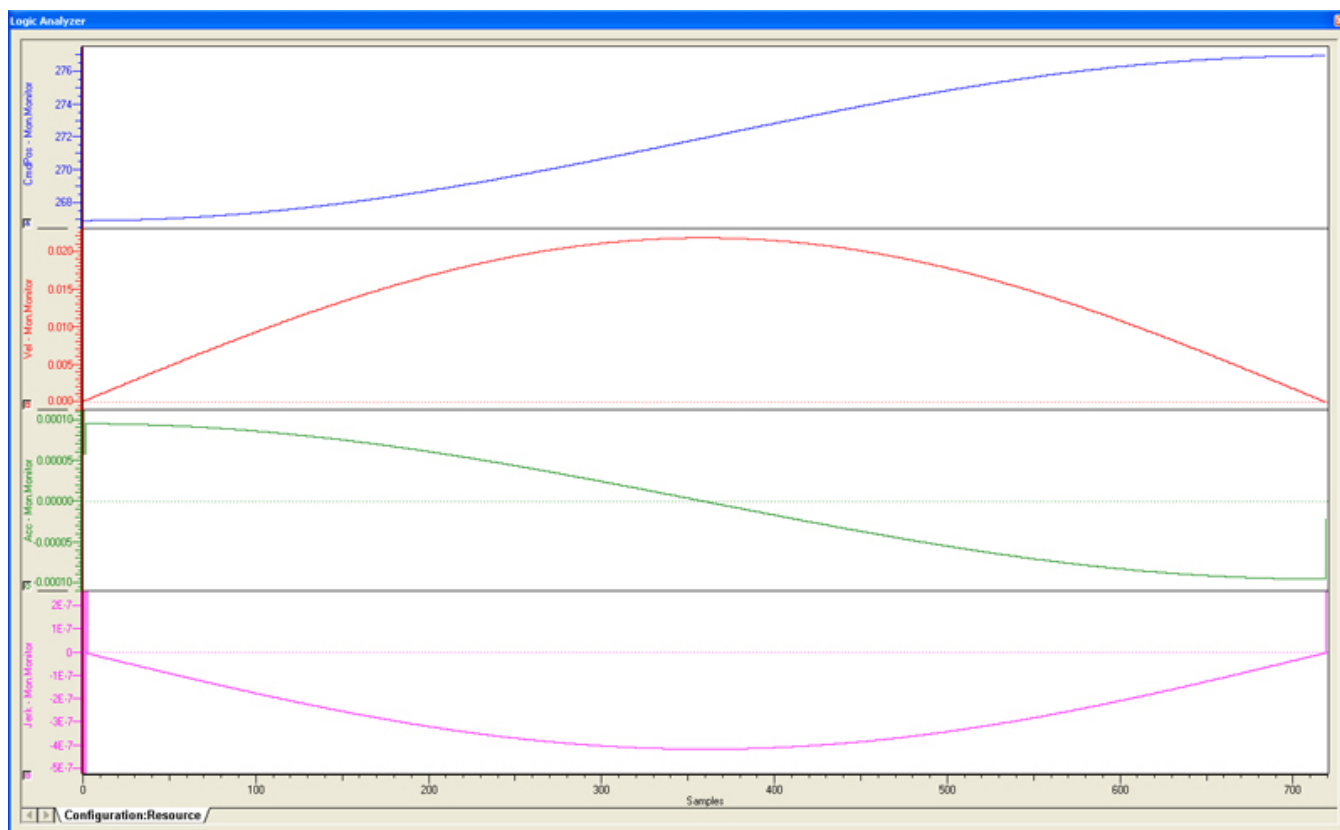
Reverse Trapecloid

This cam curve type is not supported.



Simple Harmonic

This curve is also one of the discontinuous curves that easily causes vibration, but since it has smooth and good (low) properties, it can be used for low speed applications. When this curve is used for no-dwell applications, (out & back) the discontinuity of acceleration at the starting and end points is not a factor and then this curve is regarded as the best curve for no-dwell use. The modified sine curve is considered an improvement over the simple harmonic.





Tangent Blending

Provides the same profile as [Tangent Matching](#), but designed for use with the [CamBlend](#) function block. The difference between this and Tangent Matching is how the matching velocity is determined. For this formula type, two segments are required: a straight line and a tangent blend. Which segment comes first dictates whether a "blend in" or "blend out" profile is created.

See the [CamBlend](#) function block for application examples



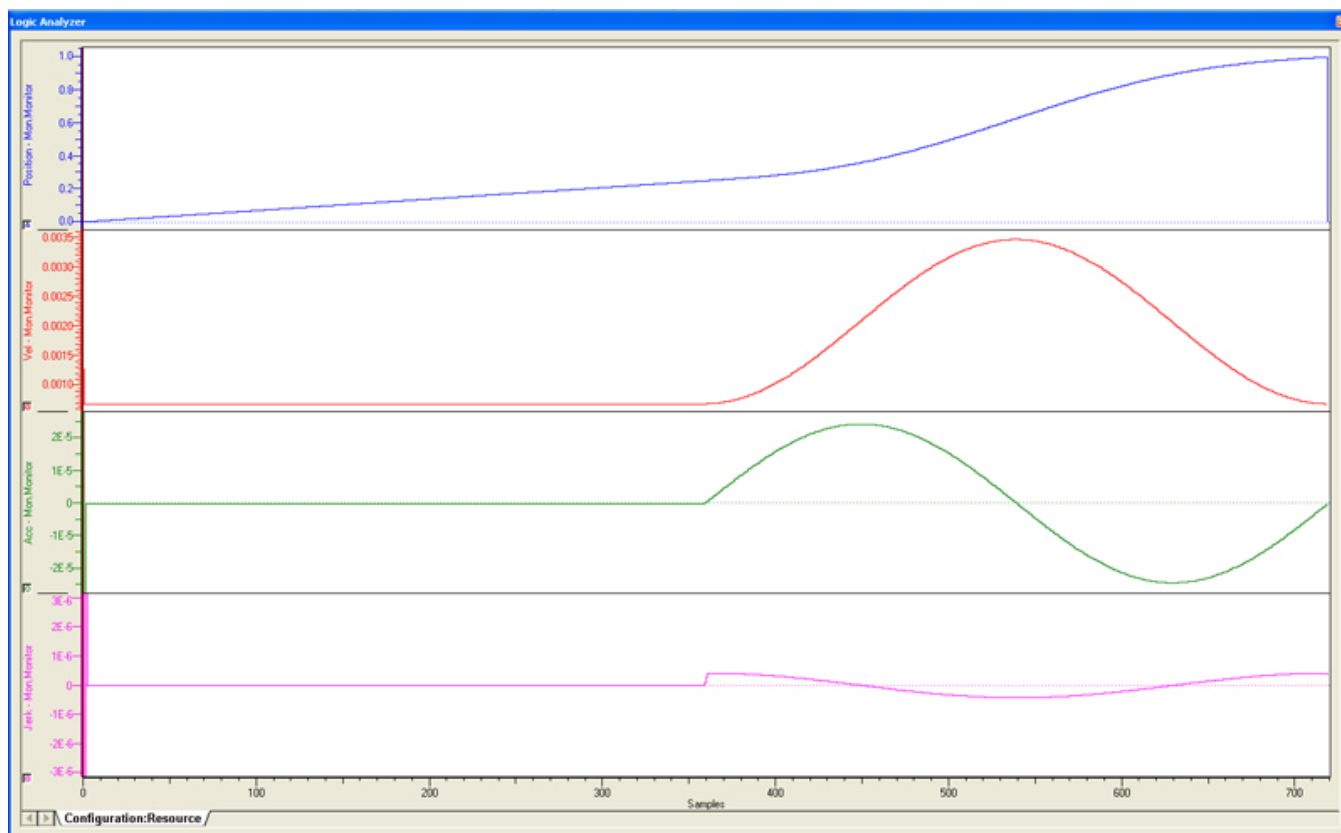
Tangent Matching

Provides a speed matched profile to minimize jerk between segments. Matches to the previous and next segment. In the case of the Tangent match segment coming first or last, a wraparound match is calculated. A straight line segment is required before and after the tangent match segment.

```

0.000  CamTool.SlaveStart:=LREAL#0.0;
2      CamTool.LastSegment:=INT#2;
1      CamTool.CamParameters[1].CurveType:=INT#1;
180.000 CamTool.CamParameters[1].MasterEnd:=LREAL#180.0;
0.250  CamTool.CamParameters[1].SlaveEnd:=LREAL#0.25;
0.500  CamTool.CamParameters[1].Resolution:=REAL#0.5;

22     CamTool.CamParameters[2].CurveType:=INT#22;
360.000 CamTool.CamParameters[2].MasterEnd:=LREAL#360.0;
1.000  CamTool.CamParameters[2].SlaveEnd:=LREAL#1.0;
0.500  CamTool.CamParameters[2].Resolution:=REAL#0.5;
    
```



```

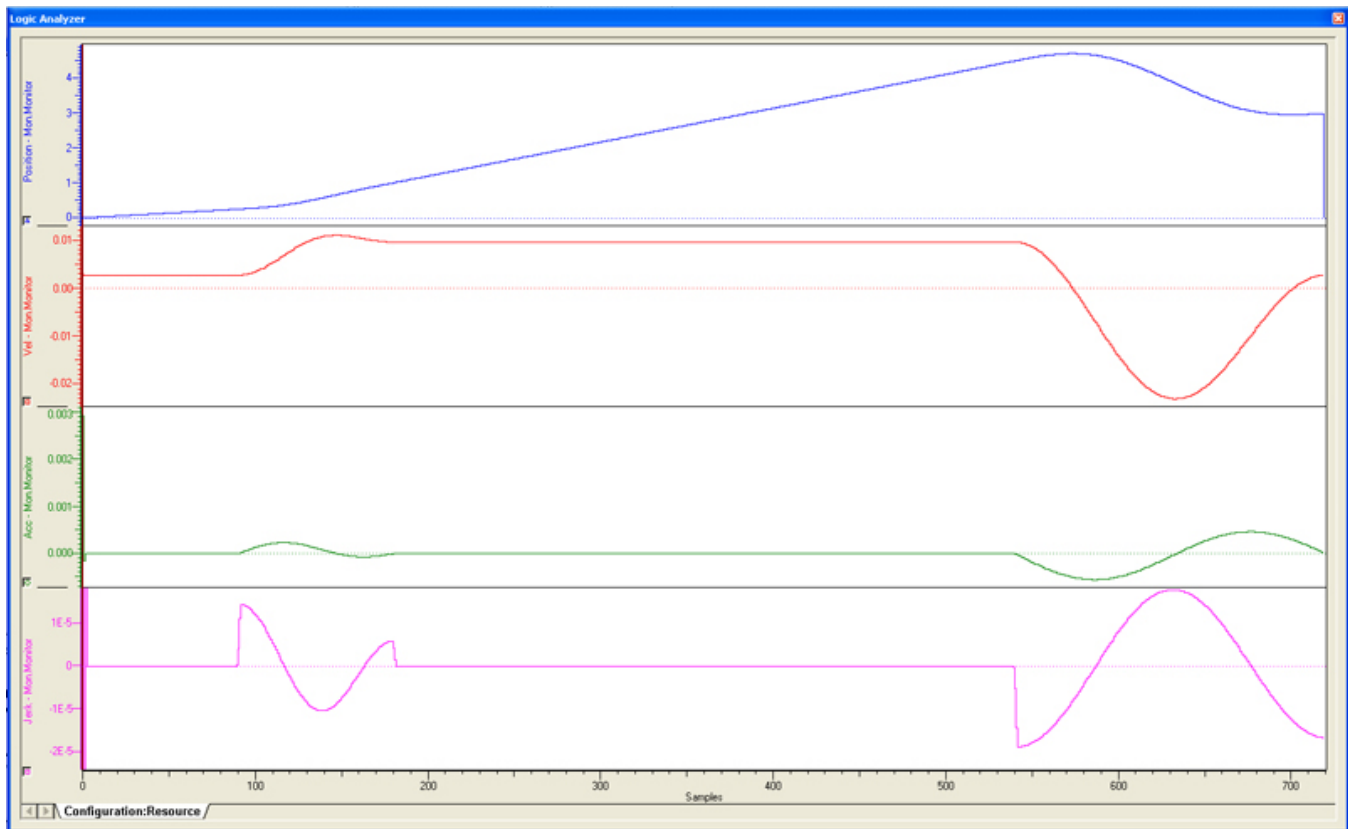
0.000 CamTool.SlaveStart:=LREAL#0.0;
4 CamTool.LastSegment:=INT#4;
1 CamTool.CamParameters[1].CurveType:=INT#1;
45.000 CamTool.CamParameters[1].MasterEnd:=LREAL#45.0;
0.250 CamTool.CamParameters[1].SlaveEnd:=LREAL#0.25;
0.500 CamTool.CamParameters[1].Resolution:=REAL#0.5;

22 CamTool.CamParameters[2].CurveType:=INT#22;
90.000 CamTool.CamParameters[2].MasterEnd:=LREAL#90.0;
1.000 CamTool.CamParameters[2].SlaveEnd:=LREAL#1.0;
0.500 CamTool.CamParameters[2].Resolution:=REAL#0.5;

1 CamTool.CamParameters[3].CurveType:=INT#1;
270.000 CamTool.CamParameters[3].MasterEnd:=LREAL#270.0;
4.500 CamTool.CamParameters[3].SlaveEnd:=LREAL#4.5;
0.500 CamTool.CamParameters[3].Resolution:=REAL#0.5;

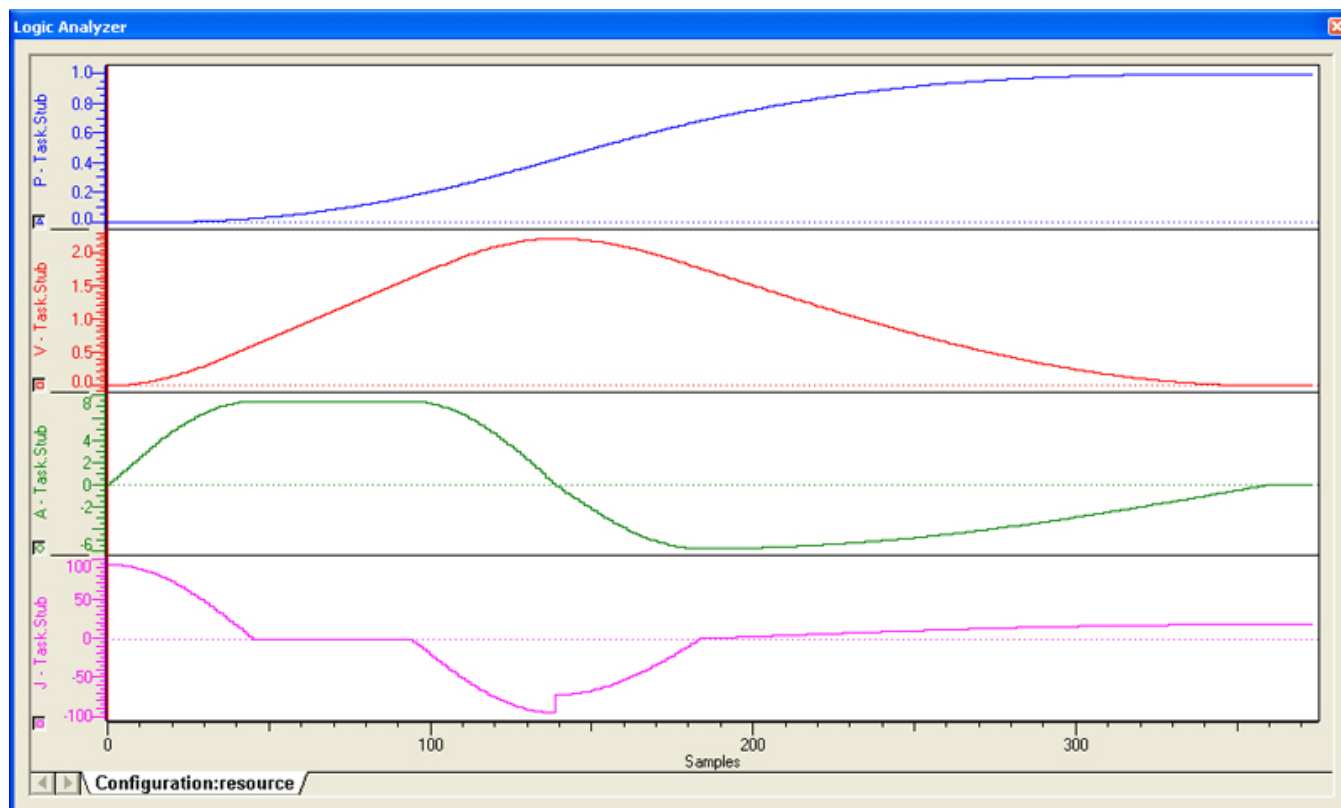
22 CamTool.CamParameters[4].CurveType:=INT#22;
360.000 CamTool.CamParameters[4].MasterEnd:=LREAL#360.0;
3.000 CamTool.CamParameters[4].SlaveEnd:=LREAL#3.0;
0.500 CamTool.CamParameters[4].Resolution:=REAL#0.5;

```





Trapezoid



Communications Toolbox

Toolbox Help Documentation

Help version created 1/31/2018

YASKAWA



Getting Started with Communications Toolbox

Requirements for v340

To use the Communications Toolbox, your project must also contain the following:

Firmware libraries:

- YDeviceComm
- PROCONOS

User libraries:

The following User Libraries must be listed above the Communications Toolbox:

- Yaskawa_Toolbox (v340 or higher)



Communications Revision History

Current Version:

***** 2017-12-06 v340 released

- 1) CommunicationChannel - Improved operation by not causing any errors when the host application closes the socket. DCR 1206.
- 2) CommunicationChannel - Added PacketCount and BytesReceived as VAR_OUTPUTs. DCR 1298.
- 3) CommunicationChannel / InputBufferManager - Added auto setting of CircularByteBuffer.Size using UPPER_BOUND so the user is not required to initialize it. DCR 1373.

Previous Versions:

***** 2016-12-13 v301 released

- 1) CommunicationChannel - Changed PacketSizeError logic.
- 2) GetCommand FB - DCR 701 Bug fix when buffer ends with partial command.
- 3) CommunicationChannel - DCR 1028, added explicit setting of TCP read Buffer, added 'CopyBusy' flag to throttle Y_ReadDevice DB
- 4) InputBufferManager - DCR 1029, FB was not making sure there was enough room for the entire copy from InputBuffer to CircularByteBuffer before starting to copy. Only a big problem (corrupted data) if heavy data streaming pushed the buffering capacity to its limits.
- 5) CommandProcessor - DCR 816 - Changed WHILE LOOP to IF block to eliminate the risk of watchdog if a partial command was sent, or if many many commands are sent. If necessary, performance can be increased by going back to the WHILE loop strategy, but checks must be in place to safeguard against watchdog faults.

(***** 2015-01-31 v300 released
*****)

(***** Created from v202, but recompiled specifically for MotionWorks IEC v3.x.
*****)

- 1) CircularBufferStruct DataType: Added BufferedCount and BufferedPercent in preparation for support of a host PC which streams part data and must monitor the buffer levels.
- 2) CommunicationChannel - Changed CommConfig from VAR_INPUT to VAR_IN_OUT. This allows the RemoteIPAddress to be added to the structure, and shared with other parts of the program to open additional sockets to the remote host.

(***** 2014-05-02: v202 released. Requires firmware 2.2.0 and the YDeviceComm firmware library
*****)

- 1) Improved capability by switching from a STRING of 512 character to a BYTE array of 2048 characters for Command Streaming lower level functions. This change REQUIRES users who are upgrading from an older toolbox version to CHANGE the data-type of the CommandString variable in CommandProcessor function blocks in your main project from YTB_STRING512 to CTB_CommandStruct.
- 2) GetCommand - Changed DataType of CommandString from YTB_STRING512 to CTB_CommandStruct. This allows the functions to work on the data as a byte array instead of a string, which reduces scan time (fewer STRING operations) and allows for longer command strings to be processed. Previous limit was 512 characters, now it is 2048 per line (between delimiters).
- 3) GetParameter - Same changes as listed for GetCommand.
- 4) CircularByteBuffer.PrmDelimiter - changed data type from YTB_STRING1 to BYTE. Related to improvements listed above.
- 5) GetParameter - Added DecimalDetected output. This can be used to prevent string conversion errors when using STRING_TO_INT or similar conversions.

***** 2013-09-02: v201 released. Requires firmware 2.2.0 and the YDeviceComm firmware library *****

- 1) ReName_CommandProcessor - Changed logic to call a sub function "GetCommand" to reduce the amount of code that resides on the user project side.

***** 2013-08-08: v200 released. Requires firmware 2.2.0 and the YDeviceComm firmware library *****

- 1) First release, includes Email, FTP, and Command Processing functions

Communications DataTypes

Toolbox Help Documentation

Help version created 1/31/2018

YASKAWA



Data Type: CircularBufferStruct

Data Structure used to manage a circular buffer of data used by several function blocks in the Communications Toolbox.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|-----|------------------------|----------------------|---|--|
| | MyCircularBufferStruct | CircularBufferStruct | | |
| C | StorePointer | INT | Pointer updated when new elements added to buffer. | MyCircularBufferStruct.StorePointer |
| U | UsePointer | INT | Pointer updated when elements of buffer have been read. | MyCircularBufferStruct.UsePointer |
| U | Size | INT | Size of circular buffer. | MyCircularBufferStruct.Size |
| U | CmdDelimiters | ARRAY[0..3] OF BYTE; | Specify the delimiters which separate Command Strings. If no CmdDelimiters are specified, a carriage return or carriage return line feed will be assumed. | MyCircularBufferStruct.CmdDelimiters [0] |
| U | PrmDelimiter | STRING | Delimiters separating parameters within a command. Default is a comma. | MyCircularBufferStruct.PrmDelimiter |
| U | LastDelimiter | INT | Element used by GetCommand. | MyCircularBufferStruct.LastDelimiter |
| U/C | Data | YTB_ByteArray8192 | Array of 8192 bytes of data. | MyCircularBufferStruct.Data |



Data Type: CommStruct

For use with [CommunicationChannel](#) function block. Contains information about the communication interface used.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|---------------------|-------------------|---|---------------------------------|
| | MyCommStruct | CommStruct | | |
| U | CommType | INT | Set 1 for Serial, 2 for Ethernet | MyCommStruct.CommType |
| U | InactivityTimeout | TIME | Use this to allow the MPiec to close the socket if no communication has been received on the channel in the time specified. | MyCommStruct.InactivityTimeout |
| U | BufferSize | UDINT | The number of bytes to read per scan from buffer, if left at 0, the entire buffer will be transferred. | MyCommStruct.BufferSize |
| U | Serial | SerialConfig | | MyCommStruct.Serial.something |
| U | Ethernet | EthernetConfig | | MyCommStruct.Ethernet.something |



Data Type: DelimiterArray

Supporting array for [CircularBufferStruct](#)

Data Type Declaration

DelimiterArray: ARRAY[0..3] OF BYTE;



Data Type: EthernetConfig

Supporting data structure for CommStruct, contains information about Ethernet interface configuration.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-------------------------|-----------------------|--|----------------------------------|
| | MyEthernetConfig | EthernetConfig | | |
| U | LocalIPAddress | STRING | Ethernet address of controller | MyEthernetConfig.LocalIPAddress |
| U | LocalPort | UINT | Ethernet port number to open | MyEthernetConfig.LocalPort |
| C | RemoteIPAddress | STRING | Ethernet address of the device the MPiec controller is communicating with. | MyEthernetConfig.RemoteIPAddress |
| C | RemotePort | UINT | Port number used by the device the MPiec controller is communicating with. | MyEthernetConfig.RemotePort |



Data Type: FTP_Data

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-------------------|-----------------|--|----------------------|
| | MyFTP_Data | FTP_Data | | |
| U | Username | YTB_STRING32 | Username to log in to the FTP server. | MyFTP_Data.Username |
| U | Password | YTB_STRING32 | Password to log in to the FTP server. | MyFTP_Data.Password |
| U | LocalIP | YTB_STRING16 | Local IP of the controller. | MyFTP_Data.LocalIP |
| U | FTPDomain | YTB_STRING128 | The domain name of the FTP server that will be resolved via DNS. | MyFTP_Data.FTPDomain |
| U | FTPIP | YTB_STRING16 | The IP of the FTP server if a domain is not known or set. | MyFTP_Data.FTPIP |
| U | FTPPort | UINT | The port to connect to the FTP server through, default 21. | MyFTP_Data.FTPPort |
| U | DNSIP | YTB_STRING16 | The DNS lookup server IP. | MyFTP_Data.DNSIP |
| U | DNSPort | UINT | The DNS port to connect through, the default is 53. | MyFTP_Data.DNSPort |
| U | Timeout | TIME | Timeout for connecting to the FTP server or data connection, default 5s. | MyFTP_Data.Timeout |

Code Example

```

ftpdata.LocalIP := '192.168.1.1';
ftpdata.FTPDomain := 'ftp.example.com';
ftpdata.DNSIP := '8.8.8.8';
ftpdata.Username := 'mp2300';
ftpdata.Password := 'securepassword';

```




Data Type: RecipientArray

If more than 10 recipients are needed then the declaration of RecipientArray must be changed to reflect that.

Data Type Declaration

TYPE

RecipientArray : ARRAY[0..9] OF RecipientStruct;

END_TYPE

Data Type: RecipientStruct



| | * | Element | Data Type | Description | Usage |
|--|---|-------------------|-----------------|-------------|-------------------------|
| | | MyRecipientStruct | RecipientStruct | | |
| | U | Email | YTB_STRING128 | | MyRecipientStruct.Email |
| | U | Name | YTB_STRING32 | | MyRecipientStruct.Name |



Data Type: SerialConfig

Supporting data structure for CommStruct, contains information about Serial interface configuration.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-----------------------|---------------------|---------------------------------|-----------------------------|
| | MySerialConfig | SerialConfig | | |
| U | PortNum | UINT | For use with Y_OpenSerialPort. | MySerialConfig.PortNum |
| U | BaudRate | DINT | For use with Y_SetDeviceOption. | MySerialConfig.BaudRate |
| U | DataBits | DINT | For use with Y_SetDeviceOption. | MySerialConfig.DataBits |
| U | StopBits | DINT | For use with Y_SetDeviceOption. | MySerialConfig.StopBits |
| U | Parity | DINT | For use with Y_SetDeviceOption. | MySerialConfig.Parity |
| U | HandShake | DINT | For use with Y_SetDeviceOption. | MySerialConfig.HandShake |
| U | CalcChecksum | BOOL | For use with Y_SetDeviceOption. | MySerialConfig.CalcChecksum |



Data Type: SMTP_Data

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|----------|--------------------|-----------------------|---|------------------------|
| | MySMTP_Data | SMTP_Data | | |
| U | DNSIP | YTB_STRING16 | DNS server IP (local), used to perform lookup of mail server domain. | MySMTP_Data.DNSIP |
| U | DNSPort | UINT | DNS port, default is 53, leave blank unless other port is used. | MySMTP_Data.DNSPort |
| U | SMTPDomain | YTB_STRING128 | SMTP server domain name (e.g. smtp.yourcompany.com), used for DNS lookup. | MySMTP_Data.SMTPDomain |
| U | SMTPIP | YTB_STRING16 | The IP of the SMTP server, blank by default, provide IP to override DNS lookup. | MySMTP_Data.SMTPIP |
| U | SMTPPort | UINT | SMTP port, usually 25 - note: does not support SSL encrypted SMTP. | MySMTP_Data.SMTPPort |
| U | LocalIP | YTB_STRING16 | Local IP of the controller. | MySMTP_Data.LocalIP |
| U | Domain | YTB_STRING128 | Domain for SMTP EHLO/HELO command, example: yaskawa.com. | MySMTP_Data.Domain |
| U | Sender | YTB_STRING128 | Sender e-mail address, example: john_smith@yaskawa.com. | MySMTP_Data.Sender |
| U | SenderName | YTB_STRING32 | Name of sender, example: John Smith. | MySMTP_Data.SenderName |
| U | Subject | YTB_STRING128 | Subject of the email. | MySMTP_Data.Subject |
| U | Recipient | RecipientArray | Array of STRING of email addresses which will receive the message. | |
| U | Email | YTB_STRING128 | MySMTP_Data.RcptArray[0].Email | MySMTP_Data.NumRcpt |
| U | Name | YTB_STRING32 | MySMTP_Data.RcptArray[0].Name | |
| U | Recipients | INT | Number of emails in Recipient | |
| U | Timeout | TIME | Timeout for connecting to the SMTP server, defaults to 5s | MySMTP_Data.Timeout |

Code Example

```

smtpdata.LocalIP      := '192.168.1.1';
smtpdata.SMTPDomain   := 'smtp.example.com';
smtpdata.Domain       := 'example.com';
smtpdata.Sender       := 'johnsmith@example.com';
smtpdata.SenderName   := 'John Smith';
smtpdata.Subject      := 'Hello from your MP2300iec';
smtpdata.RcptArray[0].email := 'yourfriend@othercompany.com';
smtpdata.RcptArray[0].name  := 'Your Friend';

```

smtpdata.NumRcpt := 1;



Enumerated Types in the Communication Toolbox

Some blocks accept an enumerated type (ENUM), which is a keyword (or constant) representing a value which will configure the operation of the function block. Enumerated types are equivalent to zero-based integers (INT). Therefore, the first value equates to zero, the second to 1, etc. The format for enumerated types is as follows: ENUM:(0, 1, 2...) as displayed in the example below (MC_BufferMode#Aborting).

Enumerated Types Declaration

| Enumerated Type | #INT Value | Enum Value | Description |
|-----------------|--|------------|-------------|
| COM_Type | Enumerated type to be used with CommStruct.CommType | | |
| | 0 | na | |
| | 1 | Serial | |
| | 2 | Ethernet | |
| Method | For use with the GetParameter function. Specifies how the value is obtained. | | |
| | 0 | Parameter | |
| | 1 | Character | |

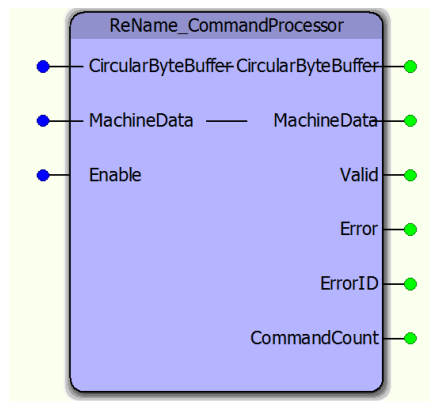
Enumerated Type: Method

Enumerated Type: COM_Type

Communications FBs



CommandProcessor



This function block must be copied and renamed into your main project and customized for your application. It is deigned to identify variable length commands in the CircularByteBuffer and process them on a case by case basis. Typically machine specific information is populated within a CASE statement for use on the IEC application.

Library

Comm Toolbox

Parameters

| * | Parameter | Data Type | Description |
|------------|--------------------|--------------------------------------|---|
| VAR_IN_OUT | | | |
| V | CircularByteBuffer | CircularBufferStruct | |
| V | MachineData | YTB_STRING512 | A string of characters such as MV;1.0;-10.5;3.007 |
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| VAR_OUTPUT | | | |

| | | | |
|---|--------------|-------|---|
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |
| V | CommandCount | UDINT | Reports the number of commands processed since Enable was set high. |

Notes

:

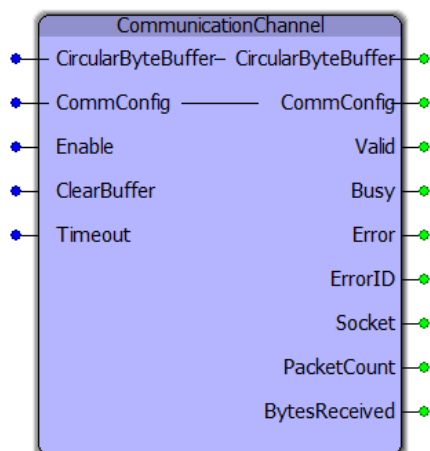
Error Description

| ErrorID | Meaning |
|----------------------|--|
| 0 | No error. |
| 8705 | The maximum number of concurrently open user sockets/IO device handles has been reached or exceeded. |

Example



CommunicationChannel



The CommunicationChannel function block is designed to manage an input stream of data from either a serial or TCP socket communication interface. It collects portions of data from Y_ReadDevice each time that function's Done output goes high, and adds it to a circular buffer for further analysis. The CommConfig structure must be initialized by the user to configure the necessary communication parameters.

Library

Comm Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|--------------------|--------------------------------------|--|
| VAR_IN_OUT | | | |
| V | CircularByteBuffer | CircularBufferStruct | Structure containing a data buffer and other operational information required to manage the CircularByteBuffer. |
| V | CommConfig | CommStruct | Structure containing information to be used in establishing socket or serial communication |
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | ClearBuffer | BOOL | Resets the StorePointer and UsePointer, which logically clears the contents of the circular buffer, but any existing data is not actually cleared. |

| | | | | |
|-------------------|---------------|------|--|-------|
| V | Timeout | TIME | If necessary, specify a time value when after no data is received, the MPiec should close the connection. When Timeout is T#0S, the MPiec will never close the connection on its own, the host which initiated the connection can send a close command, which is the normal procedure. | T#0mS |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |
| V | Socket | DINT | File handle to be used when writing to device connected to the socket. Only valid when non-zero. | |
| V | PacketCount | BOOL | Total packet count since this function block was enabled. | |
| V | BytesReceived | UINT | Total bytes received since this function was enabled. | |

Error Description

| ErrorID | Meaning |
|----------------------|--|
| 0 | No error. |
| 8705 | The maximum number of concurrently open user sockets/IO device handles has been reached or exceeded. |
| 8706 | The socket/IO device handle was invalid. Invalid IP address. |
| 8707 | The IP address string was not in a valid format. |
| 8708 | The socket/IO device handle could not be created. |
| 8709 | The specified address or port is already in use on the local network. |
| 8710 | The specified address or port is not available for use. (Maybe the IP address specified is not assigned to one of the networks available on this MPiec?) |
| 8711 | Unable to accept new socket/IO device handle connection. |
| 8712 | Unable to bind to the specified address. |
| 8713 | The socket/IO device handle type argument was invalid. |
| 8714 | The local address or port was not valid. |
| 8715 | Connecting to the socket/IO device handle failed. |
| 8716 | The remote IP address is unreachable. Check the default gateway. |
| 8717 | The socket/IO device handle is already connected to another endpoint. |
| 8718 | The socket/IO device handle connection attempt was actively refused by the remote device. |
| 8719 | The socket/IO device handle was not connected to a remote endpoint. Call Y_ConnectSocket prior to Y_ReadDevice or Y_WriteDevice. |
| 8720 | An error occurred trying to get or set the device option. |
| 8721 | The communication device could not be read. |
| 8722 | The communication device could not be written. |
| 8723 | A valid buffer argument to WriteDevice and ReadDevice is required. |
| 8724 | Invalid Device Option ID. |
| 8725 | The device option value was not the right size or the data was out of range. |
| 8726 | The serial port ID was not a valid serial port. |

| | |
|-----------------------|--|
| 8727 | The serial port specified could not be opened. |
| 10022 | Product or circular buffer overrun / full. |
| 10023 | Buffer size too small / cannot be zero. |

Setup

Follow these steps to initialize the CommConfig structure. Steps 1 & 2 show an optional easy way for the IEC application to automatically obtain its own IP Address. One of the inputs required for the Y_DeviceComm basic functions is the MPiec controllers own IP Address. This is necessary because the MPiec controller may have more than one physical Ethernet connector / MAC address, and the YDeviceComm functions need to know which interface to use. Steps 1 & 2 show a way to automatically obtain the IP address so the user will not be required to manually enter the controller's IP address for each system deployed. It is also possible to simply initialize the IPAddress as a sting such as IPAddress:='129.168.207.115';

1. Add a variable of type CONTROLLER_INFO to Global Variables as shown below. The Address must be %MD3.66560.

| Name / | Type | Usage | Description | Address |
|------------|-----------------|------------|-------------|------------|
| Controller | CONTROLLER_INFO | VAR_GLOBAL | | %MD3.66560 |

2. Add the following code to the initialize routine to obtain controller's IP address. The variable IPAddress is a STRING. The BUF_TO_STRING function block is located in the PROCONOS firmware library. As shown below, we are using it to extract 15 bytes of the IPAddress. These bytes equate to xxx.xxx.xxx.xxx of the IP Address.

```

50  BUF_TO_STRING      (* Get the controller IP address *)
51  (
52      REQ:=TRUE,
53      BUF_FORMAT:=TRUE,
54      BUF_OFFS:=DINT#0,
55      BUF_CNT:=DINT#17,
56      BUFFER:=Controller.Network.Interface[1].IPAddress,
57      DST:=IPAddress
58  );
59  Controller.Network.Interface[1].IPAddress:=BUF_TO_STRING.BUFFER;
60  IF BUF_TO_STRING.DONE THEN
61      IPAddress:=BUF_TO_STRING.DST;
62  END_IF;

```

3. Initialize variable of data type CommStruct as shown below. Set .LocalPort to the desired connection port number that you choose to use in your application. If multiple sockets will be used, ensure they each have a unique port number.

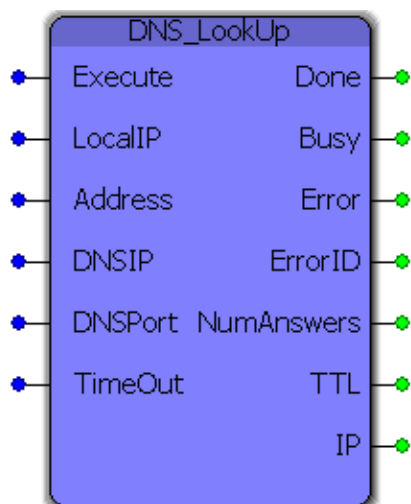
```

67  CommConfig.CommType:=COM_Type#Ethernet;
68  CommConfig.Ethernet.LocalIPAddress:=IPAddress;
69  CommConfig.Ethernet.LocalPort:=UINT#5000;

```



DNS_LookUp



This function block performs a DNS lookup for a provided domain name (Address) using a specified DNS IP and port and returns the number of answers, the resolved IPV4 address and the Time To Live of the returned IP.

Library

Comm Toolbox

Parameters

| * | Parameter | Data Type | Description | |
|-----------|-----------|--------------|--|-----------|
| VAR_INPUT | | | | Default |
| B | Execute | BOOL | Upon the rising edge, all inputs are read and the DNS lookup is performed. To perform a lookup on a different address or perform the same lookup again, change the value and re-trigger the execute input. | |
| V | LocalIP | YC_STRING16 | The IP address of the controller on the local network. | |
| V | Address | YC_STRING128 | The domain name to perform the look-up on (not an IPV4 address). | |
| V | DNSIP | YC_STRING16 | The IP address of the DNS server to perform the lookup through. | |
| V | DNSPort | UINT | The port to connect to the DNS server through. | UINT # 53 |

| | | | | |
|-------------------|------------|-------------|---|----------|
| E | TimeOut | TIME | The amount of time the DNS server has to respond. | TIME# 5s |
| VAR_OUTPUT | | | | |
| B | Done | BOOL | Set high upon the completion of a successful DNS lookup. | |
| B | Busy | BOOL | Set high upon the rising edge of 'Execute' and reset if Done or Error is true. | |
| B | Error | BOOL | Set high if an error has occurred during the DNS lookup. Cleared upon 'Execute' being reset. | |
| B | ErrorID | UINT | If error is true, this output provides the Error ID. Cleared upon 'Execute' being reset. | |
| E | NumAnswers | INT | The number of answers returned by the DNS server. The answer with the longest TTL is output at 'IP' | |
| E | TTL | UDINT | The Time To Live of the DNS response (i.e. how long the DNS server caches the answer from the authoritative nameserver instead of reissuing the query). | |
| V | IP | YC_STRING16 | The 'IP' with the longest TTL that was returned by the DNS server that resolves to the domain name provided. | |

Notes

- 'Address' must be a domain name (i.e. yaskawa.com), not an IPV4 address. Passing an IPV4 address is what is referred to as a "reverse DNS lookup" and is not supported by this block (reason: the Y_DeviceComm library needs an IPV4 address, not a domain name).
- What DNS server(s) your controller has access to depends on the network configuration. If you do not have a local DNS server (see "Setup" below) talk to your IT professional about what DNS server options you have.
- The main purpose of this block is use in other Communications blocks, such as FTP and SMTP.

Setup

In order to perform a DNS lookup a connection to a DNS server must first be established. What DNS server you configure this block to use depends on your particular network set up. The easiest way to determine what DNS server to use (or at least to get started) is to open up the Windows command prompt (Windows Key + R -> "cmd" -> Enter) and type "ipconfig /all" and under "DNS Servers" in the Ethernet LAN section you will find the DNS server(s) that your computer is configured to use.

```

C:\WINDOWS\system32\cmd.exe

yaskawa.com
ybad.ad.yaskawa.com
ybad.com
ydev.com
drives.com

Ethernet adapter VMware Network Adapter VMnet8:

    Connection-specific DNS Suffix  . : 
    Description . . . . . : VMware Virtual Ethernet Adapter for VMnet8
    Physical Address. . . . . : 00-50-56-C0-00-08
    Dhcp Enabled. . . . . : No
    IP Address. . . . . : 192.168.214.1
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 

Ethernet adapter VMware Network Adapter VMnet1:

    Connection-specific DNS Suffix  . : 
    Description . . . . . : VMware Virtual Ethernet Adapter for VMnet1
    Physical Address. . . . . : 00-50-56-C0-00-01
    Dhcp Enabled. . . . . : No
    IP Address. . . . . : 192.168.88.1
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 

Ethernet adapter Wireless Network Connection:

    Media State . . . . . : Media disconnected
    Description . . . . . : Intel(R) WiFi Link 5100 AGN
    Physical Address. . . . . : 00-24-D6-77-02-00

Ethernet adapter Local Area Connection:

    Connection-specific DNS Suffix  . : ad.yaskawa.com
    Description . . . . . : Intel(R) 82567LM Gigabit Network Connection
    Physical Address. . . . . : 00-26-B9-97-2F-4A
    Dhcp Enabled. . . . . : Yes
    Autoconfiguration Enabled . . . . : Yes
    IP Address. . . . . : 192.168.201.36
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.201.253
    DHCP Server . . . . . : 192.168.5.10
    DNS Servers . . . . . : 192.168.5.10
                           192.168.5.11
    Lease Obtained. . . . . : Wednesday, October 24, 2012 8:21:53 AM
    Lease Expires . . . . . : Thursday, October 25, 2012 8:21:53 AM

F:\>

```

You can also perform DNS lookups from the command line which may help in verifying the results of the DNS lookup performed on the controller while setting this block up.

```
C:\WINDOWS\system32\cmd.exe

F:\>nslookup athena.yaskawa.com
Server: hqdc1.ad.yaskawa.com
Address: 192.168.5.10

Non-authoritative answer:
Name: athena.yaskawa.com
Address: 192.168.8.3

F:\>nslookup nothing.yaskawa.com
Server: hqdc1.ad.yaskawa.com
Address: 192.168.5.10

*** hqdc1.ad.yaskawa.com can't find nothing.yaskawa.com: Non-existent domain

F:\>nslookup google.com
Server: hqdc1.ad.yaskawa.com
Address: 192.168.5.10

Non-authoritative answer:
Name: google.com
Addresses: 74.125.225.131, 74.125.225.128, 74.125.225.130, 74.125.225.132
          74.125.225.134, 74.125.225.142, 74.125.225.135, 74.125.225.133, 74.125
.225.136
          74.125.225.137, 74.125.225.129

F:\>_
```

The basic command structure is "nslookup [hostname] [server]" where hostname and server are both optional (if you simply type "nslookup" -> Enter it takes you in to the nslookup utility where you can then perform multiple lookups without retyping "nslookup"). For example, typing "nslookup google.com" as in the image above returns a list of IP addresses resolved for "google.com". You can also perform the lookup using a specified DNS server address which can be helpful if your block is using a different DNS server than your computer is configured to use. This is done by filling in the second optional parameter, such as "nslookup google.com 8.8.8.8" where "8.8.8.8" is a public DNS server managed by Google.

```

C:\WINDOWS\system32\cmd.exe
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\kevin_hull>nslookup google.com 8.8.8.8
Server:  google-public-dns-a.google.com
Address:  8.8.8.8

Non-authoritative answer:
Name:     google.com
Addresses: 74.125.225.136, 74.125.225.134, 74.125.225.128, 74.125.225.130
          74.125.225.135, 74.125.225.131, 74.125.225.132, 74.125.225.142, 74.125
          .225.133
          74.125.225.129, 74.125.225.137

C:\Documents and Settings\kevin_hull>_

```

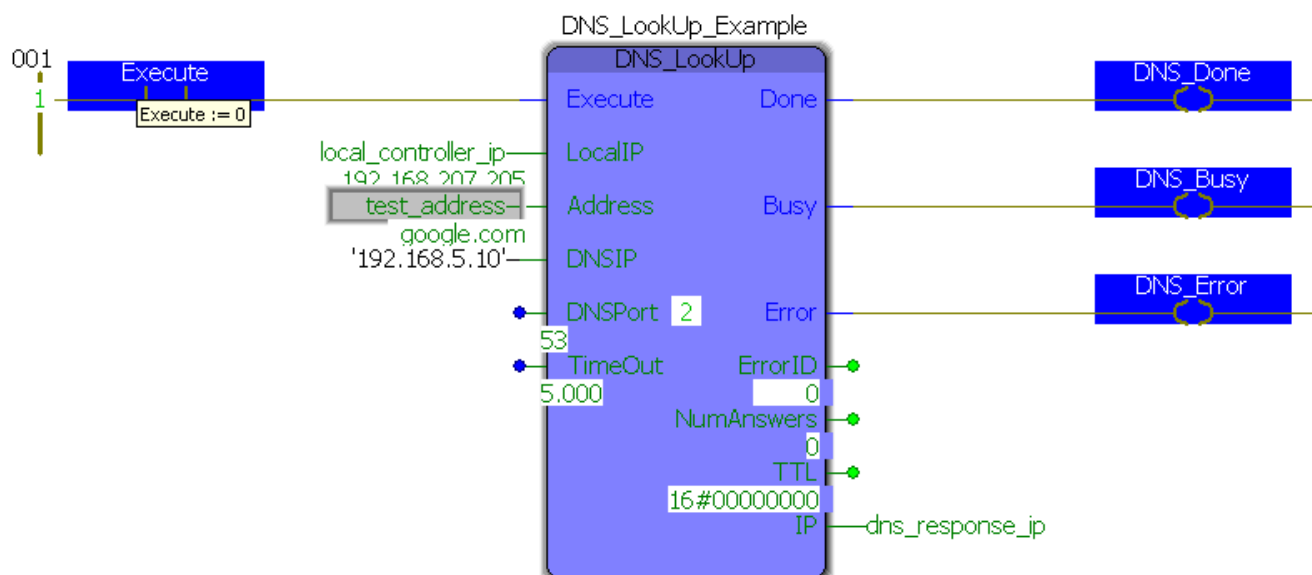
Error Description

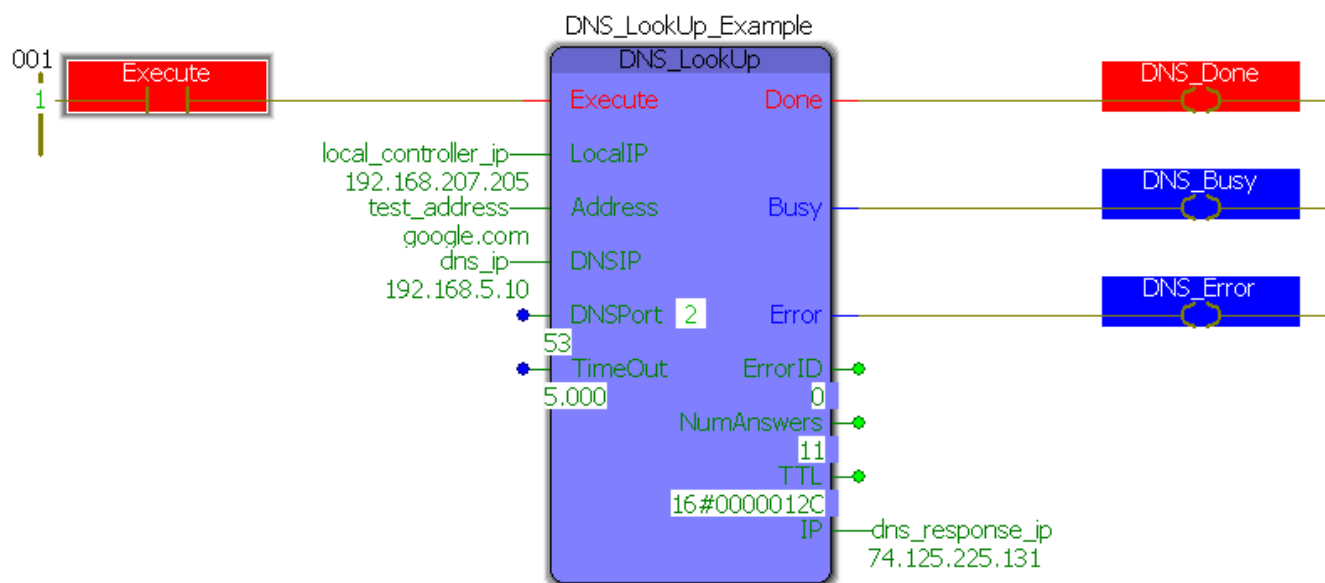
| ErrorID | Meaning |
|----------------------|--|
| 0 | No error. |
| 8705 | The maximum number of concurrently open user sockets/IO device handles has been reached or exceeded. |
| 8706 | The socket/IO device handle was invalid. Invalid IP address. |
| 8707 | The IP address string was not in a valid format. |
| 8708 | The socket/IO device handle could not be created. |
| 8709 | The specified address or port is already in use on the local network. |
| 8710 | The specified address or port is not available for use. (Maybe the IP address specified is not assigned to one of the networks available on this MPiec?) |
| 8711 | Unable to accept new socket/IO device handle connection. |
| 8712 | Unable to bind to the specified address. |
| 8713 | The socket/IO device handle type argument was invalid. |
| 8714 | The local address or port was not valid. |
| 8715 | Connecting to the socket/IO device handle failed. |
| 8716 | The remote IP address is unreachable. Check the default gateway. |
| 8717 | The socket/IO device handle is already connected to another endpoint. |
| 8718 | The socket/IO device handle connection attempt was actively refused by the remote device. |
| 8719 | The socket/IO device handle was not connected to a remote endpoint. Call Y_ConnectSocket prior to Y_ReadDevice or Y_WriteDevice. |
| 8720 | An error occurred trying to get or set the device option. |
| 8721 | The communication device could not be read. |
| 8722 | The communication device could not be written. |
| 8723 | A valid buffer argument to WriteDevice and ReadDevice is required. |
| 8724 | Invalid Device Option ID. |
| 8725 | The device option value was not the right size or the data was out of range. |
| 8726 | The serial port ID was not a valid serial port. |
| 8727 | The serial port specified could not be opened. |

| | |
|-----------------------|---|
| 12000 | Read response timeout, no response was received within the supplied TimeOut. |
| 12010 | Not a response (QR should be 1 but it was 0). |
| 12011 | Response was truncated because it extended beyond the 512byte UDP packet size. |
| 12012 | Recursive is not available but was requested by the Query packet |
| 12021 | Format error, the name server was unable to interpret the query. |
| 12022 | Server failure, the name server was unable to process the query due to an internal problem. |
| 12023 | Name error, not valid for this block (only valid for Authoritative servers). |
| 12030 | Address length was less than 3 characters which is not possible. |
| 12031 | Address format was incorrect as it does not contain a '.'. |

Example - External Address

The following example demonstrates the blocks ability to perform a look up for an external address ("google.com") using an internal DNS server. The LocalIP, Address and DNSIP have all be configured and DNSPort and TimeOut have been left to defaults.

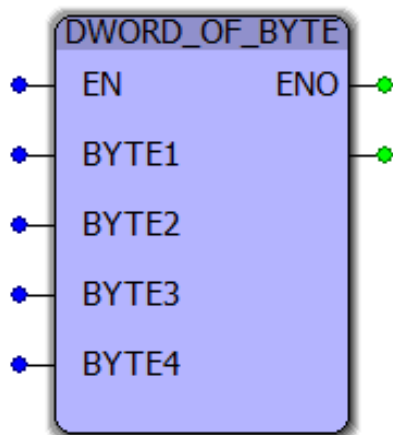




When comparing the output of the block ("74.125.225.131") to the dnslookup performed above, notice that the IP address is in the list. You can also see that NumAnswers is set to 11 which matches the number of answers returned above. Finally, the TTL is 0x0000012C which corresponds to 300 in decimal where 300s = 5 min, if you were to add the "Debug" option to nslookup ("nslookup -d google.com") then you would see that this TTL also matches.



DWORD_OF_BYTE



This function combines four bytes into a DWORD. BYTE1 is the least significant portion of the resulting DWORD.

Library

Comm Toolbox

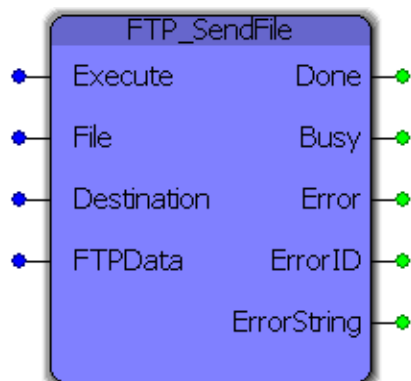
Parameters

| * | Parameter | Data Type | Description | |
|-------------------|-----------|-----------|--|----------------|
| VAR_INPUT | | | | Default |
| B | EN | BOOL | Enables the function. | FALSE |
| V | BYTE1 | BYTE | The least significant byte of the DWORD to be assembled. | BYTE#0 |
| V | BYTE2 | BYTE | | BYTE#0 |
| V | BYTE3 | BYTE | | BYTE#0 |
| V | BYTE4 | BYTE | The most significant byte of the DWORD to be assembled. | BYTE#0 |
| VAR_OUTPUT | | | | |
| B | ENO | BOOL | High if the function is executing normally. | |

Notes



FTP_SendFile



This function block uses the FTP (File Transfer Protocol) to write a file to a specified FTP server.

Library

Comm Toolbox

Parameters

| * | Parameter | Data Type | Description | |
|-------------------|-------------|--------------------------|--|----------|
| VAR_INPUT | | | | |
| B | Execute | BOOL | Upon the rising edge, all inputs are read and the file transfer is performed. To resend the file or send a different file, change the value(s) and re-trigger the execute input. | FALSE |
| V | File | YC_STRING128 | The full file name and location on the controller, e.g. '/flash/user-/data/example.csv'. | STRING#" |
| V | Destination | YC_STRING64 | The full file name and destination on the FTP server, e.g. 'metrics/example.csv'. | STRING#" |
| V | FTPData | FTP_Data | The input structure that configures the FTP transfer such as FTP server address, port, etc. | |
| VAR_OUTPUT | | | | |
| B | Done | BOOL | Set high upon the completion of a successful file transfer. | |
| B | Busy | BOOL | Set high upon the start of the file transfer and low upon 'Done' or 'Error' becoming true. | |
| B | Error | BOOL | Set high when an error occurs during the file transfer. Set low upon Execute being reset. | |
| B | ErrorID | BOOL | If 'Error' is true, this output provides the Error ID. Cleared upon 'Execute' being reset. | |
| V | ErrorString | YC_STRING256 | If 'Error' is true and it is an FTP response code related error then this output contains the response string from the FTP server. | |

Notes

- This block utilizes FTP, not SFTP as SSL is not currently supported in the firmware. As a result, all FTP traffic sent and received (e.g. username, password, file data) is sent unencrypted in plain text and is therefore visible to anyone with access to your internal network. However, this should not be a problem so long as the data you are sending is not of a sensitive matter and your FTP server account is CHROOT'd properly (talk to your IT professional about using FTP).
- The FTP server should either have an internal/external domain name or use a static IP address because if the address changes, it will prevent the function from transferring files. See "Setup" for more details.
- The FTP user account must have "Write" privileges to successfully write files to the server. Optionally, the account may also have "Append" privileges. If files already exists and the FTP account only has "Write" privileges, then the file will be overwritten. If the file exists and the user account has "Append" privileges, then the file contents transferred will be appended to the existing file.

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 8705 | The maximum number of concurrently open user sockets/IO device handles has been reached or exceeded. |
| 8706 | The socket/IO device handle was invalid. Invalid IP address. |
| 8707 | The IP address string was not in a valid format. |
| 8708 | The socket/IO device handle could not be created. |
| 8709 | The specified address or port is already in use on the local network. |
| 8710 | The specified address or port is not available for use. (Maybe the IP address specified is not assigned to one of the networks available on this MPiec?) |
| 8711 | Unable to accept new socket/IO device handle connection. |
| 8712 | Unable to bind to the specified address. |
| 8713 | The socket/IO device handle type argument was invalid. |
| 8714 | The local address or port was not valid. |
| 8715 | Connecting to the socket/IO device handle failed. |
| 8716 | The remote IP address is unreachable. Check the default gateway. |
| 8717 | The socket/IO device handle is already connected to another endpoint. |
| 8718 | The socket/IO device handle connection attempt was actively refused by the remote device. |
| 8719 | The socket/IO device handle was not connected to a remote endpoint. Call Y_ConnectSocket prior to Y_ReadDevice or Y_WriteDevice. |
| 8720 | An error occurred trying to get or set the device option. |
| 8721 | The communication device could not be read. |
| 8722 | The communication device could not be written. |
| 8723 | A valid buffer argument to WriteDevice and ReadDevice is required. |
| 8724 | Invalid Device Option ID. |
| 8725 | The device option value was not the right size or the data was out of range. |
| 8726 | The serial port ID was not a valid serial port. |
| 8727 | The serial port specified could not be opened. |
| 12200 | Connect to FTP server timeout, no connection was established within the supplied TimeOut. |
| 12201 | Connect to FTP data socket timeout, no connection was established within the supplied TimeOut. |
| 12202 | QUIT error, there was an error sending the 'QUIT' command to the server. |
| 12203 | The credentials for the FTP server were incorrect (either one or both username and password). |
| 12300 | File Error, no error information available. |
| 12301 | Invalid file handle. |

| | |
|-----------------------|---|
| 12302 | Maximum number of files are already opened. |
| 12304 | File is already opened. |
| 12305 | File is write protected or access denied. |
| 12306 | File name not defined. |
| 12310 | End of data reached. |
| 12312 | The number of characters to be read from file is greater than the data buffer. |
| 12322 | No data could be read from file. |
| 12421 | Service not available, closing control connection. This may be a reply to any command if the service knows it must shut down. |
| 12425 | Can't open data connection. |
| 12426 | Connection closed; transfer aborted. |
| 12430 | Invalid username or password. |
| 12434 | Requested host unavailable. |
| 12450 | Requested file action not taken / Requested mail action not take (mailbox unavailable). |
| 12451 | Requested action aborted. Local error in processing. |
| 12452 | Requested action not taken, insufficient storage space in system (FTP: File unavailable) |
| 12500 | Syntax error, command unrecognized. |
| 12501 | Syntax error in parameters or arguments. |
| 12502 | Command not implemented. |
| 12503 | Bad sequence of commands. |
| 12504 | Command not implemented for that parameter. |
| 12521 | [domain] does not accept mail. |
| 12530 | Not logged in / Access denied. |
| 12532 | Need account for storing files. |
| 12550 | Requested action not taken. File unavailable (e.g., file not found, no access) / Mailbox unavailable. |
| 12551 | Requested action aborted. Page type unknown / User not local. |
| 12552 | Requested file action aborted, exceeded storage allocation / Requested mail action aborted, exceeded storage allocation. |
| 12553 | Requested action not taken, file name not allowed / mailbox name not allowed. |
| 12554 | Transaction failed. |

Basic Functionality Example - Transferring a File

This examples demonstrates how to configure the block using the data structure, create a file to send and execute the FTP_SendFile block.

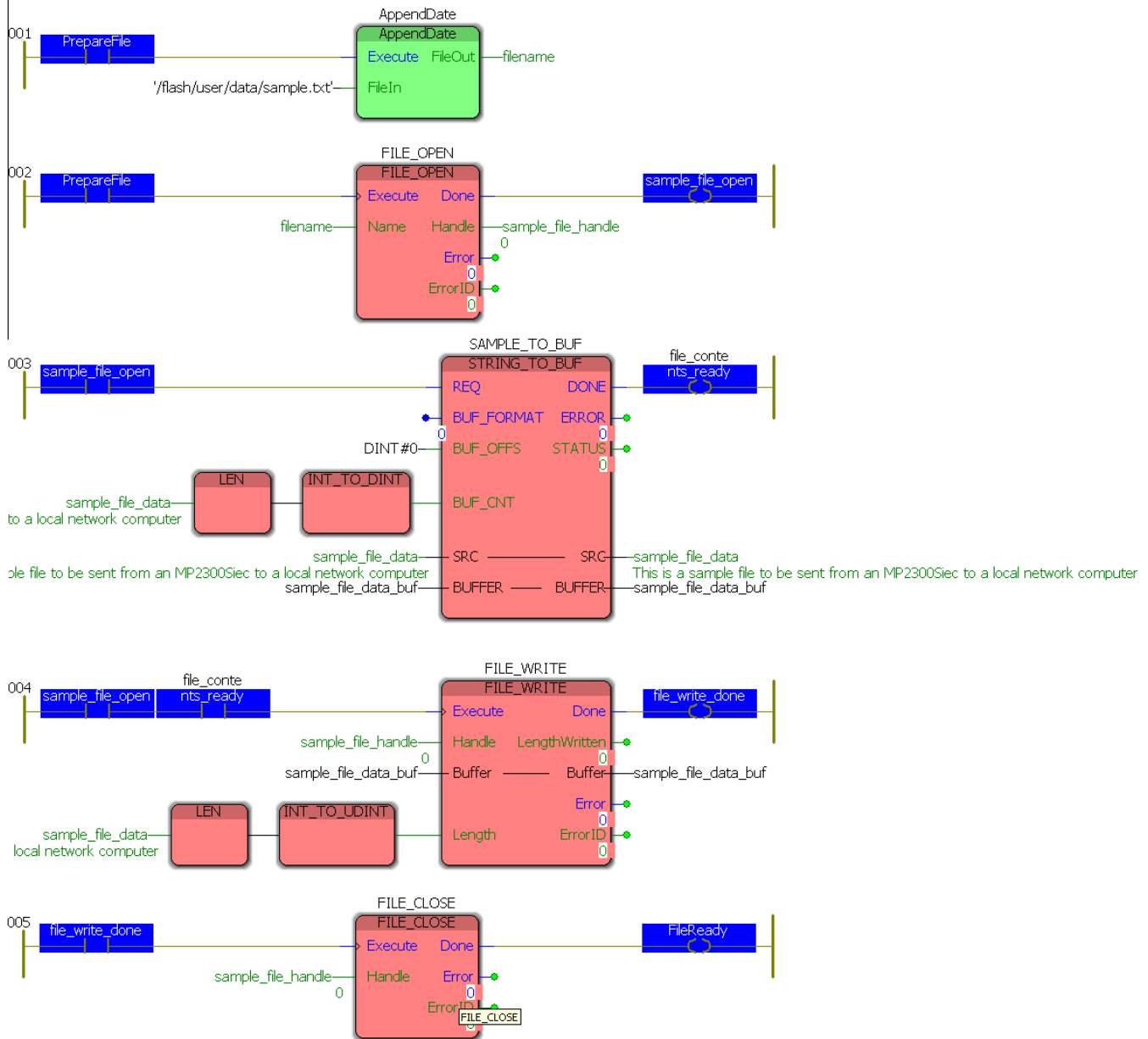
Here is the code in the "Initialize" ST program which configures the file data and the FTP structure. The FTP server is hosted on a local computer and does not have a domain name. Therefore, FTPIP was used and FTPPort was left blank as the local FTP server is configured to use the default port of 21. The LocalIP is set to the controllers IP and the username/password combination are set.

```
(* Sample file contents *)
sample_file_data := 'This is a sample file to be sent from an MP2300S1ec to a local network computer via FTP';

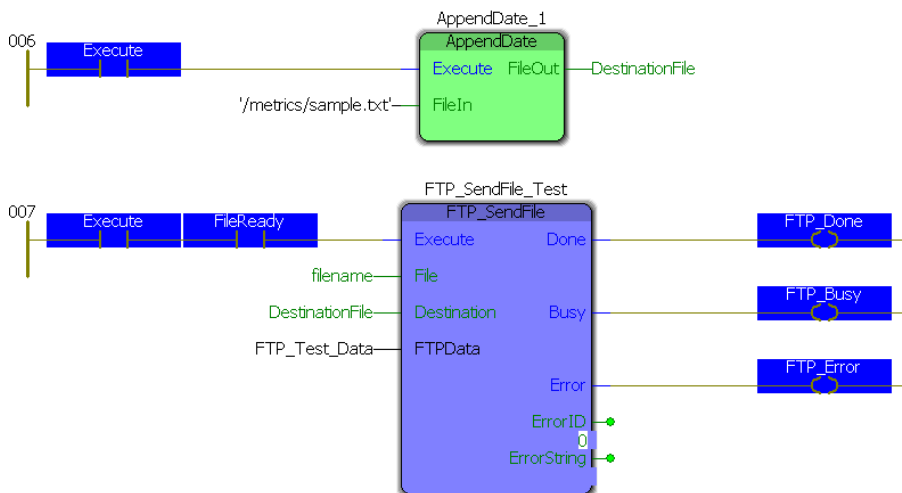
(* FTP setup structure *)
FTP_Test_Data.FTPIP := '192.168.201.36';
FTP_Test_Data.LocalIP := '192.168.207.205';
FTP_Test_Data.Password := 'anon';
FTP_Test_Data.Username := 'anon';
```

This program works by creating a file via the PROCONOS File_Open, String_to_Buf, File_Write and File_Close blocks. The contents of the file in "sample_file_data" is converted from a YC_STRING128 to YC_BYTE128 via the "SAMPLE_TO_BUF" block. Once the file is created the destination file name is prepared and the FTP block sends the file to the server.

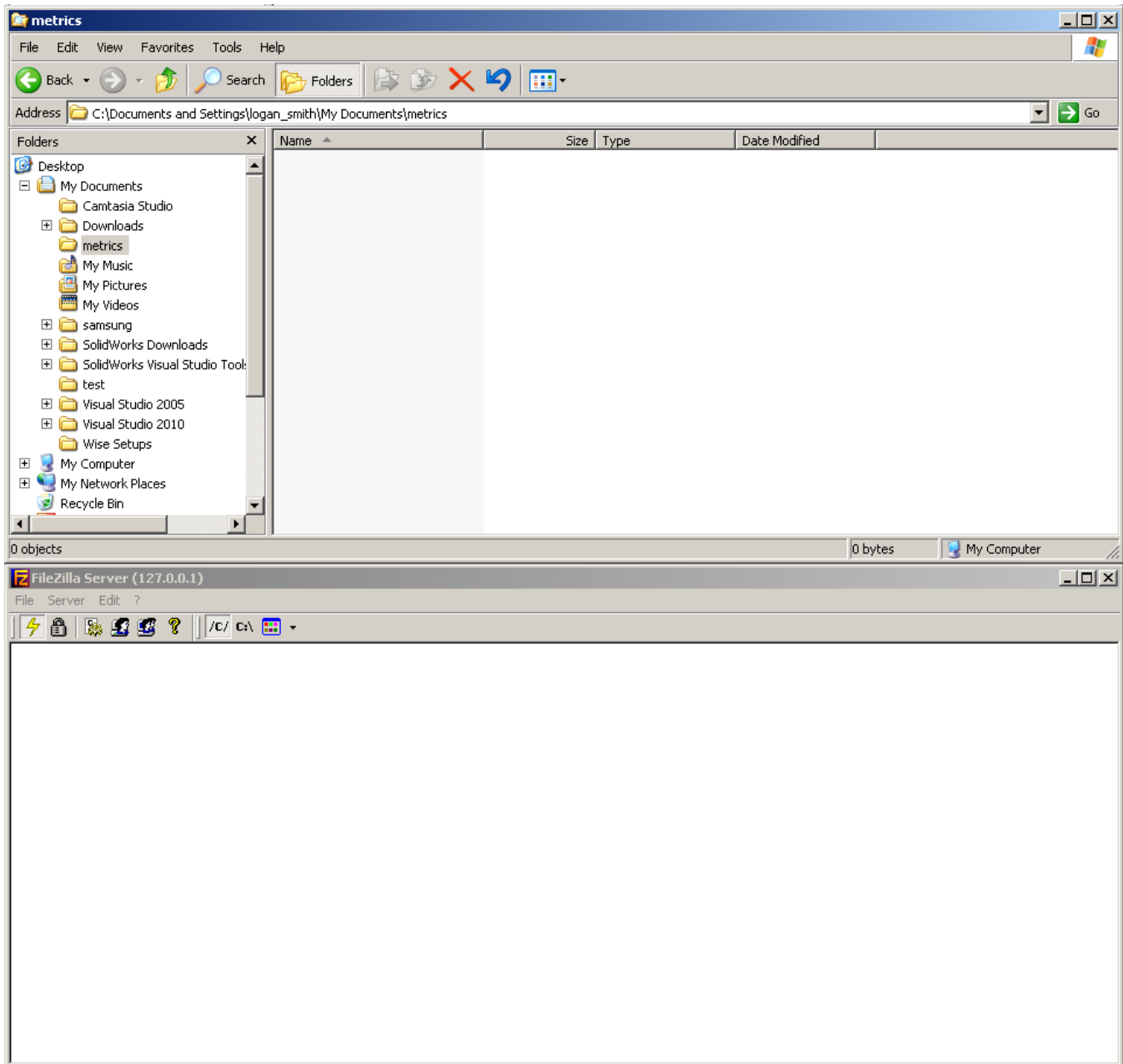
```
(* Prepare file to send *)
```



(* Send example.txt via FTP *)

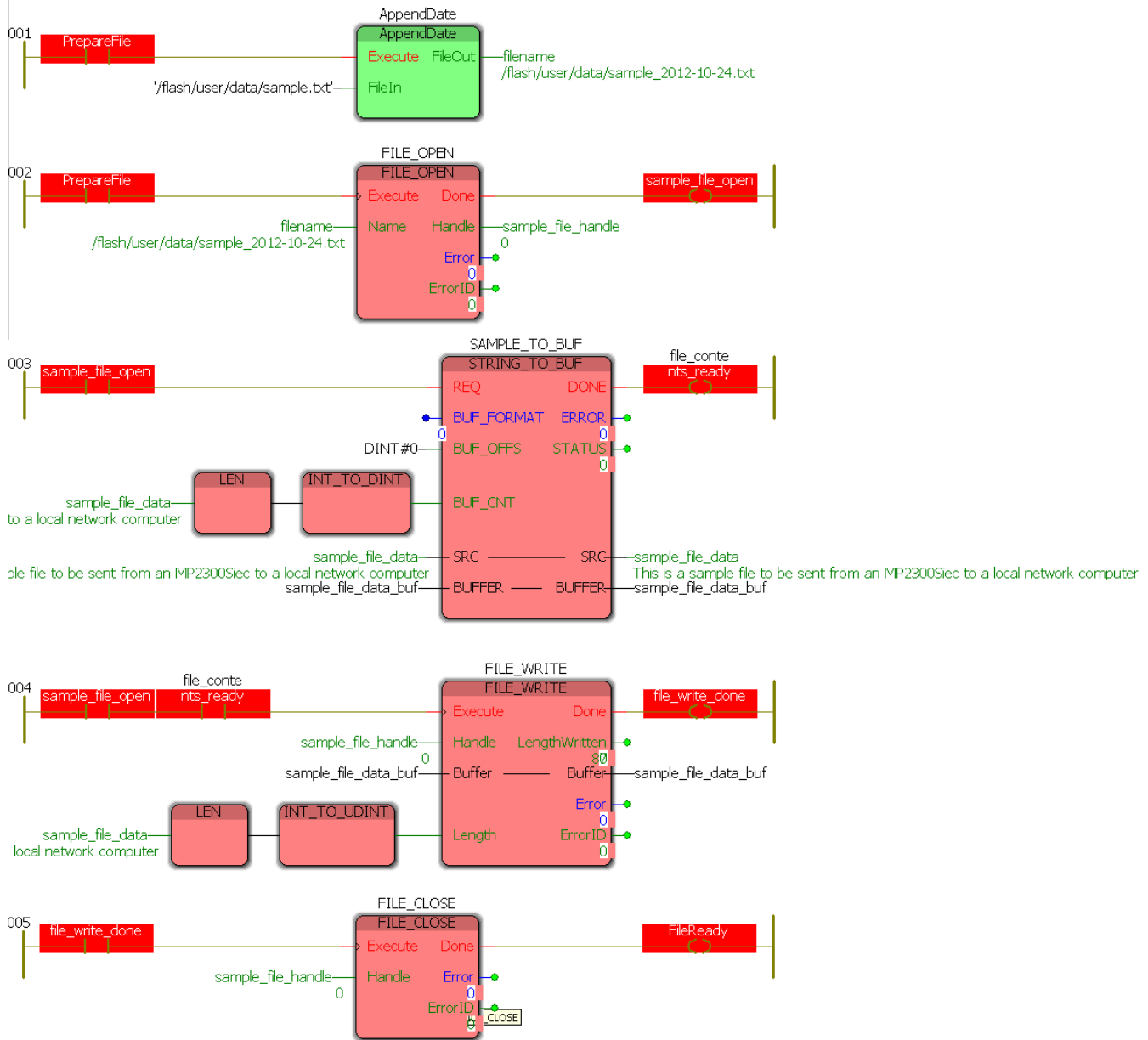


The destination folder is empty to begin with and the FTP server log has been cleared prior to connection so that the results will be obvious.

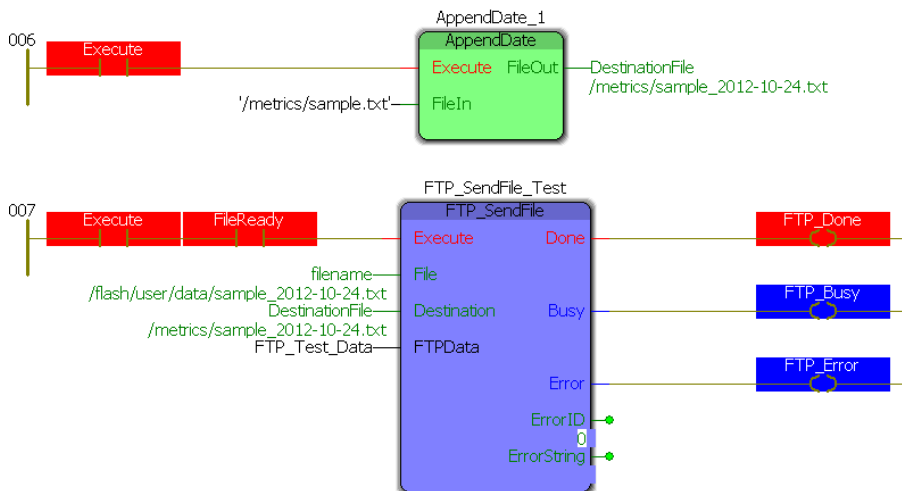


The PrepareFile contact is set true as is the Execute contact. Once both contacts are TRUE, the FTP_SendFile block sends the newly created file.

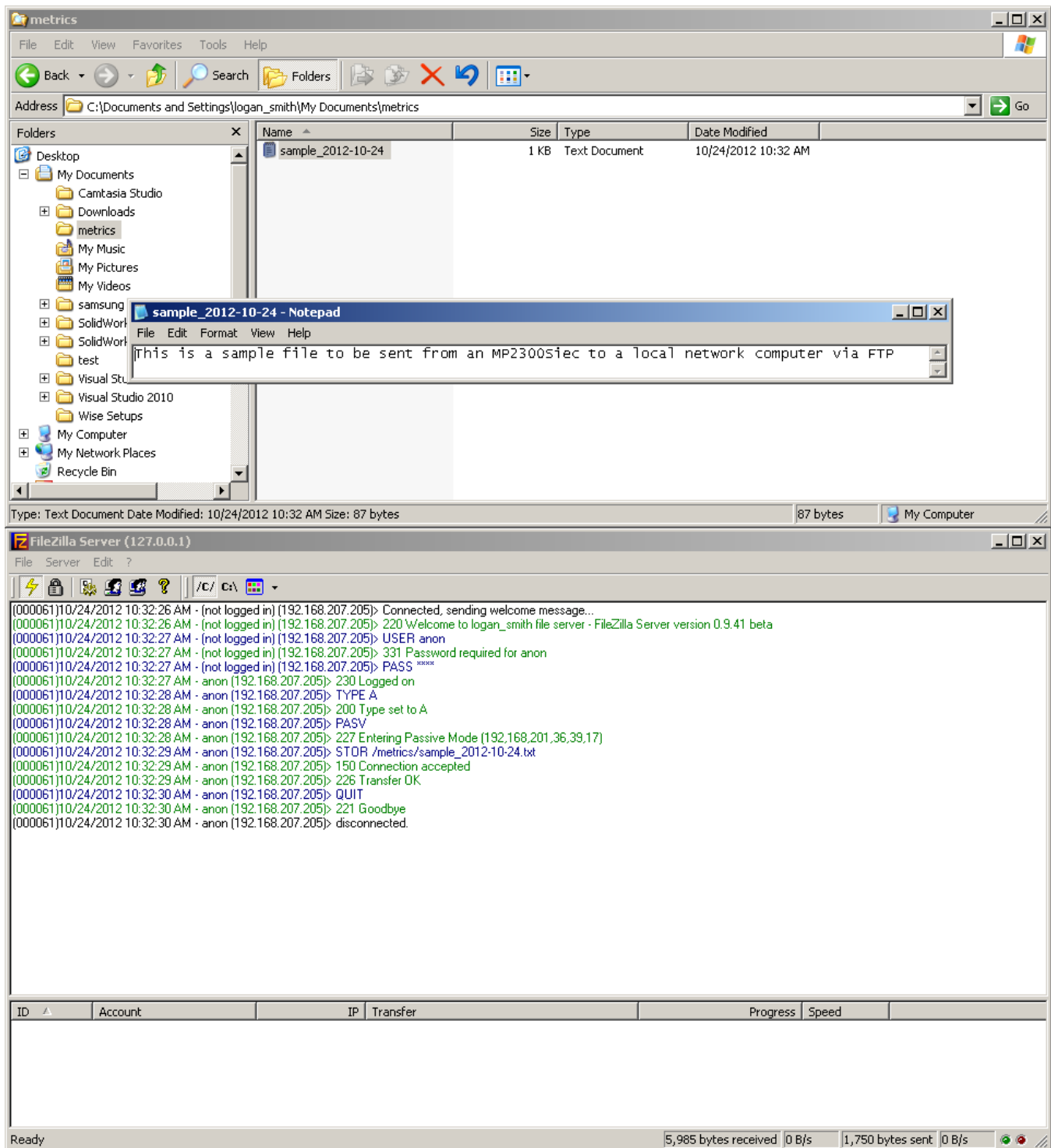
(* Prepare file to send *)



(* Send example.txt via FTP *)



The results of this block can be seen in the destination file explorer and the FTP server log:



The contents of the file match the "sample_file_data" string and the file can be seen in the explorer. In the FTP server log all of the commands sent can be viewed and it can be seen that the file was transferred properly and successfully.

Advanced Functionality Example - Transferring a Metrics File at a Specified Rate

This examples demonstrates how to write a program to send a continuously updated metrics file (with date and time stamp) to an FTP server. This kind of functionality is extremely useful to applications requiring data acquisition as the need to connect to the controller directly is eliminated and file management is handled by the controller. For this example, the controller will continuously sample the speed and position of a servo that is jogging and the store the contents in a CSV file using the File_RW Toolbox.

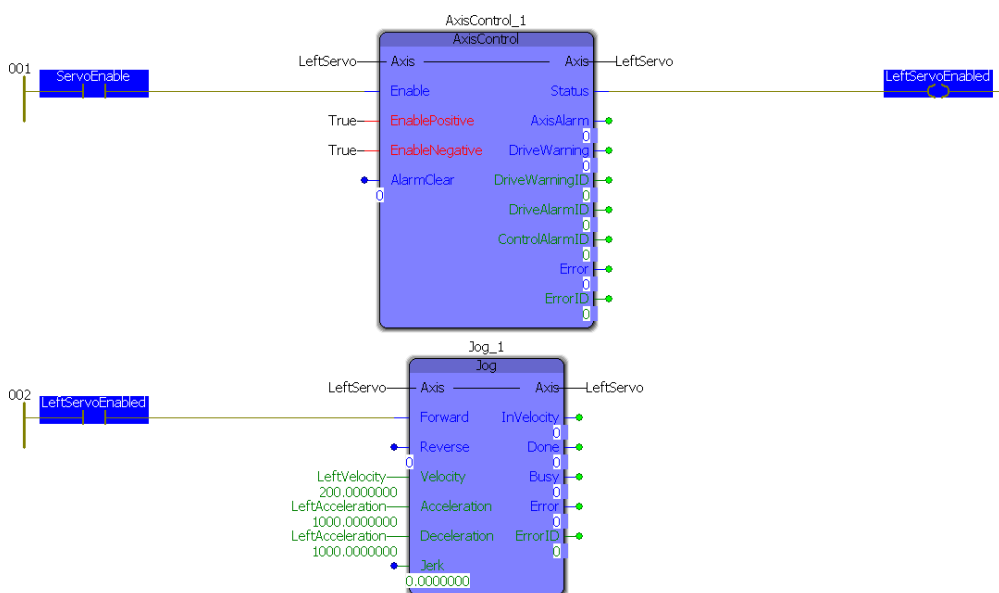
The same data configuration structure was used but there is no preset message for the file as it will be created dynamically.

```

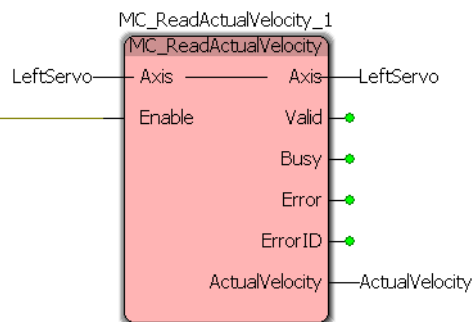
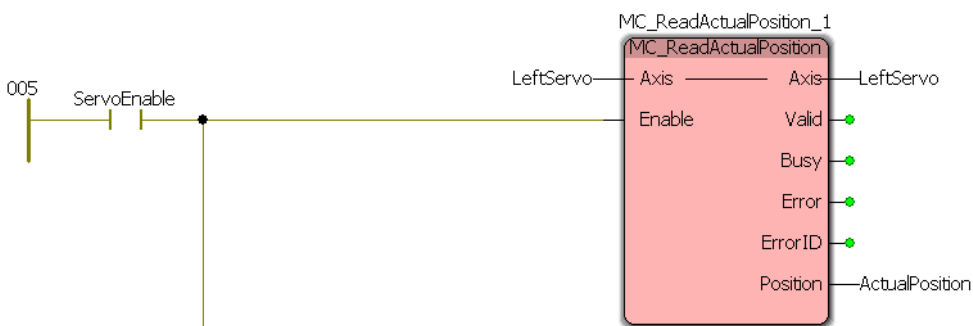
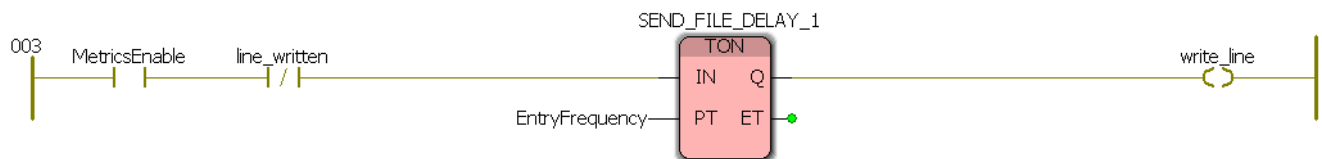
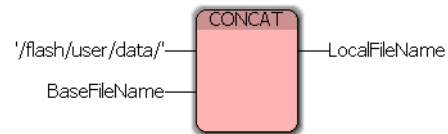
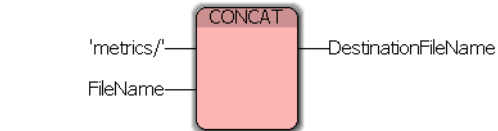
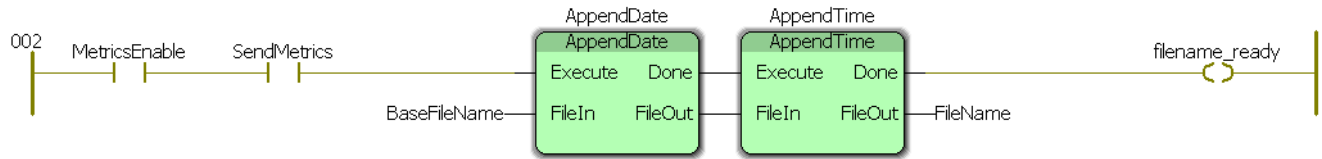
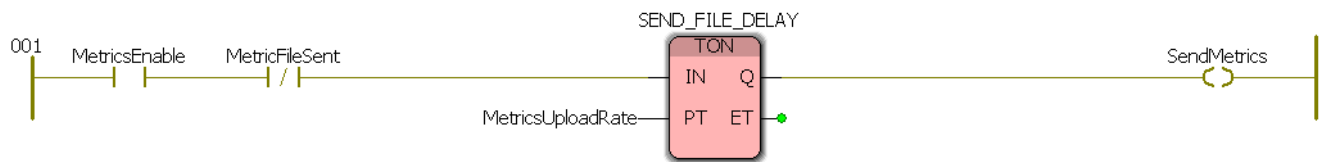
1) FTP Server Address: 192.168.1.100
2) FTP User: admin
3) FTP Password: 123456789
4) FTP Port: 21
5) FTP Path: /
6) FTP File Name: metrics.csv
7) FTP File Mode: Append
8) FTP File Encoding: UTF-8
9) FTP File Delimiter: ;
10) FTP File EOL: \n
11) FTP File Create Date: 2020-01-01
12) FTP File Create Time: 00:00:00
13) FTP File Create User: admin
14) FTP File Create Group: admin
15) FTP File Create Permissions: 0755
16) FTP File Create Mode: 0
17) FTP File Create User: admin
18) FTP File Create Group: admin
19) FTP File Create Permissions: 0755
20) FTP File Create Mode: 0

```

In addition to the Communications Toolbox, two additional Yaskawa toolboxes are used: File_RW_Toolbox and PLCOpen_Toolbox. The File_RW_Toolbox is used to create the CSV file that is uploaded to the FTP server and the PLCOpen_Toolbox is used to control the single servo used in this example.
















Controlling this example is very simple. The servo is turned on by "ServoEnable" which then in turn starts the jog at a constant velocity. The rest of the example is controlled in the main program:



This entire program is enabled by the "MetricsEnable" contact which starts two timers: the 30 second timer which sends the CSV file and the 1 second timer which takes a sample of the current position and velocity of the servo. The filename is generated each time the file is uploaded so that the timestamp is up to date and no files are overwritten.

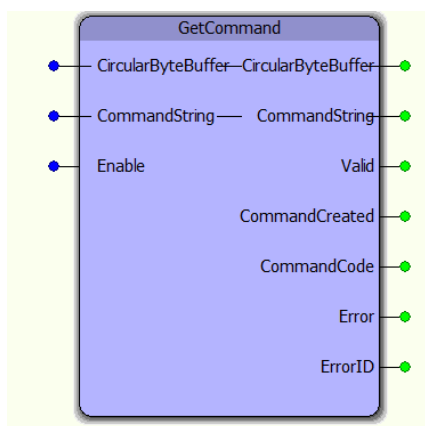
The results of this example can be monitored by exploring the target upload directory and examining the FTP server log:

```
[000074]11/12/2012 16:46:02 PM - (not logged in) (192.168.207.205)> Connected, sending welcome message...
[000074]11/12/2012 16:46:02 PM - (not logged in) (192.168.207.205)> 220 Welcome to logan_smith file server - FileZilla Server version 0.9.41 beta
[000074]11/12/2012 16:46:02 PM - (not logged in) (192.168.207.205)> USER anon
[000074]11/12/2012 16:46:02 PM - (not logged in) (192.168.207.205)> 331 Password required for anon
[000074]11/12/2012 16:46:02 PM - (not logged in) (192.168.207.205)> PASS ****
[000074]11/12/2012 16:46:02 PM - anon (192.168.207.205)> 230 Logged on
[000074]11/12/2012 16:46:02 PM - anon (192.168.207.205)> TYPE A
[000074]11/12/2012 16:46:02 PM - anon (192.168.207.205)> 200 Type set to A
[000074]11/12/2012 16:46:02 PM - anon (192.168.207.205)> PASV
[000074]11/12/2012 16:46:02 PM - anon (192.168.207.205)> 227 Entering Passive Mode (192,168,201,36,39,23)
[000074]11/12/2012 16:46:02 PM - anon (192.168.207.205)> STOR metrics\data_2012-11-12_17-44-18.csv
[000074]11/12/2012 16:46:02 PM - anon (192.168.207.205)> 150 Connection accepted
[000074]11/12/2012 16:46:02 PM - anon (192.168.207.205)> 226 Transfer OK
[000074]11/12/2012 16:46:02 PM - anon (192.168.207.205)> QUIT
[000074]11/12/2012 16:46:02 PM - anon (192.168.207.205)> 221 Goodbye
[000074]11/12/2012 16:46:02 PM - anon (192.168.207.205)> disconnected
```

| Name ^ | Size | Type | Date Modified |
|--|------|-------------------------|--------------------|
|  data_2012-11-12_17-35-40 | 1 KB | Microsoft Office Exc... | 11/12/2012 4:37 PM |
|  data_2012-11-12_17-36-10 | 1 KB | Microsoft Office Exc... | 11/12/2012 4:37 PM |
|  data_2012-11-12_17-36-41 | 1 KB | Microsoft Office Exc... | 11/12/2012 4:38 PM |
|  data_2012-11-12_17-37-11 | 1 KB | Microsoft Office Exc... | 11/12/2012 4:38 PM |
|  data_2012-11-12_17-37-42 | 1 KB | Microsoft Office Exc... | 11/12/2012 4:39 PM |
|  data_2012-11-12_17-38-12 | 0 KB | Microsoft Office Exc... | 11/12/2012 4:39 PM |
|  data_2012-11-12_17-38-43 | 1 KB | Microsoft Office Exc... | 11/12/2012 4:40 PM |
|  data_2012-11-12_17-39-13 | 1 KB | Microsoft Office Exc... | 11/12/2012 4:40 PM |
|  data_2012-11-12_17-39-44 | 1 KB | Microsoft Office Exc... | 11/12/2012 4:41 PM |
|  data_2012-11-12_17-40-14 | 1 KB | Microsoft Office Exc... | 11/12/2012 4:42 PM |
|  data_2012-11-12_17-40-45 | 1 KB | Microsoft Office Exc... | 11/12/2012 4:42 PM |
|  data_2012-11-12_17-41-15 | 1 KB | Microsoft Office Exc... | 11/12/2012 4:43 PM |
|  data_2012-11-12_17-41-46 | 0 KB | Microsoft Office Exc... | 11/12/2012 4:43 PM |



GetCommand



The GetCommand function block is a supporting function block for the ReName_CommandProcessor function block. It extracts a CommandString from the CircularByteBuffer as identified by the CmdDelimiter specified in the CircularByteBuffer structure.

Library

Comm Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|--------------------|--------------------------------------|---|
| VAR_IN_OUT | | | |
| V | CircularByteBuffer | CircularBufferStruct | Structure containing a data buffer and other operational information required to manage the CircularByteBuffer. |
| V | CommandString | CTB_CommandStruct | Input string containing at least two bytes of command characters and any optional parameters separated by a PrmDelimiter. |
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. FALSE |
| VAR_OUTPUT | | | |

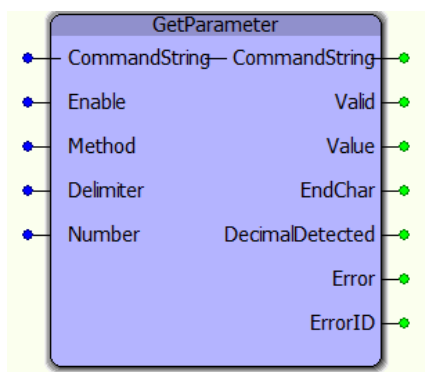
| | | | |
|---|----------------|------|--|
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| V | CommandCreated | BOOL | Indicates that the CommandString VAR_IN_OUT contains a new CommandString. |
| V | CommandCode | INT | Integer value corresponding to the first two ASCII characters of the CommandString. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 10165 | CommandString length is too long or command delimiter not found. |



GetParameter



The GetParameter function block provides a single parameter Value extracted from the CommandString. This is supporting function block for use within the CommandProcessor function block.

Library

Comm Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|---------------|-----------------------------------|---|
| VAR_IN_OUT | | | |
| V | CommandString | CTB_CommandStruct | Input string containing parameters separated by delimiters. such as MV;1.0;-10.5;3.007 |
| VAR_INPUT | | | |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | Delimiter | YTB_STRING1 | String value of the character separating parameters within the CommandString. |
| B | Number | INT | Depending on Method input, either the number of the parameter value to be found. |
| B | Method | Method | Determines method used to retrieve variable from data buffer. Method #Parameter uses the input Number to determine the parameter number within the string to output. Method #Character uses the number input as the index in the byte array to start looking for the next valid paramter. |
| VAR_OUTPUT | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |

| | | | |
|---|-----------------|--------|---|
| V | Value | STRING | Value of the parameter. |
| B | EndChar | INT | Last character index in byte buffer searched. When using Method# |
| B | DecimalDetected | BOOL | Indicates if the value output contains a decimal or not. (useful to determine conversion to a Real or Integer value) |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

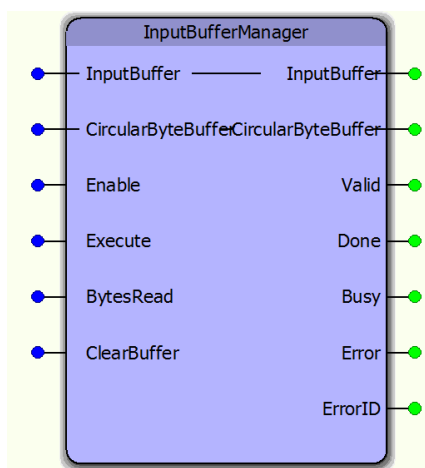
- There are two methods available with this function block; Values can be fetched via Parameter (Delimiter) count or by StartCharacter. The Parameter method always counts delimiters from the beginning of the CommandString to explicitly return the correct Value. If this Function block is executed in WHILE loop situation, it is more efficient to specify the next StartCharacter as the Number Input by feed the previous EndChar back into the function block.
- If Method = Method#Parameter, GetParameter will search through the command string to find the parameter corresponding to the Number input. This method is useful for commands with fewer parameters or when parameters are being read non-sequentially.
 - Example: CommandString = 'MV,2,4,6' Delimiter = ',' Number = 2
When Valid = TRUE, Value = 4
- If Method = Method#Character, GetParameter will search the command string for the next parameter starting at the character location equal to the Number input. The EndChar output can be used as feedback to the Number input to find the next parameter. This method is useful when parameters are being read sequentially and provides a large performance increase when parsing a CommandString with a large number of parameters.
 - Example: CommandString = 'MV,2,4,6' Delimiter = ',' Number = 5
When Valid = TRUE, Value = 4, EndChar = 7
- Further examples of both methods provided in ReName_CommandProcessor customization section.

Error Description

| ErrorID | Meaning |
|-----------------------|---|
| 0 | No error. |
| 10160 | CommandString length is invalid. |
| 10162 | Parameter being searched for is out of range. |
| 10163 | Mode input not valid. |
| 10164 | Invalid character position input. |



InputBufferManager



The InputBufferManager function block manages a circular buffer of incoming data. It is a supporting function block for the CommunicationChannel function block. A user should not need to access this function directly.

Library

Comm Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|--------------------|--------------------------------------|--|
| VAR_IN_OUT | | | |
| V | InputBuffer | YTB_ByteArray2048 | Byte array containing data to be copied into the CircularByteBuffer. |
| V | CircularByteBuffer | CircularBufferStruct | Structure containing a data buffer and other operational information required to manage the CircularByteBuffer. |
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| V | BytesRead | UDINT | Number of bytes to be copied from InputBuffer to CircularByteBuffer. |

| | | | | |
|-------------------|-------------|------|--|-------|
| V | ClearBuffer | BOOL | Resets the StorePointer and UsePointer, which logically clears the contents of the circular buffer, but any existing data is not actually cleared. | INT#0 |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

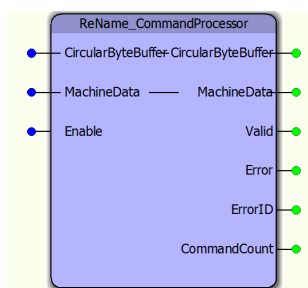
This is a hybrid function block that incorporates both PLCOpen specified behaviors: Enable and Execute. This was mainly done to separate two types of initialization: one that occurs when the Enable goes high, and another that occurs only when the Execute goes high.

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 10022 | Product or circular buffer overrun / full. |
| 10023 | Buffer size too small / cannot be zero. |



ReName_CommandProcessor



The ReName_CommandProcessor function block is a user customizable function block that parses data from a circular buffer and copies it into a user defined structure which will be used to operate the machine. To use this function, you must copy and paste into your main project, and rename it, and customize it.

Library

Comm Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|--------------------|--------------------------------------|--|
| VAR_IN_OUT | | | |
| V | MachineData | MyMachineStruct | A user customizable structure containing machine data used in processing commands. |
| V | CircularByteBuffer | CircularBufferStruct | Structure containing a data buffer and other operational information required to manage the CircularByteBuffer. |
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. FALSE |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| V | CommandCount | UDINT | Number of commands that have been processed since this function block was enabled. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

- This function block is a template for designing a unique command line interpreter and requires customization. See the customization steps below.
- The command streaming tools provided in the Comm Toolbox are designed to interpret commands starting with a two character (two byte) command code followed by either delimiter separated parameters or no parameters. The reason for this is because two ASCII bytes can easily be converted to an INT, which is used with the CASE statement in this function block. Example commands are located in the customization steps below.

Error Description

| ErrorID | Meaning |
|-----------------------|---|
| 0 | No error. |
| 10160 | CommandString length is invalid. |
| 10161 | Invalid CommandCode. |
| 10162 | Parameter being searched for is out of range. |
| 10163 | Mode input not valid. |
| 10164 | Invalid character position input. |

Customization Steps

1. Copy this Function block from the Comm Toolbox, paste it into your project, and rename with a different (but similar) name.

2. Data type MyMachineStruct (VAR_IN_OUT 'MachineData') is only an example structure. A custom structure must be designed to uniquely match the needs of the application. An example is shown below.

```

223     PositionArray : ARRAY[1..50] OF LREAL;
224
225     CommandStruct: STRUCT
226         Enable:BOOL;
227         HomeReg:BOOL;
228         StartMoveRelative:BOOL;
229         MoveRelativeSpeed:LREAL;
230         MoveRelativeAccel:LREAL;
231         MoveRelativeDist :LREAL;
232     END_STRUCT;
233
234     Monitor: STRUCT
235         Position: LREAL;
236         Velocity: LREAL;
237         Torque: LREAL;
238     END_STRUCT;
239
240     MotorDataStruct: STRUCT
241         Num:AXIS_REF;
242         Command: CommandStruct;
243         Monitor: Monitor;
244         LoadPosition: PositionArray;
245     END_STRUCT;
246
247     MotorDataArray : ARRAY[1..5] OF MotorDataStruct;
248
249     MachineInfo: STRUCT
250         Estop :BOOL;
251         ClearAlarms :BOOL;
252         RunMode :INT; (* machine running state *)
253         Conveyor : MotorDataStruct;
254         Arm : MotorDataArray;
255     END_STRUCT;

```

3. Change the 'MachineData' DataType in the CommandProcessor function block to match your structure name.

| | | |
|-------------|-------------|------------|
| MachineData | MachineInfo | VAR_IN_OUT |
|-------------|-------------|------------|

4. Initialize the configuration elements in CircularByteBuffer.

```

67 CBBuffer.CmdDelimiters[0] := BYTE#13;
68 CBBuffer.Size := INT#8192;
69 CBBuffer.PrmDelimiter := ',';

```

1. a. CmdDelimiters are used to mark the end of a complete command. Up to four characters can be specified. Typically, <cr>, which is BYTE#13 or <cr><lf>, which is BYTE#13 BYTE#10 are used. If CmdDelimiters not specified, will default functionality will automatically accept Carriage Return or Carriage Return & Line Feed.
2. b. PrmDelimiter specifies the character that separates individual parameters within a command. If PrmDelimiter is not specified, the function will automatically default to a comma, (BYTE#44).
3. c. Size must represent the defined size of the DataType definition for the CircularBufferStruct's "Data" Element. If Size not specified, it will default to zero and the InputBufferManager function block will cause an error. Normally, this value is 8192 as the structure definition is in the Comm Toolbox itself. If this must be increased for any reason, modify the Comm Toolbox DataType definition and set the Size input accordingly.
5. Locate the comments "Customize the code below?" and "Customize the code above?"

- Remove example commands to avoid potential errors in operation.

```

131  (*****
132  (***** Customize the code below
133  (*****
134
135  CASE CommandCode OF
136
137      (* insert new commands here *)
138
139  ELSE
140      Error_UnsupportedCommand:=TRUE;
141  END_CASE; (* CommandCode *)
142
143  (*****
144  (***** Customize the code above
145  (*****

```

7. Add your commands. Two examples are shown below:

1. Move Relative command

1. MR,<axisnumber>,<distance>,<speed>,<accel/decel>
2. Calculate the CommandCode which corresponds to the ASCII characters 'MR'. The equation is: $\text{CHAR_TO_INT('M')} * 256 + \text{CHAR_TO_INT('R')} = 19794$.
3. Add the CommandCode to the case statement.
4. Use the GetParameter function block to separate command parameters. The example below uses GetParameter with "Method#Parameter?"

```

19794 : (* MR - Move Relative *);
      FOR ParameterIndex := 1 TO 4 DO
          GetParameter.CommandString:=CommandString;
          GetParameter(Number:=ParameterIndex, Method := Method#Parameter);
          CommandString:=GetParameter.CommandString;
          IF ( GetParameter.Valid := TRUE ) THEN
              CASE ParameterIndex OF
                  1: AxisNum := STRING_TO_INT(GetParameter.Value);
                  2: MachineData.Arm[AxisNum].Command.MoveRelativeDist := STRING_TO_LREAL(GetParameter.Value);
                  3: MachineData.Arm[AxisNum].Command.MoveRelativeSpeed:= STRING_TO_LREAL(GetParameter.Value);
                  4: MachineData.Arm[AxisNum].Command.MoveRelativeAccel:= STRING_TO_LREAL(GetParameter.Value);
                     MachineData.Arm[AxisNum].Command.StartMoveRelative:= TRUE;
              END_CASE;
          END_IF;
      END_FOR;

```

2. Load Positions command

1. LP,<Position1>,<Position2>,...,<Position50>
2. Calculate the CommandCode which corresponds to the ASCII characters 'LP'. The equation is: $\text{CHAR_TO_INT('L')} * 256 + \text{CHAR_TO_INT('P')} = 19536$
3. Add the CommandCode to the case statement.
4. Use the GetParameter function block to separate command parameters. The example below uses GetParameter with "Method#Character?"

```

19536 : (* LP - Load Positions *)
      CharacterIndex := 0;
      FOR PositionCount := 1 TO 50 DO
          GetParameter.CommandString:=CommandString;
          GetParameter(Number:=CharacterIndex, Method := Method#Character);
          CommandString:=GetParameter.CommandString;
          CharacterIndex:= GetParameter.EndChar;
          IF ( GetParameter.Valid := TRUE ) THEN
              MachineData.Conveyor.LoadPosition[PositionCount] := STRING_TO_LREAL(GetParameter.Value);
          END_IF;
      END_FOR;

```

Optional Customization Steps

The CommandProcessor can process one or many commands per scan. This is a performance tuning issue. If the host device must send several setting at once, the MPiec controller may seem slow to process all the commands based on the Task interval. If the Task Interval and priority are set such that the CommandProcessor will have time to continue scanning the CircularByteBuffer in one scan until ALL bytes have been processed, performance will be improved by changing the following CommandProcessor code:

1. Remove AND NOT(CommandCreated) from main WHILE loop as shown

```

40
41  WHILE (CircularByteBuffer.StorePointer <> CircularByteBuffer.UsePointer) (*AND NOT(CommandCreated)*) DO
42      CommandCreated:=FALSE;

```



ReName_CommunicationsMgr

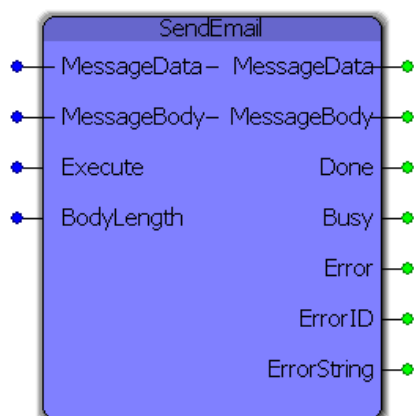
ReName_CommunicationsMgr is a reference POU showing the recommended setup of the command stream features.

Customization Required:

1. Find the ReNameCommandProcessor Function Block and change the DataType of MachineData VAR_IN_OUT in accordance with a custom structure that you will create for your application.
2. The only other area that may require customization is located under the comment "Prepare to create the Response Output for the Command Channel". Once a connection has been established, the Y_WriteDevice function block can be used to send a buffer of data (monitor information or command responses for example) back to the device issuing commands.



SendEmail



This function block sends an e-mail via SMTP commands (Simple Mail Transfer Protocol) through a specified SMTP server. The output is highly configurable including multiple recipients, any message body structure, specified sender e-mail and name and other features listed below.

Library

Comm Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-------------|---------------------------|---|
| VAR_IN_OUT | | | |
| V | MessageData | SMTP_Data | A user customized data structure for configuring the e-mail block. |
| V | MessageBody | YC_BYTE4096 | The e-mail body as a 4096 element byte array. If a larger body is required, this declaration can be changed and the library recompiled. |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all inputs are read and the e-mail(s) is sent. To resend the e-mail or send a different file, change the value(s) and re-trigger the execute input. |
| V | BodyLength | UDINT | The length (number of bytes) of the e-mail body that will be sent. While not necessary it is highly suggested, see notes below. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high upon successfully sending an e-mail. |

| | | | |
|---|-------------|--------------|--|
| B | Busy | BOOL | Set high upon the start of communications with the SMTP server and low when 'Done' or 'Error' go high. |
| B | Error | BOOL | Set high when an error occurs during e-mail configuration and sending. Set low upon Execute being reset. |
| E | ErrorID | UINT | If Error is true, this output provides the ErrorID. Cleared upon 'Execute' being reset. |
| V | ErrorString | YC_STRING256 | If 'Error' is true and it is an SMTP response code related error then this output contains the response string from the SMTP server. |

Notes

- The MPiec series controllers do not support SSL SMTP servers and therefore will most likely only work with local network SMTP servers. Talk with your IT professional about connecting to a local SMTP server from an MPiec Series Controller (see "Setup" below for more details about the required configuration).
- The "BodyLength" input is optional but highly suggested to reduce the packet size and the potential for large amounts of padding ("0") bytes on the recipients side. All examples include this Input and demonstrate how to get the correct length.

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 8705 | The maximum number of concurrently open user sockets/IO device handles has been reached or exceeded. |
| 8706 | The socket/IO device handle was invalid. Invalid IP address. |
| 8707 | The IP address string was not in a valid format. |
| 8708 | The socket/IO device handle could not be created. |
| 8709 | The specified address or port is already in use on the local network. |
| 8710 | The specified address or port is not available for use. (Maybe the IP address specified is not assigned to one of the networks available on this MPiec?) |
| 8711 | Unable to accept new socket/IO device handle connection. |
| 8712 | Unable to bind to the specified address. |
| 8713 | The socket/IO device handle type argument was invalid. |
| 8714 | The local address or port was not valid. |
| 8715 | Connecting to the socket/IO device handle failed. |
| 8716 | The remote IP address is unreachable. Check the default gateway. |
| 8717 | The socket/IO device handle is already connected to another endpoint. |
| 8718 | The socket/IO device handle connection attempt was actively refused by the remote device. |
| 8719 | The socket/IO device handle was not connected to a remote endpoint. Call Y_ConnectSocket prior to Y_ReadDevice or Y_WriteDevice. |
| 8720 | An error occurred trying to get or set the device option. |
| 8721 | The communication device could not be read. |
| 8722 | The communication device could not be written. |
| 8723 | A valid buffer argument to WriteDevice and ReadDevice is required. |
| 8724 | Invalid Device Option ID. |
| 8725 | The device option value was not the right size or the data was out of range. |
| 8726 | The serial port ID was not a valid serial port. |
| 8727 | The serial port specified could not be opened. |
| 12100 | Connect to SMTP server timeout, no connection was established within the supplied Timeout. |
| 12101 | DATA portion of e-mail was not successful and therefore the e-mail may not send/be malformed. |

| | |
|-----------------------|---|
| 12102 | QUIT error, there was an error sending the 'QUIT' command to the server. |
| 12103 | NumRcpt cannot equal 0. |
| 12421 | Service not available, closing control connection. This may be a reply to any command if the service knows it must shut down. |
| 12425 | Can't open data connection. |
| 12426 | Connection closed; transfer aborted. |
| 12430 | Invalid username or password. |
| 12434 | Requested host unavailable. |
| 12450 | Requested file action not taken / Requested mail action not take (mailbox unavailable). |
| 12451 | Requested action aborted. Local error in processing. |
| 12452 | Requested action not taken, insufficient storage space in system (FTP: File unavailable) |
| 12500 | Syntax error, command unrecognized. |
| 12501 | Syntax error in parameters or arguments. |
| 12502 | Command not implemented. |
| 12503 | Bad sequence of commands. |
| 12504 | Command not implemented for that parameter. |
| 12521 | [domain] does not accept mail. |
| 12530 | Not logged in / Access denied. |
| 12532 | Need account for storing files. |
| 12550 | Requested action not taken. File unavailable (e.g., file not found, no access) / Mailbox unavailable. |
| 12551 | Requested action aborted. Page type unknown / User not local. |
| 12552 | Requested file action aborted, exceeded storage allocation / Requested mail action aborted, exceeded storage allocation. |
| 12553 | Requested action not taken, file name not allowed / mailbox name not allowed. |
| 12554 | Transaction failed. |

Example

As this is a complicated function, additional examples are provided in separate help files listed under "Additional Examples" and prefixed with "SMTP_". The example shown here sets up the block, creates a message body and sends an e-mail to external Gmail account.

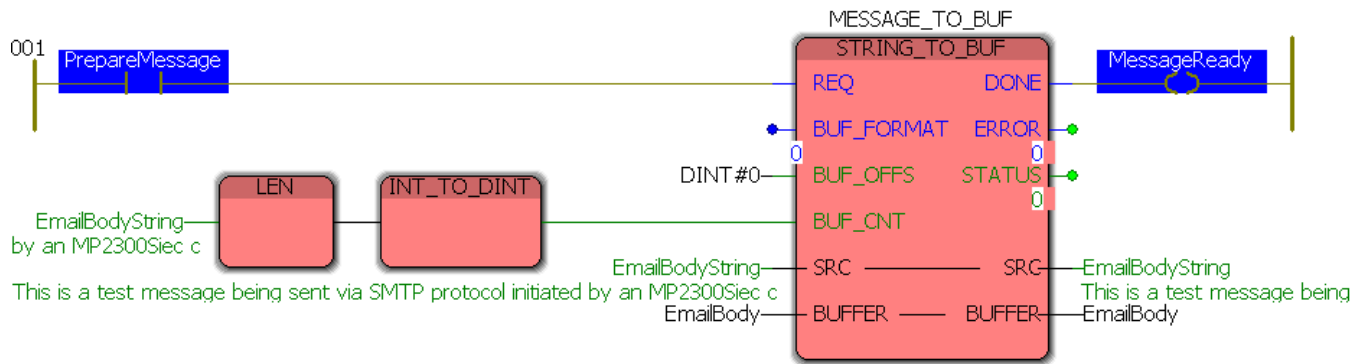
The variable EmailBodyString is of type YC_STRING256. Below is the configuration of the SMTP_Data structure:

```
(* E-mail Setup *)
EmailBodyString := 'This is a test message being sent via SMTP protocol initiated by an MP2300Siec controller.';

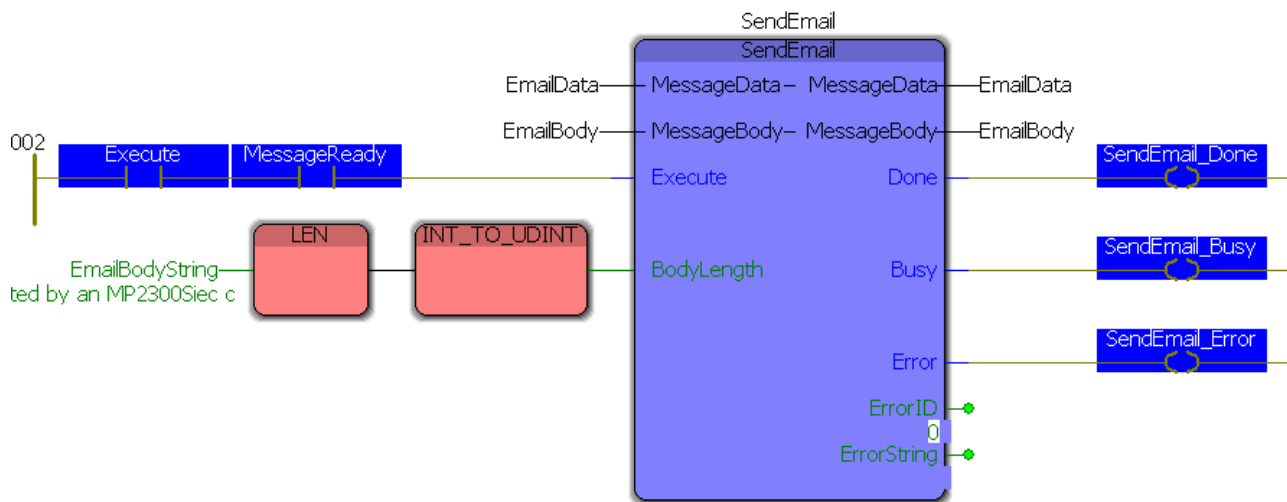
EmailData.DNSIP := '192.168.5.10';
EmailData.Domain := 'YASKAWA';
EmailData.LocalIP := '192.168.207.205';
EmailData.NumRcpt := INT#1;
EmailData.RcptArray[0].name := 'Logan Smith';
EmailData.RcptArray[0].email := '[REDACTED]';
EmailData.Sender := 'logan_smith@yaskawa.com';
EmailData.SenderName := 'MP2300Siec';
EmailData.SMTPDomain := 'athena.yaskawa.com';
EmailData.Subject := 'Test message from your MP2300Siec';
```

The most basic form of sending an e-mail is simply converting a string to a byte array via the STRING_TO_BUF function block provided in the PROCONOS firmware library. With the data structure shown above and this STRING_TO_BUF block, the email is configured and ready for use.

(* Pass the message into a buffer *)

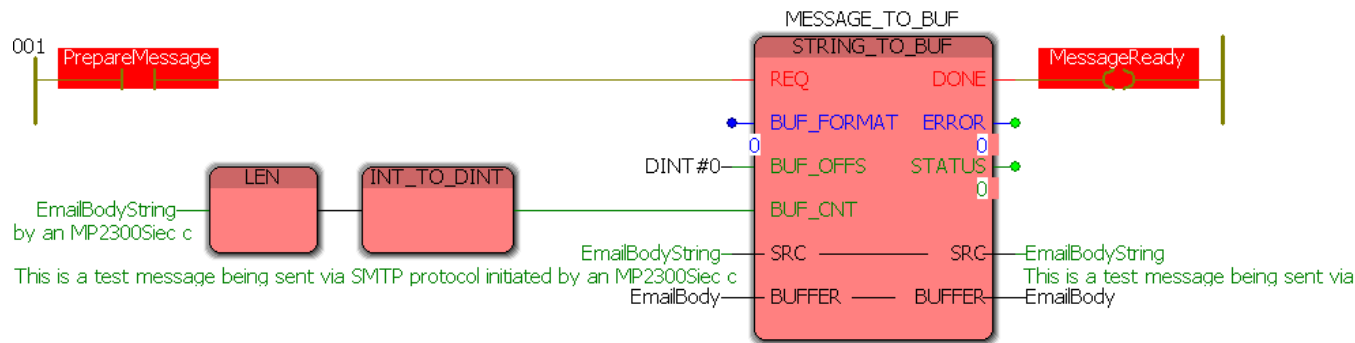


```
(* Send the message *)
```

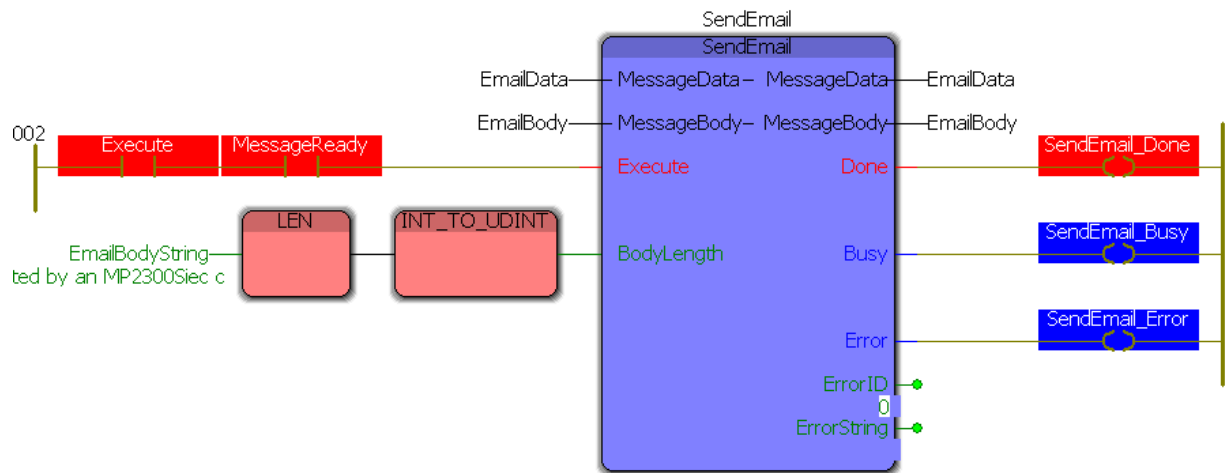


After toggling `PrepareMessage`, here is the result.

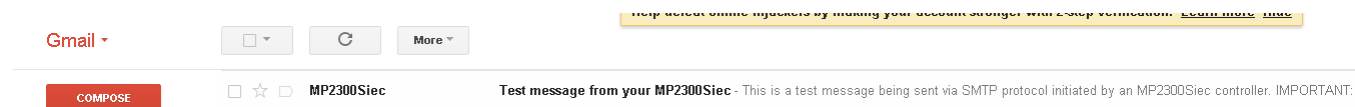
(* Pass the message into a buffer *)



(* Send the message *)

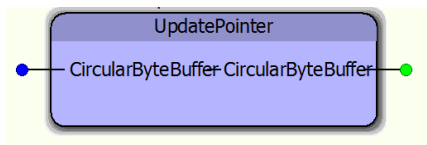


And to demonstrate the end result, here is the e-mail in the inbox of the Gmail account used. The sender and subject are both listed correctly and a portion of the send message can be seen.





UpdatePointer



The UpdatePointer function block is a supporting function block referenced by the GetCommand function block. It updates the UsePointer of the CircularByteBuffer structure.

Library

Comm Toolbox

Parameters

| * | Parameter | Data Type | Description |
|------------|--------------------|--------------------------------------|---|
| VAR_IN_OUT | | | |
| V | CircularByteBuffer | CircularBufferStruct | Structure containing a data buffer and other operational information required to manage the CircularByteBuffer. |

File Read Write Toolbox

Toolbox Help Documentation

Help version created 1/31/2018

YASKAWA



Getting Started with File Read / Write Toolbox

Requirements for v340

To use the File Read / Write Toolbox, your project must also contain the following:

Firmware libraries:

- PROCONOS

User libraries:

The following User Libraries must be listed above the File Read Write Toolbox:

- Yaskawa_Toolbox (v340 or higher)

The File Read / Write Toolbox contains some functions must be customized for use in every application.

The four main functions in this library are:

- Write_Binary_File
- Write_CSV_File
- Read_Binary_File
- Write_CSV_File

To use any of these functions, they must be copied and pasted into your main project as a function block with a different (but similar) name. To do this, copy and paste the structured text and the variable definitions grid from the toolbox version. These four main functions refer to other sub functions in the File Read Write toolbox, which do not require customization and can remain in the File Read Write Toolbox. There is no need to move the following function blocks:

- Read_Buffer
- Read_Line
- Read_Value

More detailed customization information and examples are provided for the help for each of the functions blocks mentioned above.

See Yaskawa's Youtube Webinar - [CSV File Transfer with the File_RW Template](#).



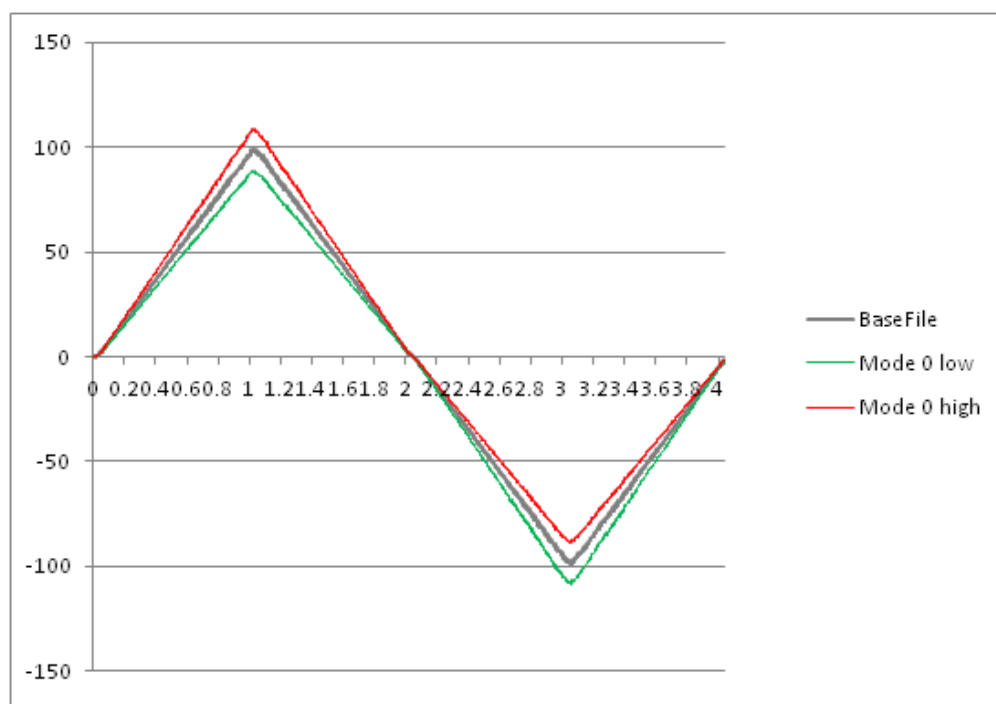
Enumerated Types in the File R/W Toolbox

Some blocks accept an enumerated type (ENUM), which is a keyword (or constant) representing a value which will configure the operation of the function block. Enumerated types are equivalent to zero-based integers (INT). Therefore, the first value equates to zero, the second to 1, etc.

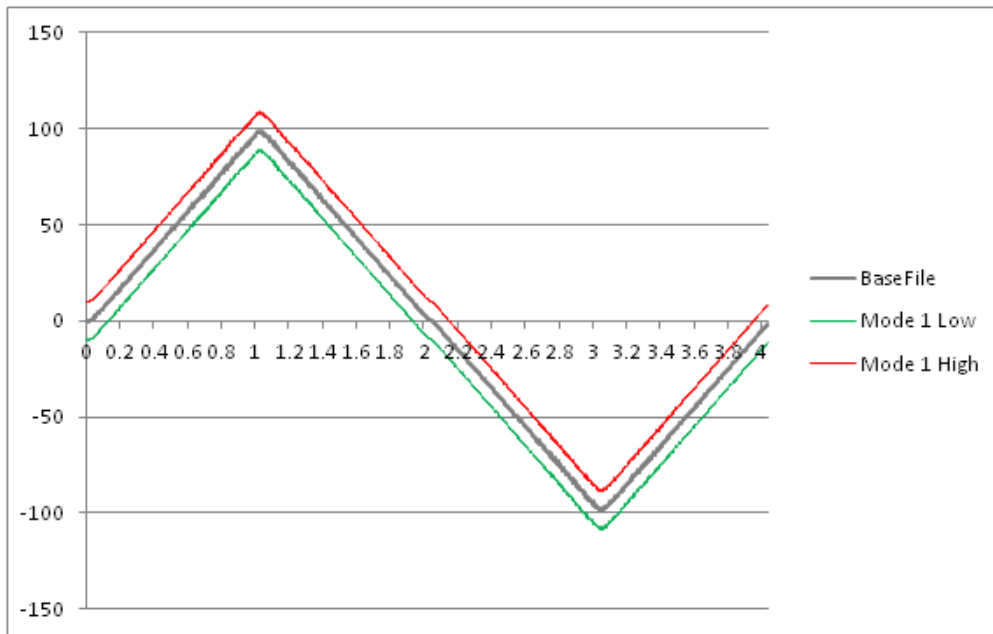
Enumerated Types Declaration

| Enumerated Type | #INT Value | Enum Value | Description |
|-----------------|---|------------------|--|
| ComparisonMode | Enumerated type to be used with CommStruct.CommType | | |
| | 0 | Percentage | Uses a percentage of the current value in the BaseFile to set the window. |
| | 1 | PercentOfMax | Uses a percentage of the maximum value found in the BaseFile to set the window. |
| | 2 | PercentOfAverage | Uses a percentage of the average absolute value found in the BaseFile to set the window. |
| | 3 | RawWindow | Uses a raw value to specify a window around the BaseFile. |

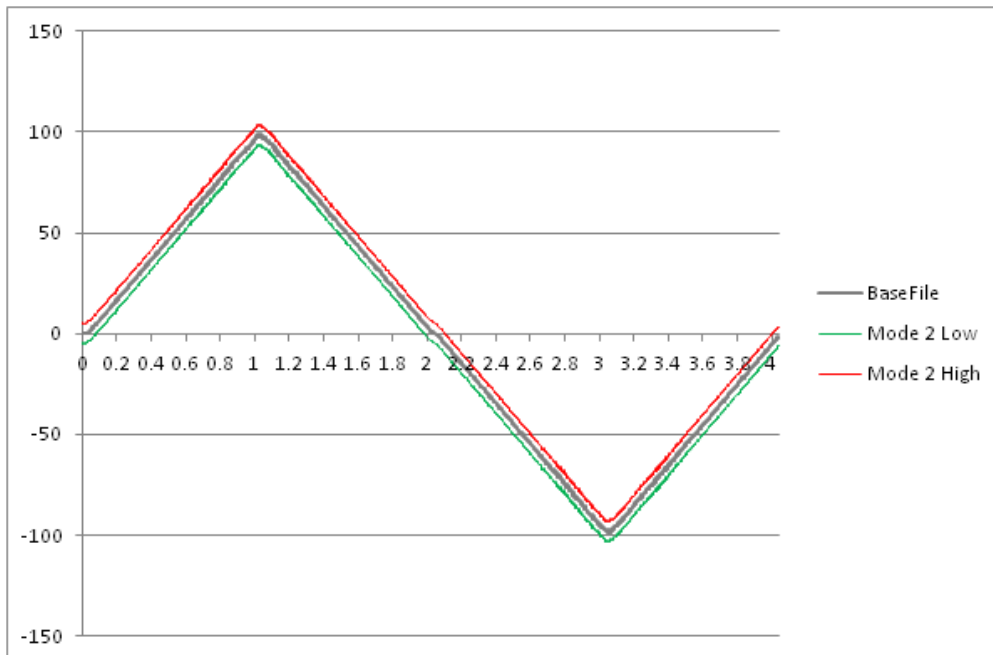
Percentage



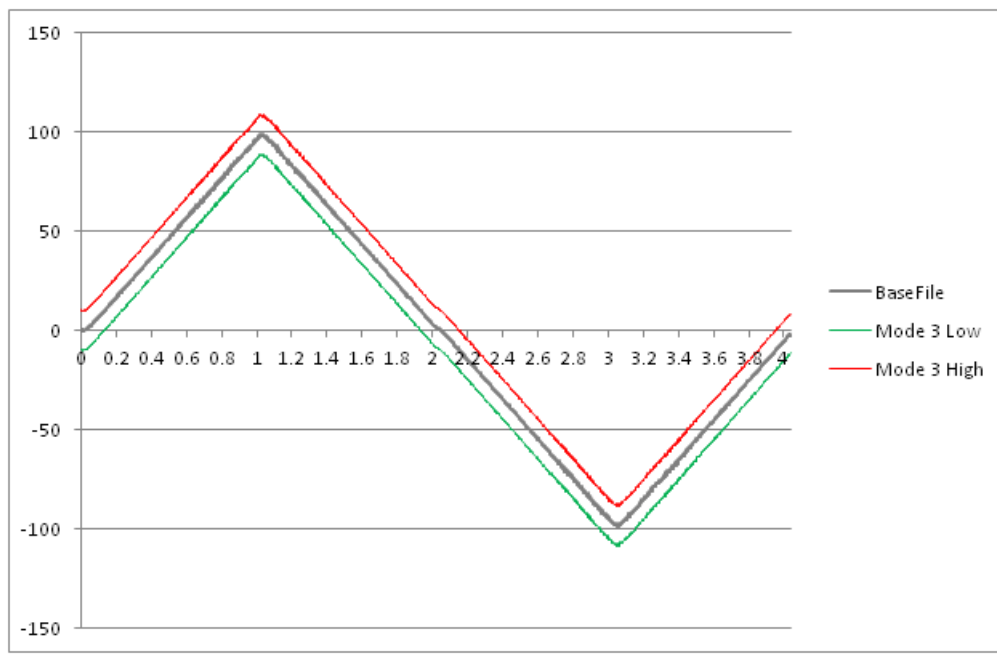
PercentOfMax



PercentOfAverage



RawWindow



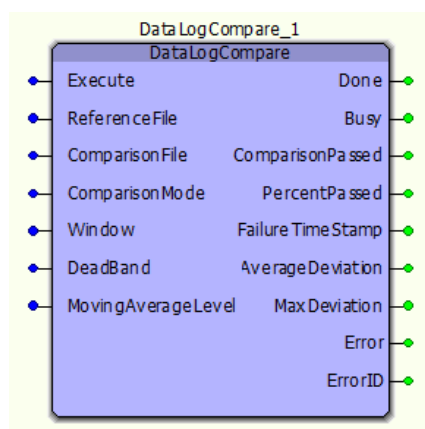
File_RW_FBs

Toolbox Help Documentation
Help version created 1/31/2018

YASKAWA



DataLogCompare



This function block will read a ComparisonFile and determine how much of the data is within a specified window of the ReferenceFile.

Library

File RW Toolbox

Parameters

| * | Parameter | Data Type | Description | |
|-----------|----------------|-----------|--|-----------|
| VAR_INPUT | | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. | FALSE |
| V | ReferenceFile | STRING | File used as reference to compare against. Example STRING#'flash/user-/data/mylog.csv' | STRING#'' |
| V | ComparsionFile | STRING | File to be characterized for determining pass / fail. Example STRING#'flash/user-/data/mylog.csv' | STRING#'' |

| | | | | |
|-------------------|--------------------|--------------------------------|--|---------------------------|
| V | ComparsionMode | ComparisonMode | Different modes of comparison, changes the calculation used to determine if ComparisonValue within range of ReferenceFile. (example graphs below) | ComparisonMode#Percentage |
| V | Window | LREAL | Allowable deviation from ReferenceFile log the ComparisonFile log to be within and still pass comparison. | LREAL#0.0 |
| V | DeadBand | LREAL | If the base value is within the deadband – no comparison will be made. | LREAL#0.0 |
| V | MovingAverageLevel | INT | Applies a moving average filter to both the ReferenceFile and ComparisonFile before comparing the values – useful when comparing logs of noisy data such as Torque. Set the size of the moving average filter from 0 – 1000. | INT#0 |
| VAR_OUTPUT | | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |
| V | ComparisonPassed | BOOL | ComparisonFile is within allowable window of the ReferenceFile 100% of the time. | |
| V | PercentPassed | LREAL | Percentage of ComparisonFile data points within allowable range of ReferenceFile. | |
| V | FailureTimeStamp | LREAL | If the comparison failed, this is the first time at which the ComparsionFile deviated from the ReferenceFile | |
| V | AverageDeviation | LREAL | The average deviation of the ComparisonFile from the ReferenceFile. (In modes Precent, PercentOfMax, and PercentOfAverage this value is a percentage, in RawWindow mode this is a raw difference) | |
| V | MaxDeviation | LREAL | The largest deviation of the ComparisonFile from the ReferenceFile. (In modes Precent, PercentOfMax, and PercentOfAverage this value is a percentage, in RawWindow mode this is a raw difference.) | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

- Don't forget to include the ProConOS firmware library in the project. It is required for this function block.

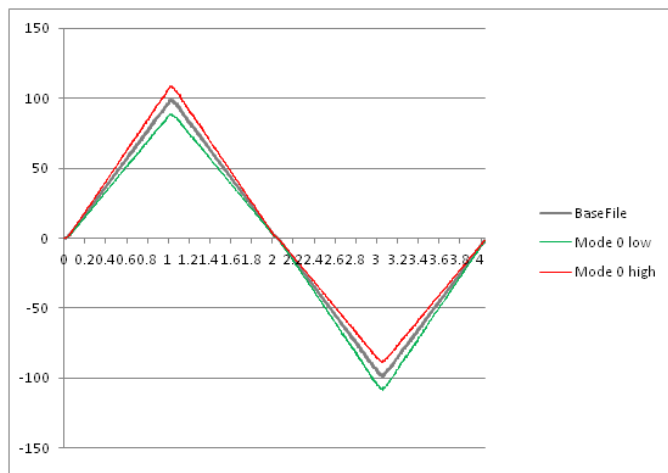
Error Description

| ErrorID | Meaning |
|-------------------|---|
| 0 | No error. |
| 4 | File is already open. |
| 5 | File is opened, write protected or access denied. |

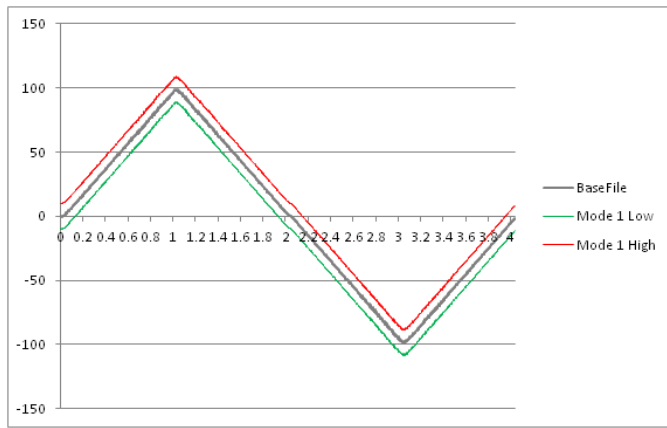
| | |
|-----------------------|---|
| 6 | File name not defined. |
| 10 | End of data reached. |
| 12 | The number of characters to be read is greater than the data buffer. |
| 13 | Invalid positioning mode or position specified is before the beginning of the file. |
| 20 | File could not be closed. |
| 22 | No data could be read. |
| 24 | Position could not be set. |
| 11000 | Header read error. Files being compared must have a header of "TimeStamp,Data". The function block GenerateDataLog automatically creates this header. |
| 11001 | Header mismatch error. Files being compared have a different header. |
| 11002 | File Name Error. File could not be read. |
| 11003 | Window Error. Window cannot be less then or equal to zero |
| 11004 | Timing mismatch. Time stamp in Reference file and Comparison file do not allign. Data was possibly recorded at different intervals |
| 11005 | Max Cycle Error. |
| 11006 | DeadBand value must be greater than or equal to zero. |
| 11007 | Invalid mode selection |
| 11008 | Moving average level must be greater than or equal to zero. |
| 11009 | Moving average level must be smaller than 1000. |
| 11010 | Was unable to pre load the comparison data buffer. |
| 11011 | Unable to load the reference data file fast enough. Comparison unable to complete. |

Comparison Modes:

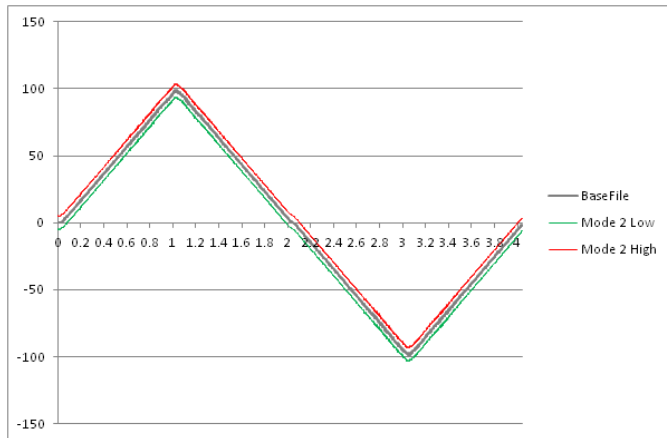
ComparisonMode#Percentage :



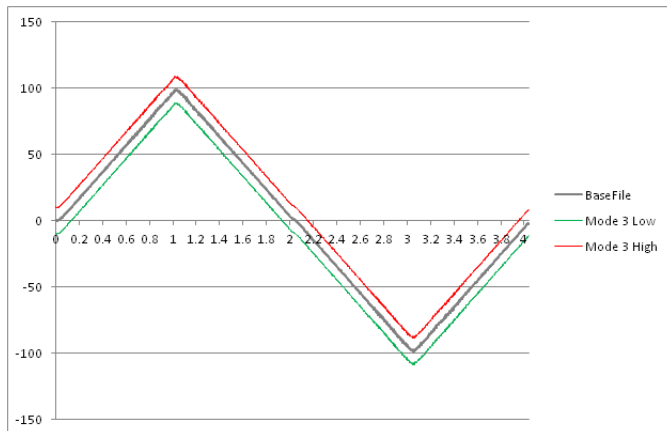
ComparisonMode#PercentOfMax :



ComparisonMode# PercentOfAverage :

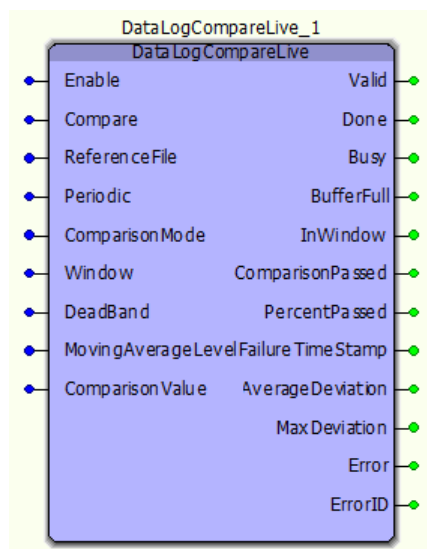


ComparisonMode# RawWindow :





DataLogCompareLive



This function block will read in a Comparison File and determine how much of the data is within a specified window of the input Reference File.

Library

File RW Toolbox

Parameters

| * | Parameter | Data Type | Description | Default |
|------------------|---------------|-----------|---|-----------|
| VAR_INPUT | | | | |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. | FALSE |
| V | ReferenceFile | STRING | File used as reference to compare against. Example STRING#'flash/user-/data/mylog.csv' | STRING#'' |

| | | | | |
|-------------------|--------------------|----------------|---|---------------------------|
| V | Periodic | BOOL | When False, enable will only load the reference buffer for one comparison and hold outputs as long as Enable is true. When True, as long as enable is high, the reference buffer will be loaded continuously and outputs will be held as long as Compare is True. (Error and ErrorID being the exception, Enable will need to be toggled to clear errors still) | FALSE |
| V | ComparsionMode | ComparisonMode | Different modes of comparison, changes the calculation used to determine if ComparisonValue within range of ReferenceFile. (example graphs below) | ComparisonMode#Percentage |
| V | Window | LREAL | Allowable deviation from ReferenceFile log the ComparisonFile log to be within and still pass comparison. | LREAL#0.0 |
| V | DeadBand | LREAL | If the base value is within the deadband – no comparison will be made. | LREAL#0.0 |
| V | MovingAverageLevel | INT | Applies a moving average filter to both the ReferenceFile and ComparisonFile before comparing the values – useful when comparing logs of noisy data such as Torque. Set the size of the moving average filter from 0 – 1000. | INT#0 |
| V | Comparison Value | LREAL | Value to be compared to the Reference file. | LREAL#0.0 |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |
| V | BufferFull | BOOL | Indicates that buffer of values read in from the BaseFile is full. To ensure that the comparison will complete it is recommended to wait until this signal is True before beginning a comparison. | |
| V | InWindow | BOOL | Indicates that the current Value being input is within the specified window of the BaseFile. This is a live indicator of how the comparison is doing. | |
| V | ComparisonPassed | BOOL | ComparisonFile is within allowable window of the ReferenceFile 100% of the time. | |
| V | PercentPassed | LREAL | Percentage of ComparisonFile data points within allowable range of ReferenceFile. | |
| V | FailureTimeStamp | LREAL | If the comparison failed, this is the first time at which the ComparsionFile deviated from the ReferenceFile | |
| V | AverageDeviation | LREAL | The average deviation of the ComparisonFile from the ReferenceFile. (In modes Precent, PercentOfMax, and PercentOfAverage this value is a percentage, in RawWindow mode this is a raw difference) | |
| V | MaxDeviation | LREAL | The largest deviation of the ComparisonFile from the ReferenceFile. (In modes Precent, PercentOfMax, and PercentOfAverage this value is a percentage, in RawWindow mode this is a raw difference.) | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |

| | | | |
|---|---------|------|--|
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |
|---|---------|------|--|

Notes

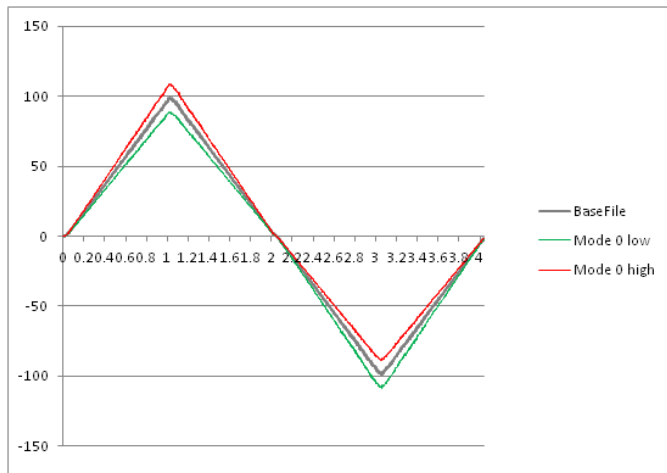
- Don't forget to include the ProConOS firmware library in the project. It is required for this function block.
- This function block requires that the variable PLC_SYS_TICK_CNT be defined as a global variable corresponding to a specified hardware address. This variable is automatically created and added to the System Variables when a new template project is opened.
- There is a known bug that if the ReferenceFile has < 1000 samples, setting periodic mode = TRUE will always cause the function block to error.

Error Description

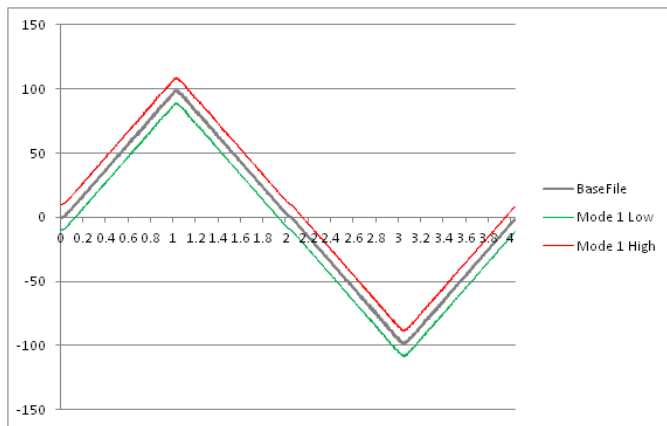
| ErrorID | Meaning |
|-----------------------|---|
| 0 | No error. |
| 4 | File is already open. |
| 5 | File is opened, write protected or access denied. |
| 6 | File name not defined. |
| 10 | End of data reached. |
| 12 | The number of characters to be read is greater than the data buffer. |
| 13 | Invalid positioning mode or position specified is before the beginning of the file. |
| 20 | File could not be closed. |
| 22 | No data could be read. |
| 24 | Position could not be set. |
| 11000 | Header read error. Files being compared must have a header of "TimeStamp,Data". The function block GenerateDataLog automatically creates this header. |
| 11001 | Header mismatch error. Files being compared have a different header. |
| 11002 | File Name Error. File could not be read. |
| 11003 | Window Error. Window cannot be less then or equal to zero |
| 11004 | Timing mismatch. Time stamp in Reference file and Comparison file do not align. Data was possibly recorded at different intervals |
| 11005 | Max Cycle Error. |
| 11006 | DeadBand value must be greater than or equal to zero. |
| 11007 | Invalid mode selection |
| 11008 | Moving average level must be greater than or equal to zero. |
| 11009 | Moving average level must be smaller than 1000. |
| 11010 | Was unable to pre load the comparison data buffer. |
| 11011 | Unable to load the reference data file fast enough. Comparison unable to complete. |

Comparison Modes:

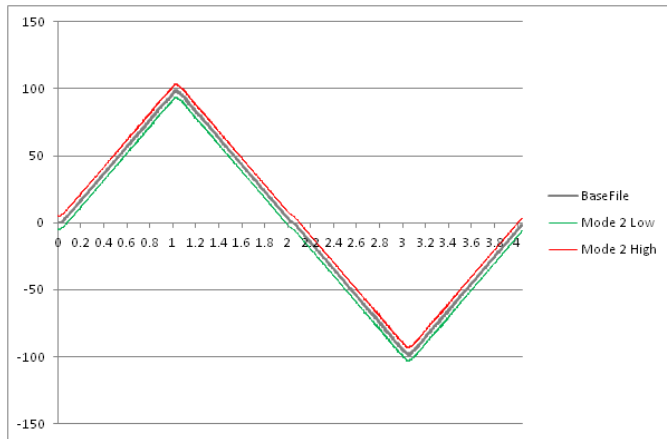
ComparisonMode#Percentage :



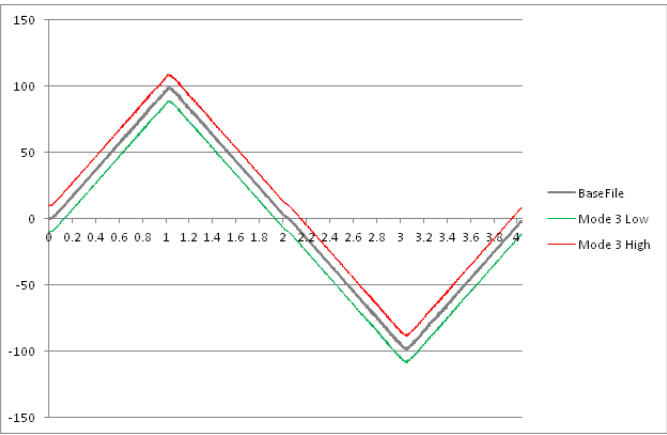
ComparisonMode# PercentOfMax :



ComparisonMode# PercentOfAverage :

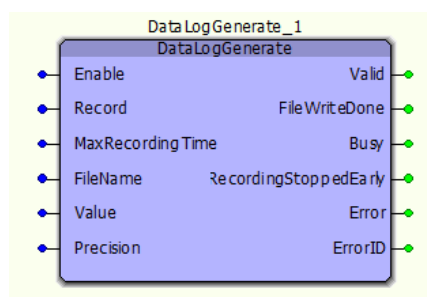


ComparisonMode# RawWindow :





DataLogGenerate



This function block will record a log file containing [TimeStamp, Value input] for a given duration. This CSV file can then be exported from the controller for post processing of the data logged.

Library

File RW Toolbox

Parameters

| * | Parameter | Data Type | Description | |
|-------------------|------------------|-----------|--|----------------|
| VAR_INPUT | | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. | FALSE |
| V | Record | BOOL | Will begin recording a new log when this input is set high. (this operation will delete previous log of same name if it exists on the controller). Logging stops when record input becomes false or MaxRecordingTime is reached. | FALSE |
| V | MaxRecordingTime | LREAL | Maximum length of time data will be logged for. If left unconnected, data will be logged as long as Record is TRUE. | LREAL#0.0 |
| V | FileName | STRING | Name of file to be read or written. Example STRING#'/-flash/user/data/myFile.csv' | STRING#'' |
| V | Value | LREAL | Desired value to be recorded. | LREAL#0.0 |
| V | Precision | INT | Number of characters after the decimal point to be written to the log file. (Ex. Precision = 4, value = 15.346781, value written to log file = 15.3467). Default will write full LREAL value to log file. | INT#0 |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |

| | | | |
|---|-----------------------|------|--|
| V | FileWriteDone | BOOL | Indicates when log has completed writing – depending on scan times and length of recording this might take longer to complete |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| V | RecordingStoppedEarly | BOOL | Internal buffer ran out of space to record more data. Will complete writing all valid data in buffers and close log file. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

- Don't forget to include the ProConOS firmware library in the project. It is required for this function block.
- This function block requires that the variable PLC_SYS_TICK_CNT be defined as a global variable corresponding to a specified hardware address. This variable is automatically created and added to the System Variables when a new template project is opened.

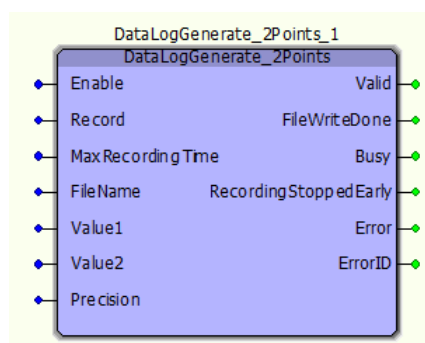
Error Description

| ErrorID | Meaning |
|--------------------|---|
| 0 | No error. |
| 4 | File is already open. |
| 5 | File is opened, write protected or access denied. |
| 6 | File name not defined. |
| 10 | End of data reached. |
| 12 | The number of characters to be read is greater than the data buffer. |
| 13 | Invalid positioning mode or position specified is before the beginning of the file. |
| 20 | File could not be closed. |
| 22 | No data could be read. |
| 24 | Position could not be set. |

Example



DataLogGenerate_2Points



This function block will record a log file containing [TimeStamp, Value1 input, Value2 input] for a given duration. This CSV file can then be exported from the controller for post processing of the data logged.

Library

File RW Toolbox

Parameters

| * | Parameter | Data Type | Description | Default |
|------------------|------------------|-----------|--|-----------|
| VAR_INPUT | | | | |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. | FALSE |
| V | Record | BOOL | Will begin recording a new log when this input is set high. (this operation will delete previous log of same name if it exists on the controller). Logging stops when record input becomes false or MaxRecordingTime is reached. | FALSE |
| V | MaxRecordingTime | LREAL | Maximum length of time data will be logged for. If left unconnected, data will be logged as long as Record is TRUE. | LREAL#0.0 |
| V | FileName | STRING | Name of file to be read or written. Example STRING#'/-flash/user/data/myFile.csv' | STRING#'' |
| V | Value1 | LREAL | Desired value to be recorded. | LREAL#0.0 |
| V | Value2 | LREAL | Desired value to be recorded. | LREAL#0.0 |
| V | Precision | INT | Number of characters after the decimal point to be written to the log file. (Ex. Precision = 4, value = 15.346781, value written to log file = 15.3467). Default will write full LREAL value to log file. | INT#0 |

| VAR_OUTPUT | | | |
|------------|-----------------------|------|--|
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| V | FileWriteDone | BOOL | Indicates when log has completed writing – depending on scan times and length of recording this might take longer to complete |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| V | RecordingStoppedEarly | BOOL | Internal buffer ran out of space to record more data. Will complete writing all valid data in buffers and close log file. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

- Don't forget to include the ProConOS firmware library in the project. It is required for this function block.
- This function block requires that the variable PLC_SYS_TICK_CNT be defined as a global variable corresponding to a specified hardware address. This variable is automatically created and added to the System Variables when a new template project is opened.

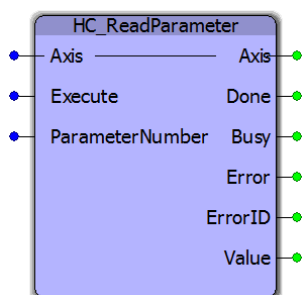
Error Description

| ErrorID | Meaning |
|--------------------|---|
| 0 | No error. |
| 4 | File is already open. |
| 5 | File is opened, write protected or access denied. |
| 6 | File name not defined. |
| 10 | End of data reached. |
| 12 | The number of characters to be read is greater than the data buffer. |
| 13 | Invalid positioning mode or position specified is before the beginning of the file. |
| 20 | File could not be closed. |
| 22 | No data could be read. |
| 24 | Position could not be set. |

Example



HC_ReadParameter



This Function Block is an extension of MC_ReadParameter from the PLCopenPlus_2_2a firmware library and reads configuration specific parameters from the appropriate XML configuration file(s). See the table below for the parameters supported by this function.

Parameters

| * | Parameter | Data type | Description |
|-------------------|-----------------|--------------------------|--|
| VAR_IN_OUT | | | |
| B | Axis | AXIS REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| VAR_INPUT | | | |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| B | ParameterNumber | UINT | Hardware Configuration parameter number. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |
| B | Value | LREAL | Value of the parameter. |

Supported Parameters

| Name | Parameter | R/W | Default | Min | Max | Comments |
|-----------------------------|-----------|------------|---------|-------|---------------|---|
| PositionScale | 999 | Write | 1.0 | 1.0 | 1.0 | |
| External Encoder Resolution | 1047 | Read/Write | 1.0 | 10 | 16777216 | |
| Load Type | 1807 | Read/Write | 1.0 | 0 | 1 | Rotary or linear |
| FeedConstant | 1808 | Read/Write | 1.0 | 0.001 | 1000000000000 | |
| OutputRatio | 1815 | Read/Write | 1.0 | 1 | 2147483647 | |
| MachineCycle | 1833 | Read/Write | 1.0 | 0.001 | 1000000000000 | |
| InputRatio | 1834 | Read/Write | 1.0 | 1 | 2147483647 | |
| User Units | 1813 | Read/Write | 0.0 | 0 | 5 | 0=inches, 1=mm, um=2, 3=pulses, 4=degrees, 5=revolutions |

| ErrorID | Meaning |
|-----------------------|---|
| 0 | No error. |
| 4 | The file is already opened. |
| 5 | The file is write protected or access is denied. Tip: Make sure a leading / has not been omitted. Example STRING#'/flash/user/data/myfile.txt' |
| 22 | No data could be read from the file |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4648 | The parameter number does not exist for the specified axis - OR The parameter number requires the other function block (e.g. MC_WriteParameter vs MC_WriteBoolParameter) |
| 8725 | The device option value was not the right size or the data was out of range. |
| 10115 | XML Tag not found. Possibly the file is corrupt or the schema is not compatible with this function block. |
| 10120 | File could not be opened. Check for accurate directory path and use of "/" |
| 10122 | Row Error. The data is out of sync with the expected row / column arrangement expected. |
| 10125 | Conversion Error. Check the ErrorRow and ErrorCol / ErrorString outputs for details. |
| 10126 | NoDataError - The End Of File was reached, but the record count is zero. Verify the file is not corrupted. |
| 10127 | TooManyRecords - DataType is not large enough. |
| 10128 | MaxNotDefined - The user must set the maximum number of records that can be added to the structure. |
| 10165 | CommandString length is too long or command delimiter not found. |

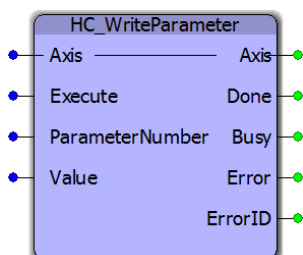
Related Function Blocks

[HC_WriteParameter](#): Writes a Hardware Configuration parameter.

MC_WriteParameter: Writes an axis specific parameter available at run time.



HC_WriteParameter



This Function Block is an extension of MC_WriteParameter from the PLCopenPlus_2_2a firmware library and writes configuration specific parameters to the appropriate XML configuration file(s). See the table below for the parameters supported by this function. Changes to parameters written by this function requires controller power cycle or reboot to take effect.

Parameters

| * | Parameter | Data type | Description |
|-------------------|-----------------|--------------------------|--|
| VAR_IN_OUT | | | |
| B | Axis | AXIS REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| VAR_INPUT | | | |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| B | ParameterNumber | UINT | Hardware Configuration parameter number. |
| B | Value | LREAL | Value of the parameter to be updated. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Supported Parameters

| Name | Parameter | R/W | Default | Min | Max | Comments |
|-----------------------------|-----------|------------|---------|-------|---------------|---|
| PositionScale | 999 | Write | 1.0 | 1.0 | 1.0 | |
| External Encoder Resolution | 1047 | Read/Write | 1.0 | 10 | 16777216 | |
| Load Type | 1807 | Read/Write | 1.0 | 0 | 1 | Rotary or linear |
| FeedConstant | 1808 | Read/Write | 1.0 | 0.001 | 1000000000000 | |
| OutputRatio | 1815 | Read/Write | 1.0 | 1 | 2147483647 | |
| MachineCycle | 1833 | Read/Write | 1.0 | 0.001 | 1000000000000 | |
| InputRatio | 1834 | Read/Write | 1.0 | 1 | 2147483647 | |
| User Units | 1813 | Read/Write | 0.0 | 0 | 5 | 0=inches, 1=mm, um=2, 3=pulses, 4=degrees, 5=revolutions |

Error Description

Many of these Errors should never occur, but are detected and exposed by supporting functions for debugging purposes. Please consult with Yaskawa America.

| ErrorID | Meaning |
|-----------------------|---|
| 0 | No error. |
| 4 | The file is already opened. |
| 5 | The file is write protected or access is denied. Tip: Make sure a leading / has not been omitted. Example STRING#'/flash/user/data/myfile.txt' |
| 22 | No data could be read from the file |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4648 | The parameter number does not exist for the specified axis - OR The parameter number requires the other function block (e.g. MC_WriteParameter vs MC_WriteBoolParameter) |
| 8725 | The device option value was not the right size or the data was out of range. |
| 10115 | XML Tag not found. Possibly the file is corrupt or the schema is not compatible with this function block. |
| 10116 | Problem converting string data to the output buffer. |
| 10117 | The controller already has a String Conversion Error at the rising edge of this function. Clear the alarm using Y_ClearAlarms and try again. |
| 10119 | In the Data Structure, rows must be set greater than zero and columns must be set greater than zero. |
| 10120 | File could not be opened. Check for accurate directory path and use of "/" |
| 10122 | Row Error. The data is out of sync with the expected row / column arrangement expected. |
| 10125 | Conversion Error. Check the ErrorRow and ErrorCol / ErrorMessage outputs for details. |
| 10126 | NoDataError - The End Of File was reached, but the record count is zero. Verify the file is not corrupted. |
| 10127 | TooManyRecords - DataType is not large enough. |
| 10128 | MaxNotDefined - The user must set the maximum number of records that can be added to the structure. |
| 10165 | CommandString length is too long or command delimiter not found. |

Related Function Blocks

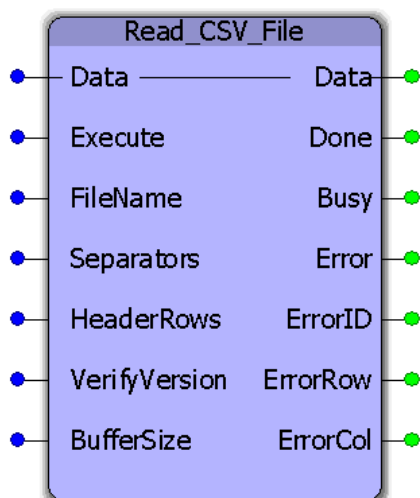
[HC_ReadParameter](#): Reads a Hardware Configuration parameter.

MC_ReadParameter: Reads an axis specific parameter.

Example



Read_CSV_File



This function block will read CSV (ASCII) data from a file on the controllers flash or ram disk. The raw file data will be parsed and copied into a user defined data structure. This function block requires customization to accommodate application specific data requirements. Any variety of rows and columns and datatypes can be specified. Read_CSV_File must be customized to accommodate your data. See the example customization below.

Library

File RW Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|--------------|--|
| VAR_IN_OUT | | | |
| V | Data | MyDataStruct | A user customized data structure containing the definition of the rows and columns of data to be processed. |
| VAR_INPUT | | | Default |
| V | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| V | FileName | STRING | The file to be read. Example STRING#'/-flash/user/data/mydata.csv' |

| | | | | |
|-------------------|---------------|---------------|---|-----------------|
| V | Separators | SeparatorList | Optional. If unconnected, the default separator is a comma (BYTE#44) to detect each value column by column. If a different or multiple characters must be treated as a value separator, populate the SeparatorList with up to four byte values equating to the ASCII value of the separators. | Comma (BYTE#44) |
| V | HeaderRows | UINT | Optional. If connected, the value indicates the number of rows this function block must ignore before starting to look for actual data. | UINT#0 |
| V | VerifyVersion | BOOL | Optional. If TRUE, this function block will expect the first line of the file to contain a version code for identifying the data format of the file, i.e columns, datatypes, etc.. This allows for future changes to the MyDataStruct while retaining the ability to parse older files created before a change was made to the structure of the file. | FALSE |
| V | BufferSize | UDINT | Specifies the number of bytes in the file to process at one time. If unconnected, the default is 2048 bytes. BufferSize can be adjusted up or down if necessary to accommodate various file sizes and will depend upon the CYCLIC task in which the Read_CSV_File function block is executed. | UDINT#2048 |
| VAR_OUTPUT | | | | |
| E | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |
| V | ErrorRow | INT | If Error is true and pertains to a problem with the source data, this value will indicate the location of processing when the error occurred. | |
| E | ErrorCol | INT | If Error is true and pertains to a problem with the source data, this value will indicate the location of processing when the error occurred. | |

Notes

- Don't forget to include the ProConOS firmware library in the project. It is required for this function block.
- The filename must conform to 8.3 format, but is not case sensitive.
- Any separator can be specified provided it is an ASCII byte, and will not be confused with the actual data.
- Header rows are not required to contain the same number of separators as the data content. (Separators are not checked in the header rows.)

Supports Carriage Return and Line Feed as end of line delimiters.

- It takes 6 scans per processing of each BufferSize of data. If a file has 20480 bytes, and the BufferSize is 2048, and the function block is placed in a 100mSec scan, then the total time to process the file will be 60 scans, or 6 seconds. $(20480/2048 * 6 * 100) = 6000 \text{ mSec}$.
- See Yaskawa's Youtube Webinar - [CSV File Transfer with the File_RW Template](#).

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4 | The file is already opened. |
| 5 | The file is write protected or access is denied. Tip: Make sure a leading / has not been omitted. Example STRING#'/flash/user/data/myfile.txt' |
| 6 | File name not defined. |
| 10 | End of data reached. |
| 12 | The number of characters to be written is greater than the data buffer. |
| 13 | Invalid positioning mode or position specified is before the beginning of the file. |
| 20 | File could not be closed. |
| 22 | No data could be read from the file |
| 10117 | The controller already has a String Conversion Error at the rising edge of this function. Clear the alarm using Y_ClearAlarms and try again. |
| 10118 | STRING_TO_BUF Conversion Error. |
| 10119 | In the Data Structure, rows must be set greater than zero and columns must be set greater than zero. |
| 10120 | File could not be opened. Check for accurate directory path and use of "/" |
| 10121 | The CSV file was written in a format unsupported by this function block. |
| 10122 | Row Error. The data is out of sync with the expected row / column arrangement expected. |
| 10123 | Column Start Error. The data is corrupted. |
| 10124 | Unsupported Case condition. |
| 10125 | Conversion Error. Check the ErrorRow and ErrorCol / ErrorString outputs for details. |
| 10126 | NoDataError - The End Of File was reached, but the record count is zero. Verify the file is not corrupted. |
| 10127 | TooManyRecords - DataType is not large enough. |
| 10128 | MaxNotDefined - The user must set the maximum number of records that can be added to the structure. |
| 10129 | No Carriage return found in CSV buffer. The function searched the file for twice the length of the specified buffer and was unable to find a carriage return indicating the end of a row. Either the buffer size is too small, or the data is invalid. |

Example Customization

Read_CSV_File must be customized to accommodate your data. Some supporting functions used by Read_CSV_File (ReadBuffer and ReadValue) do not require customization and can remain in the File_RW_Toolbox. To effectively use this function, follow these steps:

- 1) Copy & paste the MyDataStruct and associated datatypes into your project, and rename them to avoid conflict with MyDataStruct in the File_RW_Template.

```

64  (***** Structure information relating to a CSV file *****)
65      MyData : STRUCT
66          XData : LREAL;
67          YData : LREAL;
68          ZData : LREAL;
69      END_STRUCT;
70
71      MyDataArray : ARRAY [UINT#0..UINT#300] OF MyData;
72
73      MyDataStruct: STRUCT
74          File: MyDataArray;
75          Version:STRING; (* If file versioning is used, apply a unique value to allow the identification of different file formats *)
76          Columns:INT;    (* Configure this value to indicate the number of columns in the data file. *)
77          Records:INT;    (* This value will be updated by the function as the data is processed *)
78          MaxRecords:INT; (* Initialize MaxRecords to the NUMBER OF ELEMENTS defined in the MyDataArray definition above *)
79      END_STRUCT;
80
81  (***** Structure information relating to a CSV file *****)

```

- 2) Modify the "MyData" dataType definition shown above such that it represents the number of columns and the relevant data-types. An example follows:

```

2  (***** Job *****)
3  JobData : STRUCT
4      Move_X      : DINT;
5      Move_Y      : DINT;
6      Outs_01     : DINT;
7      Outs_02     : DINT;
8      Outs_03     : DINT;
9      Vel_X       : BYTE;
10     Acc_X       : BYTE;
11     Vel_Y       : BYTE;
12     Acc_Y       : BYTE;
13     Execute     : INT;
14     Jump        : BYTE;
15     Wait        : INT;
16     Loop        : BYTE;
17     AltX        : BYTE;
18     LinkTo      : INT;
19 END_STRUCT;
20
21 JobArray : ARRAY [UINT#0..UINT#3399] OF JobData;
22
23 JobStruct: STRUCT
24     Job: JobArray;
25     Version:STRING; (* If file versioning is used, apply a unique value to allow the identification of different file formats *)
26     Columns:INT;    (* Configure this value to indicate the number of columns in the data file. *)
27     Records:INT;    (* This value will be updated by the function as the data is processed *)
28     MaxRecords:INT; (* Initialize MaxRecords to the NUMBER OF ELEMENTS defined in the MyDataArray definition above *)
29 END_STRUCT;
30
31 (***** Job *****)

```

The 15 columns of data defined above relate to the data shown in the following Excel file. Notice that the data has three header rows before the actual data begins. In this case, set the HeaderRows function block input correctly at UINT#3, otherwise, the data will not be read properly.

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O |
|----|--------|--------|---------|---------|---------|-------|-------|-------|-------|---------|------|------|------|-------|---------|
| 1 | Move_x | Move_y | Outs_01 | Outs_02 | Outs_03 | Vel_x | Acc_x | Vel_y | Acc_y | Execute | Jump | Wait | Loop | Alt_x | Link_to |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 |
| 3 | 1E+08 | 1E+08 | 2.1E+09 | 2.1E+09 | 2.1E+09 | 100 | 100 | 100 | 100 | 999 | 100 | 9999 | 1 | 1 | 3400 |
| 4 | 1 | 1 | 1 | 0 | 3401 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 5 | 2 | 2 | 2 | 1 | 3400 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 6 | 3 | 3 | 3 | 2 | 3399 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 7 | 4 | 4 | 4 | 3 | 3398 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 8 | 5 | 5 | 5 | 4 | 3397 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 9 | 6 | 6 | 6 | 5 | 3396 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 10 | 7 | 7 | 7 | 6 | 3395 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 11 | 8 | 8 | 8 | 7 | 3394 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 12 | 9 | 9 | 9 | 8 | 3393 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 13 | 10 | 10 | 10 | 9 | 3392 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 14 | 11 | 11 | 11 | 10 | 3391 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 15 | 12 | 12 | 12 | 11 | 3390 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 16 | 13 | 13 | 13 | 12 | 3389 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 17 | 14 | 14 | 14 | 13 | 3388 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 18 | 15 | 15 | 15 | 14 | 3387 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 19 | 16 | 16 | 16 | 15 | 3386 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 20 | 17 | 17 | 17 | 16 | 3385 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 21 | 18 | 18 | 18 | 17 | 3384 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 22 | 19 | 19 | 19 | 18 | 3383 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 23 | 20 | 20 | 20 | 19 | 3382 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 24 | 21 | 21 | 21 | 20 | 3381 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 25 | 22 | 22 | 22 | 21 | 3380 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 26 | 23 | 23 | 23 | 22 | 3379 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 27 | 24 | 24 | 24 | 23 | 3378 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 28 | 25 | 25 | 25 | 24 | 3377 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 29 | 26 | 26 | 26 | 25 | 3376 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 30 | 27 | 27 | 27 | 26 | 3375 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 31 | 28 | 28 | 28 | 27 | 3374 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 32 | 29 | 29 | 29 | 28 | 3373 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 33 | 30 | 30 | 30 | 29 | 3372 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 34 | 31 | 31 | 31 | 30 | 3371 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 35 | 32 | 32 | 32 | 31 | 3370 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 36 | 33 | 33 | 33 | 32 | 3369 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 37 | 34 | 34 | 34 | 33 | 3368 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 38 | 35 | 35 | 35 | 34 | 3367 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |
| 39 | 36 | 36 | 36 | 35 | 3366 | 100 | 100 | 100 | 100 | 1 | 0 | 0 | 0 | 0 | 0 |

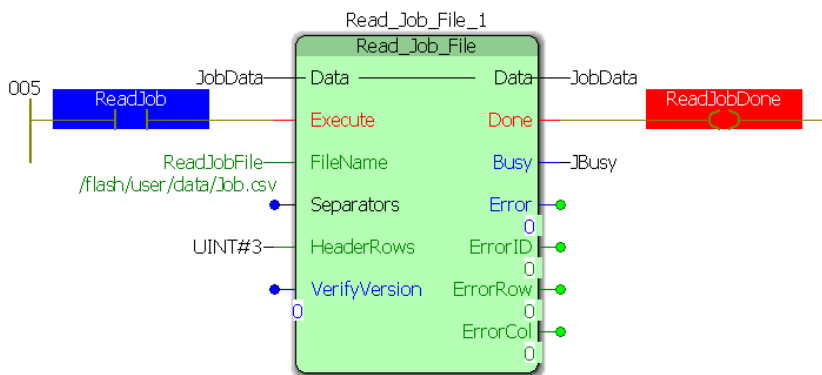
3) Initialize the data required for "MyDataStruct" as shown below. Most importantly, set Columns and MaxRecords.

```

12 ReadJobFile:= '/flash/user/data/job.csv';
13 WriteJobFile:= '/flash/user/data/JobW.csv';
14 JobData.Columns:=INT#15;
15 JobData.MaxRecords:=INT#3400; (* Set to same as DataType Definition *)

```

4) Copy & paste the Read_CSV_File function block into your main project so it can be customized. This will allow you to retain the original function in the template for future reference. Rename the function to avoid name conflict with Read_CSV_File in the Toolbox.



| Watch Window | | | |
|--------------|-------|---------------|-----------|
| Variable | Value | Default value | Type |
| JobData | | | JobStruct |
| Job | | | JobArray |
| [0] | | | StruBlock |
| Move_X | 1 | | DINT |
| Move_Y | 1 | | DINT |
| Outs_01 | 1 | | DINT |
| Outs_02 | 0 | | DINT |
| Outs_03 | 3401 | | DINT |
| Vel_X | 100 | | BYTE |
| Acc_X | 100 | | BYTE |
| Vel_Y | 100 | | BYTE |
| ACC_Y | 100 | | BYTE |
| Execute | 1 | | INT |
| Jump | 0 | | BYTE |
| Wait | 0 | | INT |
| Loop | 0 | | BYTE |
| AIK | 0 | | BYTE |
| LinkTo | 0 | | INT |
| [1] | | | StruBlock |
| Move_X | 2 | | DINT |
| Move_Y | 2 | | DINT |
| Outs_01 | 2 | | DINT |
| Outs_02 | 1 | | DINT |
| Outs_03 | 3400 | | DINT |
| Vel_X | 100 | | BYTE |
| Acc_X | 100 | | BYTE |
| Vel_Y | 100 | | BYTE |
| ACC_Y | 100 | | BYTE |
| Execute | 1 | | INT |
| Jump | 0 | | BYTE |
| Wait | 0 | | INT |
| Loop | 0 | | BYTE |
| AIK | 0 | | BYTE |
| LinkTo | 0 | | INT |
| [2] | | | StruBlock |

Customizing the code in the function block

5) To customize the function block, go to the variables grid and rename the datatype used as the VAR_IN_OUT to the datatype you customized in step 2 above (Use the name as modified from ST code line 23 above).

6) Locate the comments near the middle of the Read_CSV_File function indicating the area to be customized. Modify the lines that convert the STRING data from the file into the MyDataStruct structure.

```

151      (* Data is ignored if HeaderRows are specified until after the specified number of header rows have been read. *)
152      IF ReadColumn.Valid AND HeaderRowsRead THEN
153
154          0: CASE UINT_TO_INT(VersionCode) OF      (* Extract the CSV values from the file as specified by the VersionCode *)
155              (*-----*)
156              CUSTOMIZE THIS TEMPLATE BELOW TO ACCOMODATE YOUR DATA AND TO ADD SUPPORT FOR DIFFERENT FILE OUTPUT VERSIONS      (*-----*)
157              (*-----*)
158              CUSTOMIZE THIS TEMPLATE BELOW TO ACCOMODATE YOUR DATA AND TO ADD SUPPORT FOR DIFFERENT FILE OUTPUT VERSIONS      (*-----*)
159
160              0: (***** Non Versioned file format *****)
161
162              1: CASE ActiveColumn.OF
163                  1:Data.Job[Row].Move_X :=STRING_TO_DINT(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
164                  2:Data.Job[Row].Move_Y:=STRING_TO_DINT(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
165                  3:Data.Job[Row].Outs_01:=STRING_TO_DINT(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
166                  4:Data.Job[Row].Outs_02:=STRING_TO_DINT(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
167                  5:Data.Job[Row].Outs_03:=STRING_TO_DINT(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
168                  6:Data.Job[Row].Vel_X:=STRING_TO_BYTE(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
169                  7:Data.Job[Row].Acc_X:=STRING_TO_BYTE(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
170                  8:Data.Job[Row].Vel_Y:=STRING_TO_BYTE(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
171                  9:Data.Job[Row].Acc_Y:=STRING_TO_BYTE(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
172                  10:Data.Job[Row].Execute:=STRING_TO_INT(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
173                  11:Data.Job[Row].Jump:=STRING_TO_BYTE(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
174                  12:Data.Job[Row].Wait:=STRING_TO_INT(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
175                  13:Data.Job[Row].Loop:=STRING_TO_BYTE(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
176                  14:Data.Job[Row].AltX:=STRING_TO_BYTE(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
177                  15:Data.Job[Row].LinkTo:=STRING_TO_INT(ReadColumn.Value);      (* last one handled below *)
178              END_CASE;
179
180          1822: (*-----*)
181          FALSE (*-----*)
182          (*-----*)
183          2: ELSE
184          FALSE UnsupportedCase:=TRUE;
185          END_CASE;
186
187          IF ReadColumn.EOL THEN      (* The end of a row was detected *)
188              IF ActiveColumn=Data.Columns THEN      (* Set to the number of columns in the data *)
189                  Row:=Row + INT#1;
190                  Data.Records:=Row;
191                  ActiveColumn:=INT#1;
192              ELSE
193                  RowError:=TRUE;
194              END_IF;
195          END_IF;
196
197          Y_ReadAlarm_2(Enable:=TRUE);
198          IF Y_ReadAlarm_2.Valid THEN
199              ConversionError:=(Y_ReadAlarm_2.AlarmID = UDINT#16#340C0134);
200          END_IF;
201          FALSE

```

Customizing for file versioning

The function has the capability to read multiple versions of the same file. For example, assume that initially, the design requires a data file to contain 4 columns of data to be used as INT. Later, after some machines are in the field, a design change requires that the data file must now contain 5 columns of DINT. If a version code is applied as the first row, the function block can determine how to read the file for any number of variations. That may come later. This will allow the use of older data files as well as newer formats.

Original file specification:

```

original.txt - Notepad
File Edit Format View Help
20111118
3,4,7,4
234,456,344,3223
984,435,7346,333
123,4534233,9445

```

Modified file specification:

```

modified.txt - Notepad
File Edit Format View Help
20120105
767653,4786789,742323,4758656,78654
23645304,45456456,34756434,89076456,32923
98641214,4354395,7534111,7300846,3332439
1276543,4534233,9445,789786,90753

```

To use file versioning, follow the steps below:

1. Set the VerifyVersion function block input to TRUE.
2. The first line of the data file must contain a version code. The version code does NOT count as a header row. See the graphics above showing original and modified file specification
3. Customize the DataType to reflect the most current data specification.

Original DataType:

```

66  (***** JobRef *****)
67      PartData : STRUCT
68          Ref12 : INT;
69          Ref34 : INT;
70          Ref56 : INT;
71          Ref78 : INT;
72      END_STRUCT;
73
74      JobRefArray : ARRAY [UINT#0..UINT#401] OF PartData;
75
76      JobRefStruct: STRUCT
77          Ref: JobRefArray;
78          Version:STRING; (* If file versioning is used, apply a unique value to allow the identification of different file formats *)
79          Columns:INT;    (* Configure this value to indicate the number of columns in the data file. *)
80          Records:INT;    (* This value will be updated by the function as the data is processed *)
81          MaxRecords:INT; (* Initialize MaxRecords to the NUMBER OF ELEMENTS defined in the MyDataArray definition above *)
82      END_STRUCT;
83  (***** JobRef *****)

```

Modified DataType:

```

66  (***** JobRef *****)
67      PartData : STRUCT
68          Ref12 : DINT;
69          Ref34 : DINT;
70          Ref56 : DINT;
71          Ref78 : DINT;
72          Ref91 : DINT;
73      END_STRUCT;
74
75      JobRefArray : ARRAY [UINT#0..UINT#401] OF PartData;
76
77      JobRefStruct: STRUCT
78          Ref: JobRefArray;
79          Version:STRING; (* If file versioning is used, apply a unique value to allow the identification of different file formats *)
80          Columns:INT;    (* Configure this value to indicate the number of columns in the data file. *)
81          Records:INT;    (* This value will be updated by the function as the data is processed *)
82          MaxRecords:INT; (* Initialize MaxRecords to the NUMBER OF ELEMENTS defined in the MyDataArray definition above *)
83      END_STRUCT;
84  (***** JobRef *****)

```

- 3) Customize the Read-CSV_File function block to determine if the version code detected is supported.

Original code:

```

107  (***** MODIFY THIS TEMPLATE BELOW TO SUPPORT DIFFERENT FILE OUTPUT VERSIONS *****)
108  (***** MODIFY THIS TEMPLATE BELOW TO SUPPORT DIFFERENT FILE OUTPUT VERSIONS *****)
109  (***** MODIFY THIS TEMPLATE BELOW TO SUPPORT DIFFERENT FILE OUTPUT VERSIONS *****)
110
111      (* Verify that the file version matches one of the formats supported by this function (ADD MORE COMPARISONS AS NEEDED) *)
112      IF EQ_STRING(Data.Version, '20111118') THEN
113          VersionCode:=UINT#1;
114      END_IF;
115
116  (***** MODIFY THIS TEMPLATE ABOVE TO SUPPORT DIFFERENT FILE OUTPUT VERSIONS *****)
117  (***** MODIFY THIS TEMPLATE ABOVE TO SUPPORT DIFFERENT FILE OUTPUT VERSIONS *****)
118  (***** MODIFY THIS TEMPLATE ABOVE TO SUPPORT DIFFERENT FILE OUTPUT VERSIONS *****)

```

Modified code:

```

107  (***** MODIFY THIS TEMPLATE BELOW TO SUPPORT DIFFERENT FILE OUTPUT VERSIONS *****)
108  (***** MODIFY THIS TEMPLATE BELOW TO SUPPORT DIFFERENT FILE OUTPUT VERSIONS *****)
109  (***** MODIFY THIS TEMPLATE BELOW TO SUPPORT DIFFERENT FILE OUTPUT VERSIONS *****)
110
111      (* Verify that the file version matches one of the formats supported by this function (ADD MORE COMPARISONS AS NEEDED) *)
112      IF EQ_STRING(Data.Version, '20111118') THEN
113          VersionCode:=UINT#1;
114      ELSIF EQ_STRING(Data.Version, '20120105') THEN
115          VersionCode:=UINT#2;
116      END_IF;
117
118  (***** MODIFY THIS TEMPLATE ABOVE TO SUPPORT DIFFERENT FILE OUTPUT VERSIONS *****)
119  (***** MODIFY THIS TEMPLATE ABOVE TO SUPPORT DIFFERENT FILE OUTPUT VERSIONS *****)
120  (***** MODIFY THIS TEMPLATE ABOVE TO SUPPORT DIFFERENT FILE OUTPUT VERSIONS *****)

```

- 4) Customize the Read_CSV_File function block to read multiple versions.

Original code:

```

154 CASE UINT_TO_INT(VersionCode) OF      (* Extract the CSV values from the file as specified by the VersionCode *)
155     (*****
156         CUSTOMIZE THIS TEMPLATE BELOW TO ACCOMODATE YOUR DATA AND TO ADD SUPPORT FOR DIFFERENT FILE OUTPUT VERSIONS
157         CUSTOMIZE THIS TEMPLATE BELOW TO ACCOMODATE YOUR DATA AND TO ADD SUPPORT FOR DIFFERENT FILE OUTPUT VERSIONS
158         CUSTOMIZE THIS TEMPLATE BELOW TO ACCOMODATE YOUR DATA AND TO ADD SUPPORT FOR DIFFERENT FILE OUTPUT VERSIONS
159     1: (*****
160         20111118 file format
161         *****
162         CASE UINT_TO_INT(ActiveColumn) OF
163             1:Data.Ref[Row].Ref12:=STRING_TO_INT(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
164             2:Data.Ref[Row].Ref34:=STRING_TO_INT(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
165             3:Data.Ref[Row].Ref56:=STRING_TO_INT(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
166             4:Data.Ref[Row].Ref78:=STRING_TO_INT(ReadColumn.Value);      (* last one handled below *)
167         END_CASE;
168
169         CUSTOMIZE THIS TEMPLATE ABOVE TO ACCOMODATE YOUR DATA AND TO ADD SUPPORT FOR DIFFERENT FILE OUTPUT VERSIONS
170         CUSTOMIZE THIS TEMPLATE ABOVE TO ACCOMODATE YOUR DATA AND TO ADD SUPPORT FOR DIFFERENT FILE OUTPUT VERSIONS
171         CUSTOMIZE THIS TEMPLATE ABOVE TO ACCOMODATE YOUR DATA AND TO ADD SUPPORT FOR DIFFERENT FILE OUTPUT VERSIONS
172     ELSE
173         UnsupportedCase:=TRUE;
174     END_CASE;

```

Modified code:

```

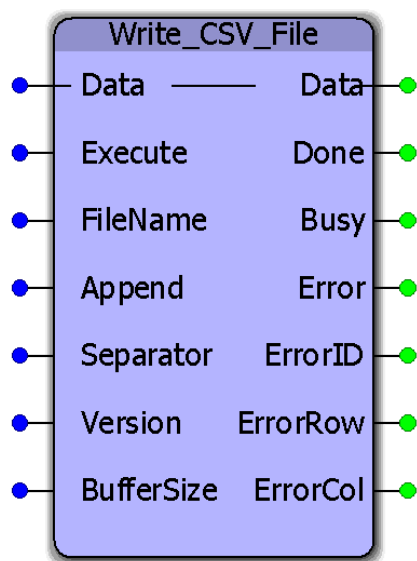
152 CASE UINT_TO_INT(VersionCode) OF      (* Extract the CSV values from the file as specified by the VersionCode *)
153     (*****
154         CUSTOMIZE THIS TEMPLATE BELOW TO ACCOMODATE YOUR DATA AND TO ADD SUPPORT FOR DIFFERENT FILE OUTPUT VERSIONS
155         CUSTOMIZE THIS TEMPLATE BELOW TO ACCOMODATE YOUR DATA AND TO ADD SUPPORT FOR DIFFERENT FILE OUTPUT VERSIONS
156         CUSTOMIZE THIS TEMPLATE BELOW TO ACCOMODATE YOUR DATA AND TO ADD SUPPORT FOR DIFFERENT FILE OUTPUT VERSIONS
157     1: (*****
158         20111118 file format
159         *****
160         CASE UINT_TO_INT(ActiveColumn) OF
161             1:Data.Ref[Row].Ref12:=STRING_TO_DINT(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
162             2:Data.Ref[Row].Ref34:=STRING_TO_DINT(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
163             3:Data.Ref[Row].Ref56:=STRING_TO_DINT(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
164             4:Data.Ref[Row].Ref78:=STRING_TO_DINT(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
165             5:Data.Ref[Row].Ref78:=DINT#0; (* Initialize new data *)      (* last one handled below *)
166         END_CASE;
167     2: (*****
168         20120105 file format
169         *****
170         CASE UINT_TO_INT(ActiveColumn) OF
171             1:Data.Ref[Row].Ref12:=STRING_TO_DINT(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
172             2:Data.Ref[Row].Ref34:=STRING_TO_DINT(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
173             3:Data.Ref[Row].Ref56:=STRING_TO_DINT(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
174             4:Data.Ref[Row].Ref78:=STRING_TO_DINT(ReadColumn.Value);      ActiveColumn:=ActiveColumn + INT#1;
175             5:Data.Ref[Row].Ref78:=STRING_TO_DINT(ReadColumn.Value);      (* last one handled below *)
176         END_CASE;
177
178         CUSTOMIZE THIS TEMPLATE ABOVE TO ACCOMODATE YOUR DATA AND TO ADD SUPPORT FOR DIFFERENT FILE OUTPUT VERSIONS
179         CUSTOMIZE THIS TEMPLATE ABOVE TO ACCOMODATE YOUR DATA AND TO ADD SUPPORT FOR DIFFERENT FILE OUTPUT VERSIONS
180         CUSTOMIZE THIS TEMPLATE ABOVE TO ACCOMODATE YOUR DATA AND TO ADD SUPPORT FOR DIFFERENT FILE OUTPUT VERSIONS
181     ELSE
182         UnsupportedCase:=TRUE;
183     END_CASE;

```

NOTE: The capability of the function block to read multiple file versions is limited by the changes that can be made to the DataType Definition. It is not practical to use the version code to read completely different data formats. Make two copies of the Read_CSV_File and customize accordingly.



Write_CSV_File



This function block will format and write a CSV (ASCII) file to the controllers flash or ram disk. The original data is a user specified structure. This function block requires customization to accommodate application specific data requirements. Any variety of rows and columns and datatypes can be customized. See the example customization below.

Library

File RW Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|--------------|--|
| VAR_IN_OUT | | | |
| B | Data | MyDataStruct | A user customized data structure containing the information (possibly still in binary format) to be written to a CSV file. |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, this function block will prepare to engage the RampIn cam profile at the master position specified in the BlendData structure. |
| V | FileName | STRING | The file to be written. Example: STRING#'ram-disk/user/data/mydata.csv' |

| | | | | |
|-------------------|------------|-------|---|---------|
| V | Append | BOOL | This flag indicates whether to delete an existing file and create new data, or add to an existing file. If Append=TRUE, data will be appended. Data.MaxRecords must be set by the user to indicate the number of rows in MyDataStruct to append. | FALSE |
| V | Separator | BYTE | The byte value of the ASCII character to be used for separating values of data on a line. If unconnected, the comma (BYTE#44) will be used. | BYTE#44 |
| V | Version | UDINT | Optional. If used, this function block has the ability to be customized to select between multiple output formats. | UDINT#0 |
| V | BufferSize | UDINT | Specifies the number of bytes in the file to process at one time. If unconnected, the default is 2048 bytes. BufferSize can be adjusted up or down if necessary to accommodate various file sizes and will depend upon the CYCLIC task in which the Read_CSV_File function block is executed. | UDINT#0 |
| VAR_OUTPUT | | | | |
| B | Done | BOOL | Set high when the axis or group is synchronized with the axis or group it is commanded to follow. Synchronized means that the two are position locked, any transitional period required to achieve synchronization has been completed. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |
| V | ErrorRow | INT | If Error is true and pertains to a problem with the source data, this value will indicate the location of processing when the error occurred. | |
| V | ErrorCol | INT | If Error is true and pertains to a problem with the source data, this value will indicate the location of processing when the error occurred. | |

Notes

- Do not reference this function block from your project. Follow the customization examples below to make a renamed copy of it and add it to your project.
- Don't forget to include the ProConOS firmware library in the project. It is required for this function block.
- It is strongly recommended to write files only to the Ramdisk portion of memory, not flash. Ramdisk is a temporary storage location, so the file should be read by another device using an HTTP file get command.
- See Yaskawa's Youtube Webinar - [CSV File Transfer with the File_RW Template](#).

Error Description

| ErrorID | Meaning |
|--------------------|--|
| 0 | No error. |
| 4 | File is already open. |
| 5 | File is opened, write protected or access denied. |
| 6 | File name not defined. |
| 10 | End of data reached. |
| 12 | The number of characters to be read is greater than the data buffer. |

| | |
|-----------------------|--|
| 13 | Invalid positioning mode or position specified is before the beginning of the file. |
| 20 | File could not be closed. |
| 22 | No data could be read. |
| 24 | Position could not be set. |
| 10117 | The controller already has a String Conversion Error at the rising edge of this function. Clear the alarm using Y_ClearAlarms and try again. |
| 10119 | In the Data Structure, rows must be set greater than zero and columns must be set greater than zero. |
| 10120 | File could not be opened. Check for accurate directory path and use of "/" |
| 10121 | The CSV file was written in a format unsupported by this function block. |
| 10122 | Row Error. The data is out of sync with the expected row / column arrangement expected. |
| 10125 | Conversion Error. Check the ErrorRow and ErrorCol / ErrorString outputs for details. |
| 10126 | NoDataError - The End Of File was reached, but the record count is zero. Verify the file is not corrupted. |

Customization Example 1

Write_CSV_File must be customized to accommodate your data. Some supporting functions used by Write_CSV_File (ReadBuffer and ReadValue) do not require customization and can remain in the File_RW_Toolbox. Two locations requiring customization are identified in the function block by several rows of comments indicating the need to customize. To effectively use this function, follow these steps:

1) Copy & paste the MyDataStruct and associated datatypes into your project, and rename them to avoid conflict with MyDataStruct in the File_RW_Template.

```

64  (***** Structure information relating to a CSV file *****)
65  MyData : STRUCT
66      XData : LREAL;
67      YData : LREAL;
68      ZData : LREAL;
69  END_STRUCT;
70
71  MyDataArray : ARRAY [UINT#0..UINT#300] OF MyData;
72
73  MyDataStruct: STRUCT
74      File: MyDataArray;
75      Version:STRING; (* If file versioning is used, apply a unique value to allow the identification of different file formats *)
76      Columns:INT;    (* Configure this value to indicate the number of columns in the data file. *)
77      Records:INT;    (* This value will be updated by the function as the data is processed *)
78      MaxRecords:INT; (* Initialize MaxRecords to the NUMBER OF ELEMENTS defined in the MyDataArray definition above *)
79  END_STRUCT;
80
81  (***** Structure information relating to a CSV file *****)

```

2) Modify the "MyData" dataType definition shown above such that it represents the data to be written. An example follows which shows a customized datatype:

```

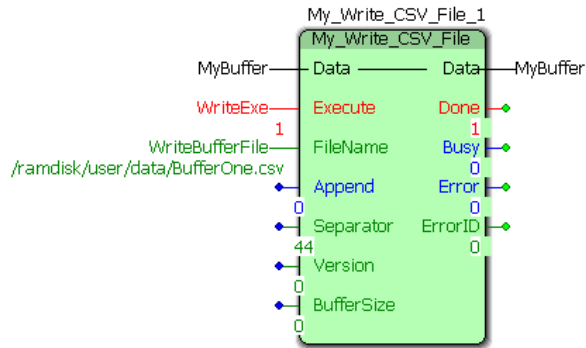
2  (***** Job *****)
3  JobData : STRUCT
4      Move_X : DINT;
5      Move_Y : DINT;
6      Outs_01 : DINT;
7      Outs_02 : DINT;
8      Outs_03 : DINT;
9      Vel_X : BYTE;
10     Acc_X : BYTE;
11     Vel_Y : BYTE;
12     Acc_Y : BYTE;
13     Execute : INT;
14     Jump : BYTE;
15     Wait : INT;
16     Loop : BYTE;
17     AltX : BYTE;
18     LinkTo : INT;
19  END_STRUCT;
20
21  JobArray : ARRAY [UINT#0..UINT#3399] OF JobData;
22
23  JobStruct: STRUCT
24      Job: JobArray;
25      Version:STRING; (* If file versioning is used, apply a unique value to allow the identification of different file formats *)
26      Columns:INT;    (* Configure this value to indicate the number of columns in the data file. *)
27      Records:INT;    (* This value will be updated by the function as the data is processed *)
28      MaxRecords:INT; (* Initialize MaxRecords to the NUMBER OF ELEMENTS defined in the MyDataArray definition above *)
29  END_STRUCT;
30
31  (***** Job *****)

```

3) Initialize the data required for "MyDataStruct" as shown below. Most importantly, set Columns and MaxRecords. MaxRecords indicates how many lines of data are to be written to the file. In the case of Append mode = TRUE, set MaxRecords to the number of lines from the MyDataStruct to be appended. Appending always starts from the first line (array element 0) of the structure and adds data to the end of the file. It is not necessary to initialize (clear) the other data elements beyond MaxRecords that may be from a previous use.

```
12 ReadJobFile:='/flash/user/data/job.csv';
13 WriteJobFile:='/flash/user/data/JobW.csv';
14 JobData.Columns:=INT#15;
15 JobData.MaxRecords:=INT#3400; (* Set to same as DataType Definition *)
```

4) Copy & paste the Write_CSV_File function block into your main project so it can be customized. This will allow you to retain the original function in the template for future reference. Rename the function to avoid name conflict with Write_CSV_File in the Toolbox. To copy & paste the function block, open a second copy of MotionWorks IEC, and open the File_Read_Write toolbox as a project. From the second MotionWorks IEC, copy & paste the function block into your project.



Customizing the code in the function block

5) To customize the function block, go to the variables grid and rename the datatype used as the VAR_IN_OUT to the datatype you customized in step 2 above (Use the name as modified from ST code line 23 above).

6) Locate the comments near the middle of the Write_CSV_File function indicating the area to be customized. Modify the lines that convert binary data from the MyDataStruct structure to STRING data for the file.

Customizing for file versioning

The function has the capability to write multiple versions of the same structure. For example, a portion of the data from the structure can be written to one file, and a different set of data can be written to another file.

To use file versioning, follow the steps below:

- 1) Set the 'Version' function block input to a unique value (Non zero).
- 2) Customize the DataType to reflect the most current data specification.

Original DataType:

```
66 (***** JobRef *****)
67 PartData : STRUCT
68   Ref12 : INT;
69   Ref34 : INT;
70   Ref56 : INT;
71   Ref78 : INT;
72 END_STRUCT;
73
74 JobRefArray : ARRAY [UINT#0..UINT#401] OF PartData;
75
76 JobRefStruct: STRUCT
77   Ref: JobRefArray;
78   Version:STRING; (* If file versioning is used, apply a unique value to allow the identification of different file formats *)
79   Columns:INT;    (* Configure this value to indicate the number of columns in the data file. *)
80   Records:INT;    (* This value will be updated by the function as the data is processed *)
81   MaxRecords:INT; (* Initialize MaxRecords to the NUMBER OF ELEMENTS defined in the MyDataArray definition above *)
82 END_STRUCT;
83 (***** JobRef *****)
```

Modified DataType:


```

66  (***** JobRef *****)
67      PartData : STRUCT
68          Ref12 : DINT;
69          Ref34 : DINT;
70          Ref56 : DINT;
71          Ref78 : DINT;
72          Ref91 : DINT;
73      END_STRUCT;
74
75      JobRefArray : ARRAY [UINT#0..UINT#401] OF PartData;
76
77      JobRefStruct: STRUCT
78          Ref: JobRefArray;
79          Version:STRING;    (* If file versioning is used, apply a unique value to allow the identification of different file formats *)
80          Columns:INT;       (* Configure this value to indicate the number of columns in the data file. *)
81          Records:INT;       (* This value will be updated by the function as the data is processed *)
82          MaxRecords:INT;    (* Initialize MaxRecords to the NUMBER OF ELEMENTS defined in the MyDataArray definition above *)
83      END_STRUCT;
84  (***** JobRef *****)

```

3) Customize the Write_CSV_File function block to determine if a specific version if the file should be written.

Original code:

Modified code:

4) Customize the Write_CSV_File function block to write multiple versions.

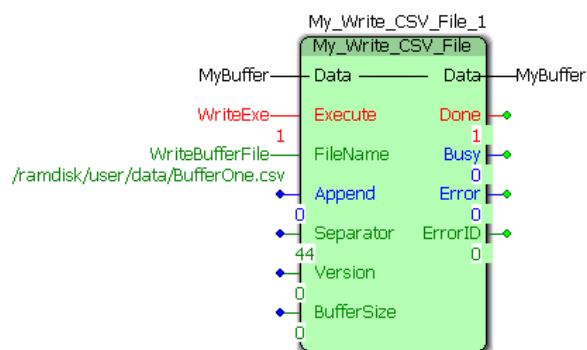
Original code:

Modified code:

Application Example

Set MyBuffer.MaxRecords to the number of items to be written to the file.

| Variable | Value | Default value |
|-------------|-----------------|---------------|
| MyBuffer | | |
| Buff | | |
| [0] | | |
| Sensor1Data | 8098925.4772730 | |
| Sensor2Data | 8098927.3813410 | |
| [1] | | |
| Sensor1Data | 8098929.3104715 | |
| Sensor2Data | 8098931.2347956 | |
| [2] | | |
| Sensor1Data | 8098933.0863352 | |
| Sensor2Data | 8098934.8403711 | |
| [3] | | |
| Sensor1Data | 8098936.5405054 | |
| Sensor2Data | 8098938.2251902 | |
| [4] | | |
| [5] | | |
| [6] | | |
| [7] | | |
| [8] | | |
| [9] | | |
| Sensor1Data | 8098958.1382532 | |
| Sensor2Data | 8098959.8236246 | |
| [10] | | |
| Sensor1Data | 0.0000000 | |
| Sensor2Data | 0.0000000 | |



Gantry Toolbox

Toolbox Help Documentation

Help version created 1/31/2018

YASKAWA



Getting Started with Gantry Toolbox

NOTE: Gantry Toolbox is obsolete now that PLCopen Part 4 functions for interpolation and the Group Toolbox is available.

An MP3000iec series controller is required for these newer features. Documentation for the Gantry Toolbox is still provided for reference.

Requirements for v301

To use the Gantry Toolbox, your project must also contain the following:

Firmware libraries:

- YMotion

User libraries:

The following User Libraries must be listed above the Gantry Toolbox and in the following order:

- DataTypes_Toolbox (v300 or higher)
- Math_Toolbox (v300 or higher)
- PLCopen_Toolbox (v300 or higher)

Using the Gantry Toolbox

See Yaskawa's Youtube Webinar - [XY Interpolation via the Gantry Toolbox](#) for more info.



Gantry Toolbox Revision History

New in v203 – All firmware library DataType definitions were moved to a new toolbox called the DataTypes Toolbox. Formerly, the PLCOpen Toolbox contained the MotionInfoTypes and the PLCTaskInfoTypes datatype files. These were removed and are now included in the DataTypes Toolbox. If upgrading from an older version of Gantry Toolbox, you must do the following:

- 1) Include the DataTypes Toolbox in your project.
- 2) Remove any other Yaskawa supplied datatype files with firmware library definitions such as
 - a. ControllInfoTypes
 - b. YDeviceCommTypes

Current Version:

(***** 2016-11-16 v301 released *****)

- 1) PathGenerator - DCR 862, fixed circle segments when gantry has Z axis. No master cam position was being set for Z.

Previous Versions:

(***** 2015-01-31 v300 released *****)

- 1) Identical to v204, but recompiled specifically for MotionWorks IEC v3.x.

(***** 2015-01-07 v204 released *****)

- 1) Added Z axis to Gantry Struct for G-Code experimentation.
- 2) Move_Path - improved ability to change speed on the fly, including zero velocity (Pause.)
- 3) Gantry_Power - Added missing line to clear ErrorID when Execute goes low.
- 4) Math Toolbox - Removed references to the toolbox where possible. Calculate_Angles still requires ATAN2 function.
- 5) Gantry_Stop - Fixed typos pertaining to setting the ErrorID for many internal errors.

(***** 2013-03-15 v203 released *****)

Created from Gantry_Toolbox_v203_d_KH

- 1) GantryDataTypes file - Added Tangent Axis to Gantry Struct. This axis will be tangential to X, Y axes.
- 2) GantryDataTypes file - Added InputConditions and StandStillDuration to Path details structure. These will be used for pause sections in the path.

- 3) GantryDataTypes file - Made PathPointArray size 1000.
- 4) GantryDataTypes file - Added StandStill and WaitForInputs enum types to TB_PatternType.
- 5) GantryDataTypes file - Added TangentAxisTable to PathIDStruct.
- 6) GantryDataTypes file - Added InputConditions and StandStillDuration to SegmentDetails.
- 7) GantryDataTypes file - Made SegmentArray size 1000.
- 8) GantryDataTypes file - Created SegmentMapArray to map between managed segments and user defined segments
- 9) GantryDataTypes file - Added ManagedSegment, LastManagedSegment, AbortPath and SegmentMap to Segmentstruct
- 10) GantryDataTypes file - Added TangentActive to PathDetails. Used to decide if a segment requires a tangent axis to be oriented correctly at the beginning and/or end.
- 11) GantryDataTypes file - PathPointArray increased to 2047.
- 12) Gantry_Power - Removed Alarm and Warning outputs.
- 13) Gantry_Power - Added support for a Tangent axis.
- 14) Gantry_Power - Added status word output. This word shows which axes are powered on.
- 15) Gantry_Stop - Added support to stop all configured Gantry Axes
- 16) PathGenerator - Added support for a tangent axis
- 17) PathGenerator - Added support for intermittent motion and pauses
- 18) Move_Path - Added ability to move and pause virtual master based on the segment details
- 19) Move_Path - Added InputConditions as a FB input for user inputs to restart motion at WaitForInputs segment
- 20) PathIDManager - Function block added. Removes paths from memory that are no longer needed.

Gantry DataTypes

Toolbox Help Documentation

Help version created 1/31/2018

YASKAWA



Data Type: GantryPositions

This datatype can be used to store absolute positions within the coordinate system. It is not used directly with any function block in the Gantry toolbox, however data from this structure can be moved into the [GantryStruct](#) prior to executing a motion function.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-------------------|-----------------|---|------------------------|
| | MyGantryPositions | GantryPositions | Three dimensional locations for positioning a gantry system | |
| U | X | XPos | Array for grid coordinate positions. | MyGantryPositions.X[0] |
| U | Y | YPos | Array for grid coordinate positions. | MyGantryPositions.Y[0] |
| U | Z | ZPos | Array for grid coordinate positions. | MyGantryPositions.Z[0] |
| U | W | WPos | Array for grid coordinate positions. | MyGantryPositions.W[0] |



Data Type: GantryStruct

This datatype contains all information pertaining to a gantry system.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-----------------------|----------------------------|--|------------------------------|
| | MyGantryStruct | GantryStruct | | |
| U | ID | INT | Can be used to uniquely identify more than one gantry in a system. | MyGantryStruct.ID |
| U | Virtual | AxisStruct | All data pertaining to the Virtual axis. | MyGantryStruct.Virtual |
| U | X | AxisStruct | All data pertaining to the X axis. | MyGantryStruct.X |
| U | Y | AxisStruct | All data pertaining to the Y axis. | MyGantryStruct.Y |
| U | Z | AxisStruct | All data pertaining to the Z axis. | MyGantryStruct.Z |
| U | W | AxisStruct | All data pertaining to the W axis. | MyGantryStruct.W |
| U | XPrime | AxisStruct | All data pertaining to the XPrime axis. | MyGantryStruct.XPrime |
| U | YPrime | AxisStruct | All data pertaining to the YPrime axis. | MyGantryStruct.YPrime |
| U | ZPrime | AxisStruct | All data pertaining to the ZPrime axis. | MyGantryStruct.ZPrime |
| U | Opened | BOOL | Gripper status. | MyGantryStruct.Opened |
| U | Closed | BOOL | Gripper status. | MyGantryStruct.Closed |
| U | OpenCommand | BOOL | Gripper open request. | MyGantryStruct.OpenCommand |
| U | CloseCommand | BOOL | Gripper close request. | MyGantryStruct.CloseCommand |
| U | GripperValue | INT | Constant that equates to the gripper. | MyGantryStruct.GripperValue |
| U | Pick | INT | Commanded picking location row or column to be used as array index to actual position. | MyGantryStruct.Pick |
| U | Place | INT | Commanded placing location row or column to be used as array index to actual position. | MyGantryStruct.Place |
| U | Up | LREAL | mm Position of the vertical axis when "UP." Alternate usage: ZPosition. | MyGantryStruct.Up |
| U | Down | LREAL | mm Position of the vertical axis when "Down." Alternate usage: ZPosition. | MyGantryStruct.Down |
| U | Velocity | LREAL | Velocity of the gantry workpiece. | MyGantryStruct.Velocity |
| U | Accel | LREAL | Acceleration of the gantry workpiece. | MyGantryStruct.Accel |
| U | Decel | LREAL | Deceleration of the gantry workpiece. | MyGantryStruct.Decel |
| U | ZVelocityUp | LREAL | Velocity of the vertical axis. | MyGantryStruct.ZVelocityUp |
| U | ZVelocityDown | LREAL | Velocity of the vertical axis. | MyGantryStruct.ZVelocityDown |
| U | ZAccel | LREAL | Acceleration of the vertical axis. | MyGantryStruct.ZAccel |
| U | ZDecel | LREAL | Deceleration of the vertical axis. | MyGantryStruct.ZDecel |



Data Type: PathDetails

For use with the [PathGenerator](#) Function Block

Data Type Declaration

PathDetails:STRUCT

SegmentType:INT; (* Indicates linear or arc, see TB_PatternType *)
XCoord:LREAL; (* If Linear segment, the absolute coordinate of the X axis relative to the start of the path. *)
YCoord:LREAL; (* If Linear segment, the absolute coordinate of the Y axis relative to the start of the path. *)
Radius:LREAL; (* If Arc segment, the radius of the arc in XY user units. *)
StartAngle:LREAL; (* If Arc segment, the starting angle on a unit circle, 0 degree = 3 O'Clock position *)
TraversedAngle:LREAL; (* If Arc segment, the traversed angle, where CW = negative, CCW = positive *)
Resolution:REAL;
OutputFlags:DWORD; (* Indicator that can be used to control outputs along the path motion *)
VectorPosition:LREAL; (* Calculated relative travel of the tool point for the current segment *)
END_STRUCT;



Data Type: PathIDStruct

This datatype contains all information pertaining to a gantry system.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|----------------|--------------|---|---------------------------|
| | MyPathIDStruct | PathIDStruct | | |
| U | XAxisTable | UINT | The CamTableID for the X axis | MyPathIDStruct.XAxisTable |
| U | YAxisTable | UINT | The CamTableID for the Y axis | MyPathIDStruct.YAxisTable |
| U | PathLength | LREAL | The total length of the path motion of the toolpoint, the distance the virtual master will travel to complete the path. | MyPathIDStruct.PathLength |



Data Type: PathPairs

For use with the [PathGenerator](#) Function Block .

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-------------|-----------|---|----------------|
| | MyPathPairs | PathPairs | | |
| U | PathPairs | UDINT | For use internally by the PathGenerator FB. | MyPathPairs[0] |



Data Type: PathPointArray

For use with the [PathGenerator](#) Function Block.

Data Type Declaration

PathPointArray: ARRAY[0..100] OF PathDetails;



Data Type: PathStruct

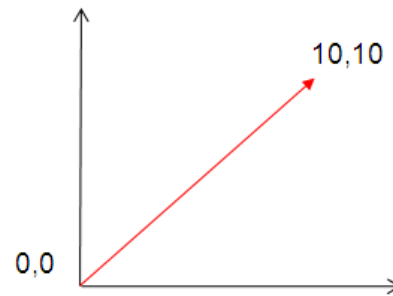
For use with the [PathGenerator](#) Function Block.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|---------------------|-----------------------|--|-------------------------------------|
| | MyPathStruct | PathStruct | | |
| | Data | PathPointArray | Data structure used with the PathGenerator function block. | |
| U | SegmentType | INT | See TB_PatternType . | MyPathStruct.Data[0].SegmentType |
| U | XCoord | LREAL | If Linear segment, the absolute coordinate of the X axis relative to the start of the path. | MyPathStruct.Data[0].XCoord |
| U | YCoord | LREAL | If Linear segment, the absolute coordinate of the Y axis relative to the start of the path. | MyPathStruct.Data[0].YCoord |
| U | ZCoord | LREAL | If Linear segment, the absolute coordinate of the Z axis relative to the start of the path. | MyPathStruct.Data[0].ZCoord |
| U | Radius | LREAL | If Arc segment, the radius of the arc in XY user units. | MyPathStruct.Data[0].Radius |
| U | StartAngle | LREAL | If Arc segment, the starting angle on a unit circle, 0 degree = 3 O'Clock position. | MyPathStruct.Data[0].StartAngle |
| U | TraversedAngle | LREAL | If Arc segment, the traversed angle, where CW = negative, CCW = positive. | MyPathStruct.Data[0].TraversedAngle |
| U | Resolution | REAL | This value determines the number of interpolated points that will be calculated along the segment. Resolution is in the same units as the X and Y axes which perform arc motion. | MyPathStruct.Data[0].Resolution |
| U | OutputFlags | DWORD | Controls outputs along the path. | MyPathStruct.Data[0].OutputFlags |
| U | VectorPosition | LREAL | Calculated travel of the tool point for the Path relative to the start of all segments. | MyPathStruct.Data[0].VectorPosition |
| U | Segments | INT | Total datapoints specified in the path. If you need more than defined in the PathPointArray, just increase. | MyPathStruct.Segments |

PathStruct Example 1

Straight Line Path Example



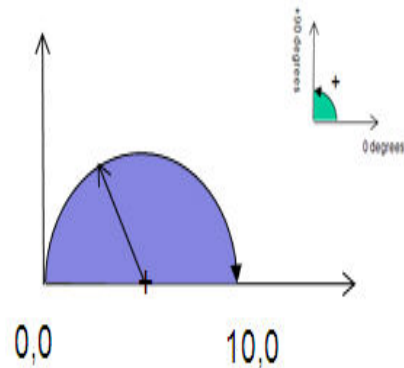
```
VectorPath.Data[1].SegmentType:=TB_PatternType#Straightline;  
VectorPath.Data[1].XCoord:=LREAL#10.0;  
VectorPath.Data[1].YCoord:=LREAL#10.0;
```

```
PathDetail:STRUCT  
  SegmentType:INT;  
  XCoord:LREAL;  
  YCoord:LREAL;  
  Radius:LREAL;  
  StartAngle:LREAL;  
  TraversedAngle:LREAL;  
  Resolution:REAL;  
  OutputFlags:DWORD;  
  MasterEnd:LREAL;  
END_STRUCT;  
  
PathPointArray: ARRAY[0..100] OF PathDetail;  
  
PathStruct: STRUCT  
  Data:PathPointArray;  
  Segments:INT;  
END_STRUCT;  
  
(* ENUM Type for PathDetail's SegmentType *)  
TB_PatternType:  
(  
  na,  
  StraightLine,  
  Arc
```

Gantry Datatypes

PathStruct Example 2

Arc Path Example



```

VectorPath.Data[2].SegmentType:=TB_PatternType#Arc;
VectorPath.Data[2].Radius:=LREAL#5.0;
VectorPath.Data[2].StartAngle:=LREAL#180.0;
VectorPath.Data[2].TraversedAngle:=LREAL#-180.0;
VectorPath.Data[2].Resolution:=REAL#0.05;
VectorPath.Data[2].OutputFlags:=DWORD#2;

PathDetail:STRUCT
  SegmentType:INT;
  XCoord:LREAL;
  YCoord:LREAL;
  Radius:LREAL;
  StartAngle:LREAL;
  TraversedAngle:LREAL;
  Resolution:REAL;
  OutputFlags:DWORD;
  MasterEnd:LREAL;
END_STRUCT;

PathPointArray: ARRAY[0..100] OF PathDetail;

PathStruct: STRUCT
  Data:PathPointArray;
  Segments:INT;
END_STRUCT;

(* ENUM Type for PathDetail's SegmentType *)
TB_PatternType:
(
  na,
  StraightLine,
  Arc

```

PathStruct Example 3

Complex Path Example

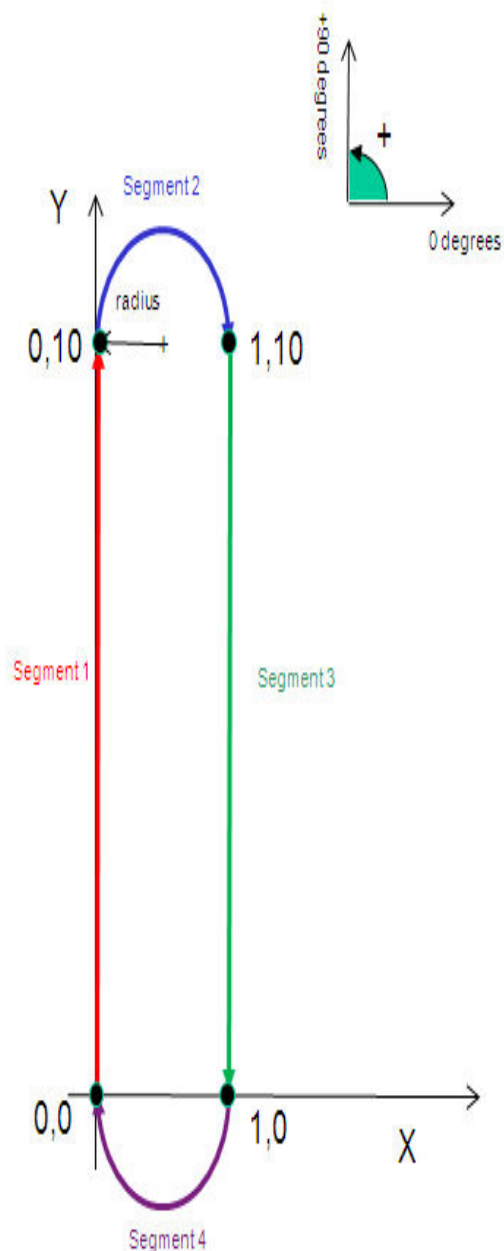
```
VectorPath.Data[1].SegmentType:=TB_PatternType#Straightline;  
VectorPath.Data[1].XCoord:=LREAL#0.0;  
VectorPath.Data[1].YCoord:=LREAL#10.0;  
VectorPath.Data[1].OutputFlags:=DWORD#1;
```

```
VectorPath.Data[2].SegmentType:=TB_PatternType#Arc;  
VectorPath.Data[2].Radius:=LREAL#0.5;  
VectorPath.Data[2].StartAngle:=LREAL#180.0;  
VectorPath.Data[2].TraversedAngle:=LREAL#-180.0;  
VectorPath.Data[2].Resolution:=REAL#0.05;
```

```
VectorPath.Data[3].SegmentType:=TB_PatternType#Straightline;  
VectorPath.Data[3].XCoord:=LREAL#1.0;  
VectorPath.Data[3].YCoord:=LREAL#0.0;  
VectorPath.Data[3].OutputFlags:=DWORD#2;
```

```
VectorPath.Data[4].SegmentType:=TB_PatternType#Arc;  
VectorPath.Data[4].Radius:=LREAL#0.5;  
VectorPath.Data[4].StartAngle:=LREAL#0.0;  
VectorPath.Data[4].TraversedAngle:=LREAL#-180.0;  
VectorPath.Data[4].Resolution:=REAL#0.05;
```

```
VectorPath.Segments:=INT#4;
```





Data Type: SegmentArray

For use with the [PathGenerator](#) and [MovePath](#) function blocks.

Data Type Declaration

TYPE

```
SegmentArray: ARRAY[0..200] OF SegmentDetails;
```

END_TYPE



Data Type: SegmentDetails

For use with the [PathGenerator](#) and [MovePath](#) function blocks.

Data Type Declaration

TYPE

SegmentDetails: STRUCT

Segment: INT;

(* Current segment number being processed *)

OutputFlags: DWORD;

(* The output flags DWORD corresponding to the segment *)

VectorDistance: LREAL;

(* Master end point for the segment, the path travelled
up to the end of this segment *)

END_STRUCT;

END_TYPE



Data Type: SegmentStruct

For use with the [PathGenerator](#) and [MovePath](#) function blocks.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|------------------------|----------------------|---|---|
| | MySegmentStruct | SegmentStruct | | |
| | Segment | SegmentArray | For use with the PathGenerator and MovePath function blocks. | |
| U | Segment | INT | Current segment number being processed. | MySegmentStruct.Segment[0].Segment |
| U | OutputFlags | DWORD | The output flags DWORD corresponding to the segment. | MySegmentStruct.Segment[0].OutputFlags |
| U | VectorDistance | LREAL | Master end point for the segment, the path traveled up to the end of this segment. | MySegmentStruct.Segment[0].VectorDistance |
| U | LastSegment | INT | | MySegmentStruct.LastSegment |



Data Type: WPos

Supporting structure for [GantryPositions](#).

Data Type Declaration

TYPE

WPos: ARRAY [0..11] OF LREAL; (* Array for grid coordinate positions *)

END_TYPE



Data Type: XPos

Supporting structure for [GantryPositions](#).

Data Type Declaration

TYPE

XPos: ARRAY [0..11] OF LREAL; (* Array for grid coordinate positions *)

END_TYPE



Data Type: YPos

Supporting structure for [GantryPositions](#).

Data Type Declaration

TYPE

YPos: ARRAY [0..11] OF LREAL; (* Array for grid coordinate positions *)

END_TYPE



Data Type: ZPos

Supporting structure for [GantryPositions](#).

Data Type Declaration

TYPE

ZPos: ARRAY [0..11] OF LREAL; (* Array for grid coordinate positions *)

END_TYPE



Enumerated Types for Gantry Toolbox

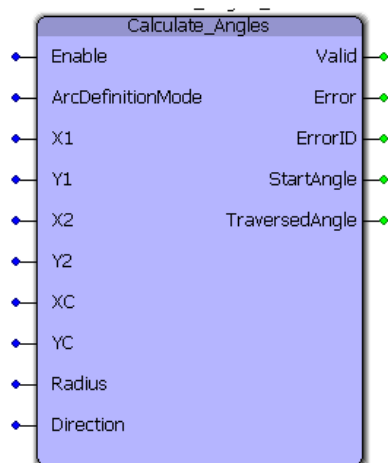
Some blocks accept an enumerated type (ENUM), which is a keyword (or constant) representing a value which will configure the operation of the function block. Enumerated types are equivalent to zero-based integers (INT). Therefore, the first value equates to zero, the second to 1, etc. The format for enumerated types is as follows: ENUM:(0, 1, 2...) as displayed in the example below (MC_BufferMode#Aborting).

Enumerated Types Declaration

| Enumerated Type | #INT Value | Enum Value | Description |
|-----------------|---|---------------|---|
| TB_PatternType | ENUM Type for PathDetails ' SegmentType | | |
| | 0 | n/a | Not a valid PatternType |
| | 1 | StraightLine | Straight line motion between two world coordinate locations. |
| | 2 | Arc | Circle or portion of a circular path in the XY plane. |
| | 3 | StandStill | For pause between segments. |
| | 4 | WaitForInputs | Path processing will wait until the specified input conditions are met. |
| | 5 | SetTangent | Move a tangent axis to remain tangent to the XY vector path. |



Calculate_Angles



This function block uses either a) two co-ordinates and center point of an arc or b) two co-ordinates and radius of an arc to calculate start and traversed angles required for [PathStruct](#) data type in the [PathGenerator](#) function block

Library

Gantry Toolbox

Parameters

| * | Parameter | Data Type | Description | |
|-----------|-------------------|-----------|--|-----------|
| VAR_INPUT | | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. | FALSE |
| B | ArcDefinitionMode | INT | Data entry mode the user wants to use. 0: Two coordinates + Center coordinate of arc, 1: Two coordinates + radius of arc | INT#0 |
| B | X1 | LREAL | X coordinate of the first coordinate. | LREAL#0.0 |
| B | Y1 | LREAL | Y coordinate of the first coordinate. | LREAL#0.0 |
| B | X2 | LREAL | X coordinate of the second coordinate. | LREAL#0.0 |
| B | Y2 | LREAL | Y coordinate of the second coordinate. | LREAL#0.0 |
| B | XC | LREAL | X coordinate of the center coordinate. | LREAL#0.0 |

| | | | | |
|-------------------|----------------|--------------|---|------------------------|
| B | YC | LREAL | Y coordinate of the center coordinate. | LREAL#0.0 |
| B | Radius | LREAL | Radius of arc | LREAL#0.0 |
| B | Direction | MC_Direction | 0: clockwise, 1: counter clockwise | MC_Direction#Clockwise |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |
| B | StartAngle | LREAL | Angle subtended by a line drawn from the arc center to the start point of the arc with the positive X axis on an XY plane | |
| B | TraversedAngle | LREAL | Angle traversed by the arc generated | |

Notes

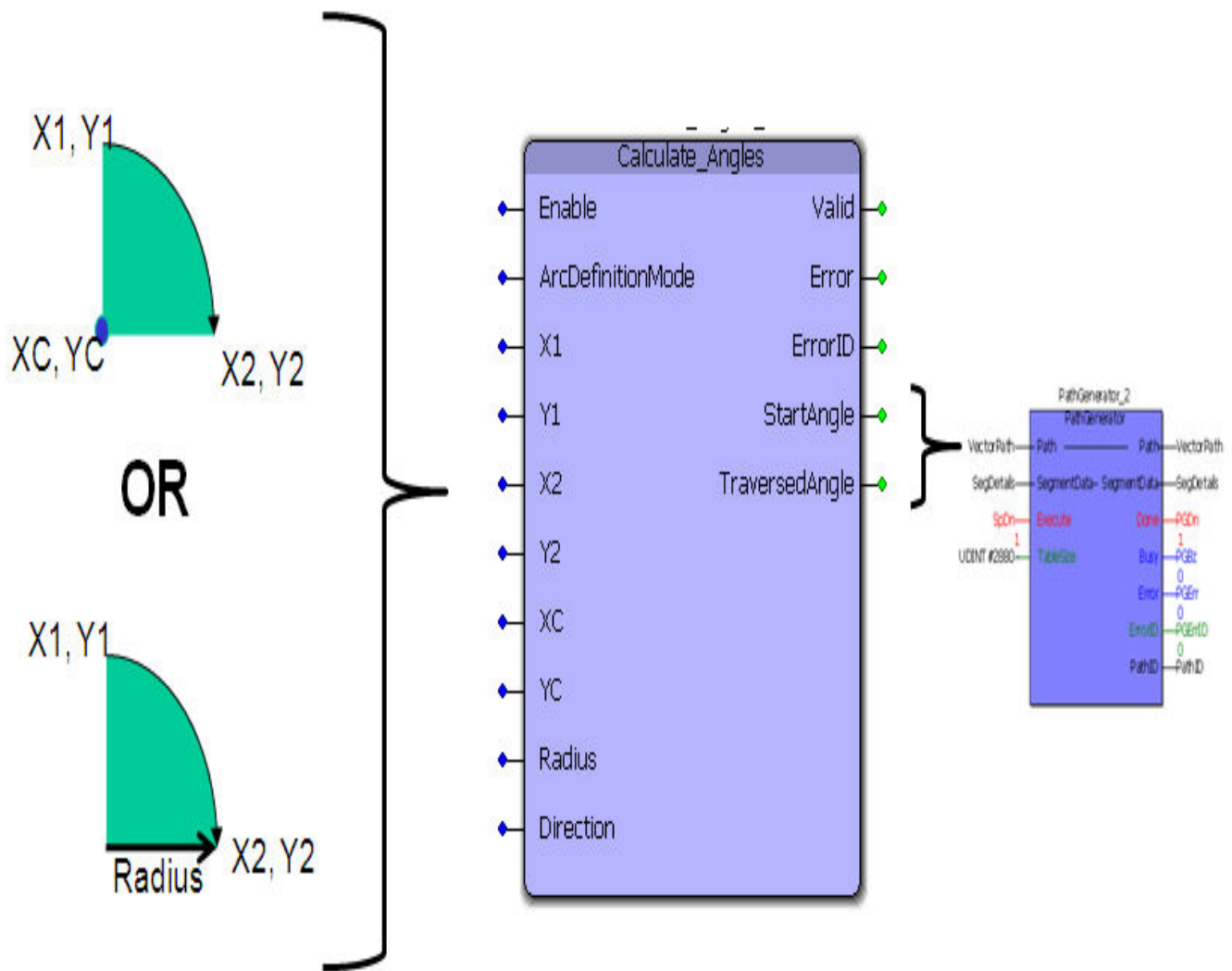
- See Yaskawa's Youtube channel for [more info](#), [details](#), and [examples](#).

Error Description

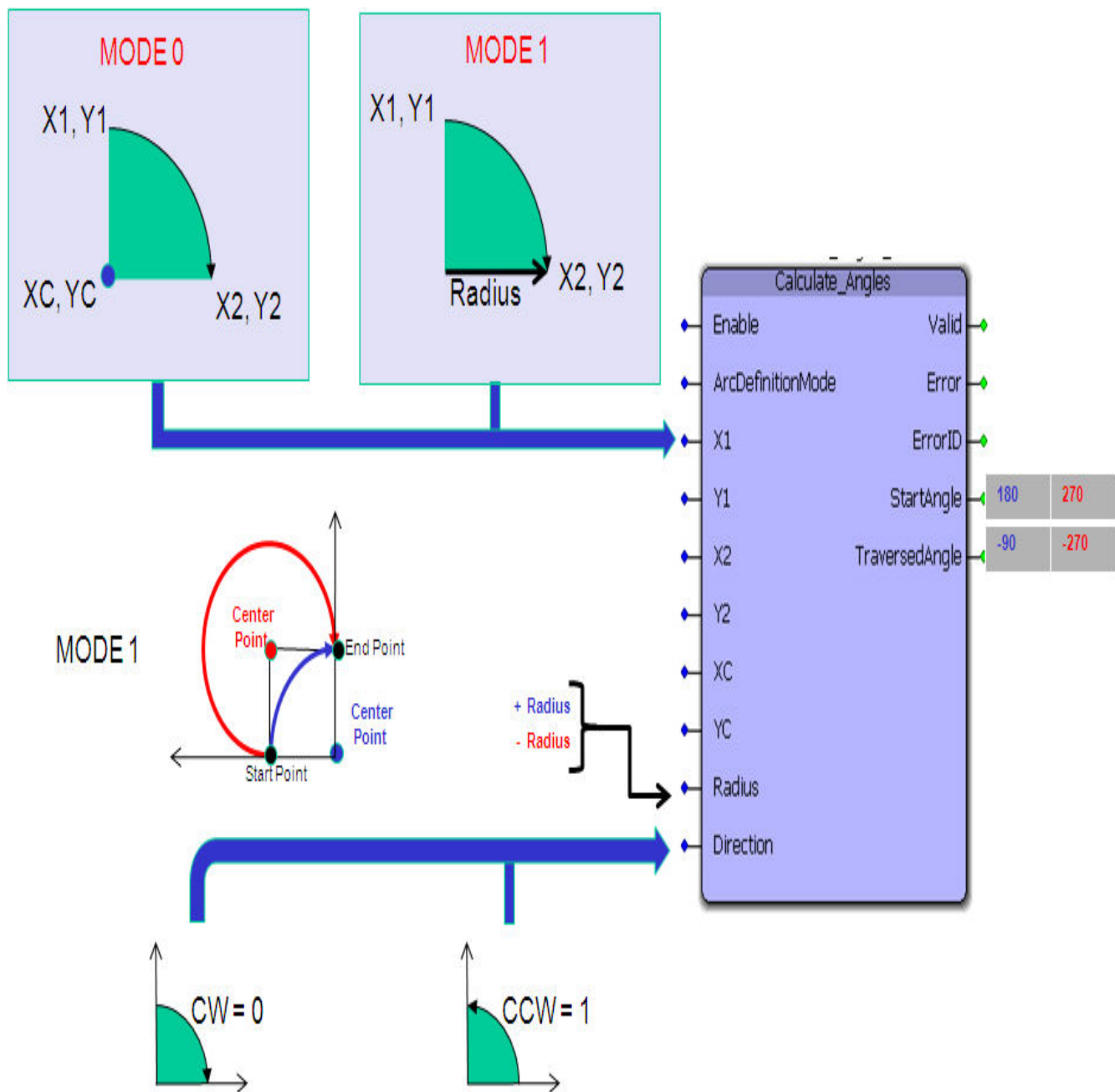
| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 10130 | The center to co-ordinate distance for the two input co-ordinates are not the same |
| 10131 | Zero radius is invalid. |
| 10132 | Only modes 0 (center + 2 co-ordinates) and 1 (radius + 2 coordinates) are supported. |
| 10133 | The coordinates of the two data points are the same. |
| 10140 | Must be greater than zero and less than 20. |

Example

The Calculate_Angles function block is used to calculate Start and Traversed angles which can be used by the [PathStruct](#) structure to create a path in the [PathGenerator](#) function block. The two modes of data entry for an arc are a) two co-ordinates and center point of an arc or b) two co-ordinates and radius as shown below.



The two modes of data entry are shown in detail below. Mode 0: 2 coordinates + center coordinate, Mode 1: 2 coordinates + radius. If the user plans to use Mode 1, the sign of the radius is important. this is illustrated in the figure below. The two arcs (red and blue) have the same start and end coordinates and they have the same radii. A negative radius would give rise to an obtuse arc (shown as red) and the start angle and traversed angle are 270 and -270 respectively. If a positive radius is specified, an acute arc (shown in blue) is generated. The start angle and traversed angle for the acute arc are 180 and -90 respectively.



Application example

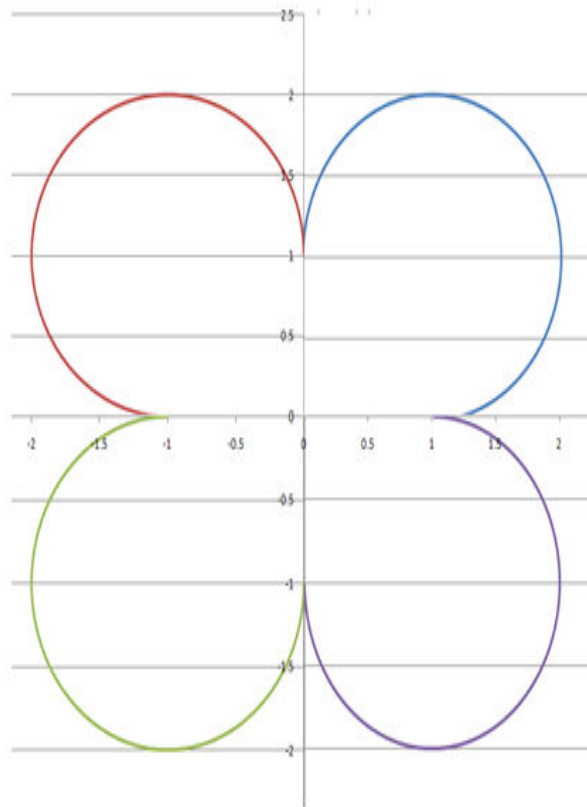
Step1: Using Calculate_Angles to calculate start and traverse angles for the flower path shown below

Calculate_Angles_1(Execute:=TRUE,ArcDefinitionMode:=INT#1,X1:=LREAL#-1.0,X2:=LREAL#0.0,Y1:=LREAL#0.0,Y2:=LREAL#1.0,Radius:=LREAL#-1.0,Direction:=FALSE);

Calculate_Angles_2(Execute:=TRUE,ArcDefinitionMode:=INT#1,X1:=LREAL#0.0,X2:=LREAL#1.0,Y1:=LREAL#1.0,Y2:=LREAL#0.0,Radius:=LREAL#-1.0,Direction:=FALSE);

Calculate_Angles_3(Execute:=TRUE,ArcDefinitionMode:=INT#1,X1:=LREAL#1.0,X2:=LREAL#0.0,Y1:=LREAL#0.0,Y2:=LREAL#-1.0,Radius:=LREAL#-1.0,Direction:=FALSE);

Calculate_Angles_4(Execute:=TRUE,ArcDefinitionMode:=INT#1,X1:=LREAL#0.0,X2:=LREAL#-1.0,Y1:=LREAL#-1.0,Y2:=LREAL#0.0,Radius:=LREAL#-1.0,Direction:=FALSE);

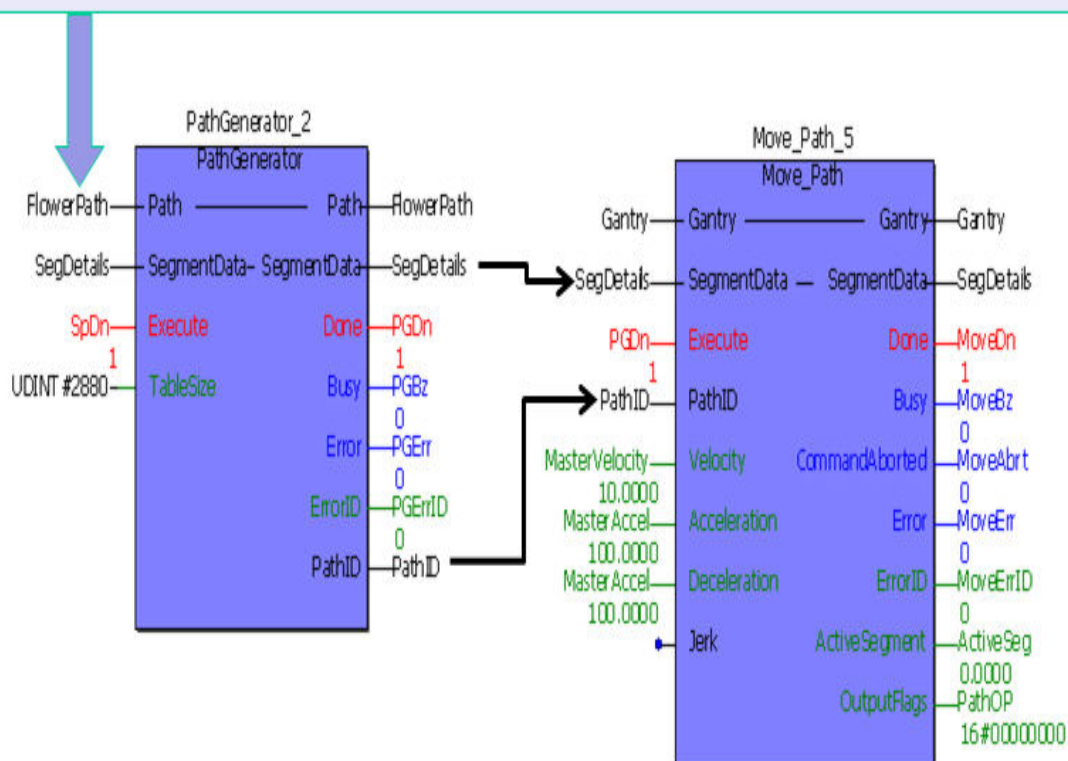


Step 2: Use [PathGenerator](#) to create the path and [Move_Path](#) to implement XY motion

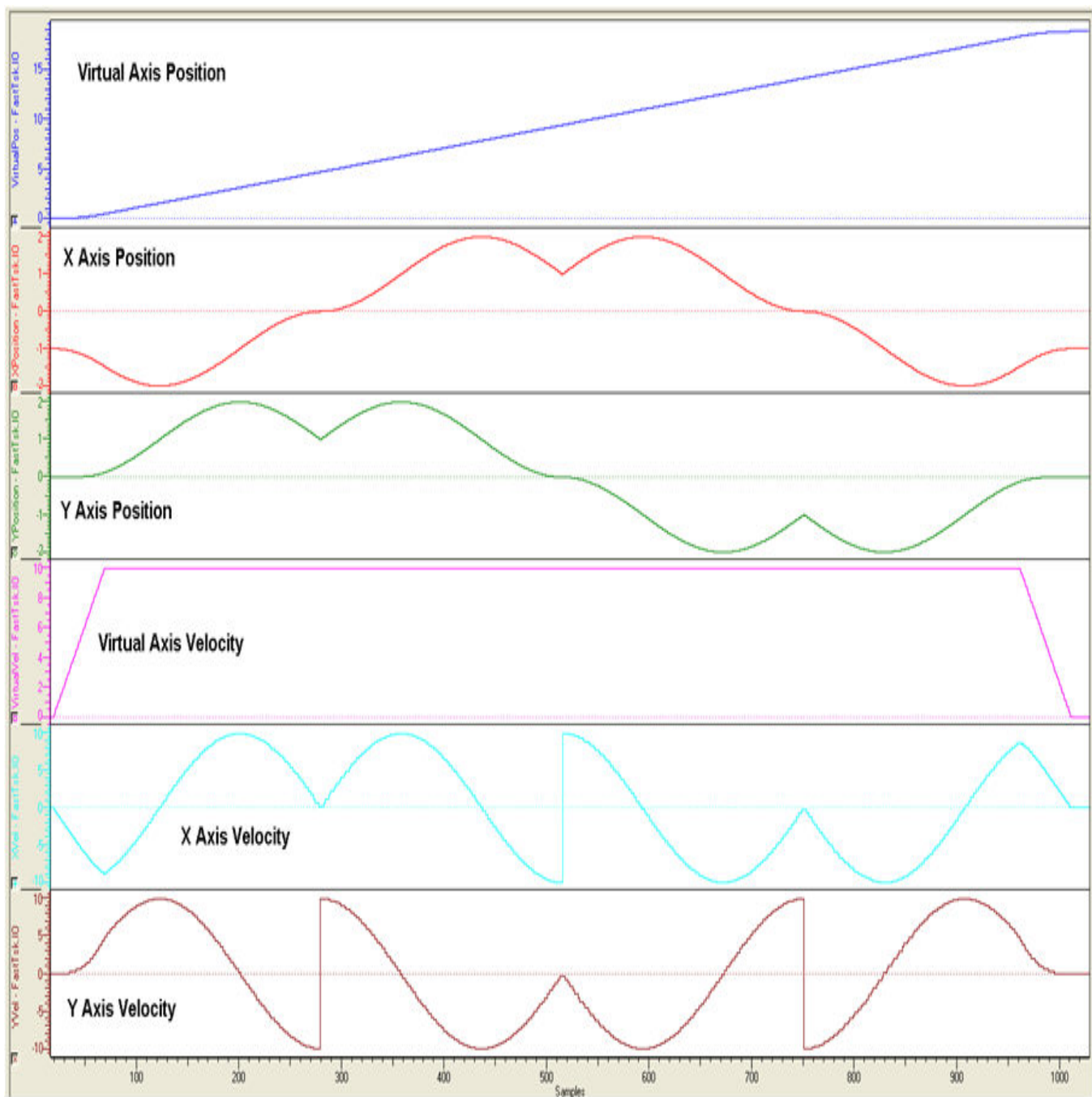
```

FlowerPath.Data[1].SegmentType:=TB_PatternType#Arc;
FlowerPath.Data[1].Radius:=LREAL#1.0;
Calculate_Angles_1(Execute:=TRUE,ArcDefinitionMode:=INT#1,X1:=LREAL#-1.0,X2:=LREAL#0.0,Y1:=LREAL#0.0,Y2:=LREAL#1.0,Radius:=LREAL#-1.0,Direction:=FALSE);
FlowerPath.Data[1].StartAngle:=Calculate_Angles_1.StartAngle;
FlowerPath.Data[1].TraversedAngle:=Calculate_Angles_1.TraversedAngle;
FlowerPath.Data[1].Resolution:=REAL#0.05;

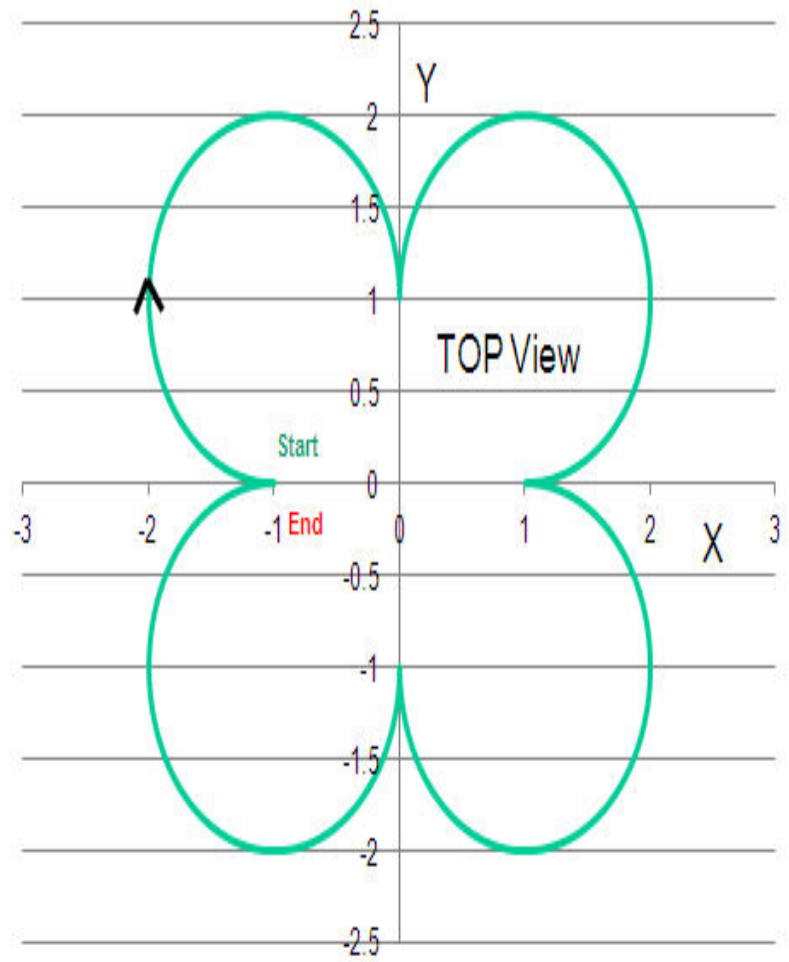
```



Step 3: Validation using logic analyzer

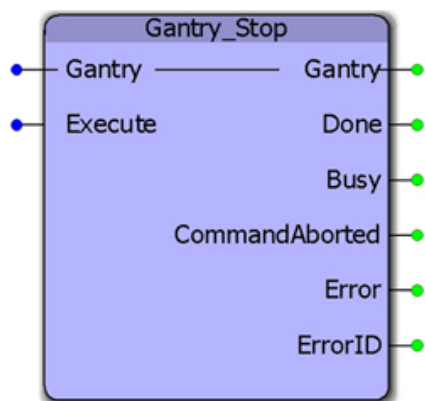


Step 4: Result on XY system





Gantry_Stop



This function block will execute the MC_Stop block for all axes configured as part of a gantry system.

Library

Gantry Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|----------------|------------------------------|--|
| VAR_IN_OUT | | | |
| V | Gantry | GantryStruct | Contains all information pertaining to a gantry system. |
| VAR_INPUT | | | |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| | | | Default FALSE |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. |

| | | | |
|---|---------|------|---|
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

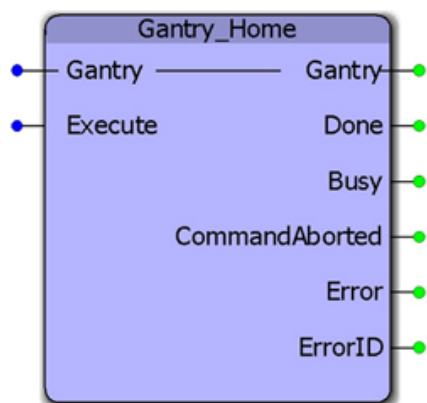
Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4660 | Deceleration is less than or equal to zero. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |

Example



Gantry_Home



This function block will move all gantry axes in search of home by first seeking one of the limit switches, and then searching in the other direction for the C channel or index pulse. This block uses the [Home_LS_Pulse](#) function block from the [PLCopen Toolbox](#). If configured, the Z axis will search for home first, then the X and Y axes will search simultaneously. This sequence was designed to prevent mechanical interferences with objects in the work coordinate system during the homing process.

Library

Gantry Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|------------------------------|--|
| VAR_IN_OUT | | | |
| V | Gantry | GantryStruct | Contains all information pertaining to a gantry system. |
| VAR_INPUT | | | |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |

| | | | |
|---|----------------|------|---|
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Error Description

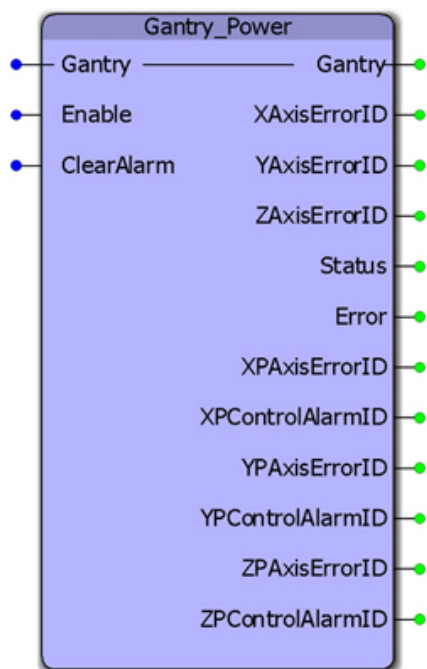
| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 1 | Time limit exceeded. |
| 2 | Distance limit exceeded. |
| 3 | Torque limit exceeded. |
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4379 | A homing sequence is already in progress. |
| 4380 | MC_SetPosition cannot be executed while the axis is already moving. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4382 | When an axis is configured for rotary mode, and the MC_SetPosition tries to set a position that is equal to or greater than the MachineCycle, this error is generated, and the position is not set. |
| 4383 | Axis must be commanded at standstill when homing is attempted. Refer to the Motion State Diagram and MC_ReadStatus. Maybe the axis is not enabled using MC_Power? |
| 4390 | Position cannot be defined while the axis is in a master / slave relationship. To redefine the position, use the MC_Stop function block for slave axis, then execute MC_SetPosition. If attempting the redefine a master position, execute MC_Stop for all slaves first. |
| 4391 | The function block cannot be used with a virtual axis. |
| 4396 | Axis latch function already in use. |
| 4397 | Over travel is limit still ON after attempting to move away from it. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4642 | Direction does not correspond to a valid enumeration value. |
| 4646 | Mode does not correspond to a valid enumeration value or the enumeration is not supported. |
| 4658 | Velocity parameter is less than or equal to zero. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 10037 | Offset cannot be in the same direction as the original motion into the limit switch. |

| | |
|-----------------------|--|
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |
| 61713 | This function block caused an internal error. Possible causes: MC_Power – Check if multiple instances of this block are executed for the same axis. Y_CamIn - Check in the cam table if the master values are the same for two datapoints or decreasing. Y_CamStructSelect – Y_MS_CAM_TABLE.Header.DataSize must not be zero. |

Example



Gantry_Power



This function block will enable or disable all axes configured as part of a gantry system. This block uses the [AxisControl](#) function block from the [PLCopen Toolbox](#). If the gantry is configured with dual motors on the same physical axis, then the secondary or prime axes are geared to the other axis in the same physical motion plane.

Library

Gantry Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|------------|------------------------------|---|
| VAR_IN_OUT | | | |
| V | Gantry | GantryStruct | Contains all information pertaining to a gantry system. |
| VAR_INPUT | | | |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | ClearAlarm | BOOL | This input will clear any axis specific alarms on the Gantry axes. |

| VAR_OUTPUT | | | |
|------------|------------------|------|---|
| V | XAxisErrorID | UINT | ErrorID on the X axis. |
| V | YAxisErrorID | UINT | ErrorID on the Y axis. |
| V | ZAxisErrorID | UINT | ErrorID on the Z axis. |
| B | Status | BOOL | TRUE if the drive is enabled. This output is derived from the Status output of MC_Power. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| V | XPAxisErrorID | UINT | ErrorID on the X' axis. |
| V | XPControlAlarmID | UINT | Controller ErrorID caused by the X' axis. |
| V | YPAxisErrorID | UINT | ErrorID on the Y' axis. |
| V | YPControlAlarmID | UINT | Controller ErrorID caused by the Y' axis. |
| V | ZPAxisErrorID | UINT | ErrorID on the Z' axis. |
| V | ZPControlAlarmID | UINT | Controller ErrorID caused by the Z' axis. |

Error Description

This function block uses the AxisControl function block from the PLCopen Toolbox. Refer to the [Error IDs from the Axis Control function block](#).

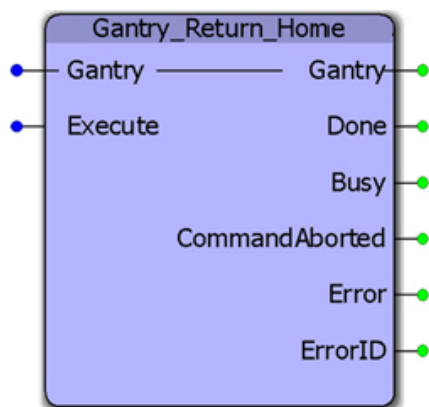
| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4371 | The servo drive failed to enable or disable. Check the amplifier wiring for L1 / L2 / L3. The amplifier could be e-stopped or has an alarm. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4399 | The L1 / L2 / L3 power inputs on the drive may not be supplied with power, possibly due to an E-Stop condition. |
| 4400 | The safety input (HBB on the CN8 connector) is preventing the drive from enabling. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 4894 | The specified virtual axis may not be used with this function block. |
| 45332 | Sending clear alarms command to servo drive failed. |

| | |
|-----------------------|--|
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |
| 61713 | This function block caused an internal error. Possible causes: MC_Power – Check if multiple instances of this block are executed for the same axis. Y_CamIn - Check in the cam table if the master values are the same for two datapoints or decreasing. Y_CamStructSelect – Y_MS_CAM_TABLE.Header.DataSize must not be zero. |

Example



Gantry_Return_Home



This function block will move all gantry axes back to the home position as defined by the home positions in the [GantryStruct](#). If configured, the Z axis will move to home first, then the X and Y axes will move together. This sequence was designed to prevent mechanical interferences with objects in the work coordinate system during the homing process. This block uses the MC_MoveAbsolute function block from the PLCopenPlus firmware library. It is assumed that the home location has been previously determined either by using the [Gantry_Home](#) function block or because the system uses absolute encoders that have been calibrated to the physical machine.

Library

Gantry Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|------------------------------|--|
| VAR_IN_OUT | | | |
| V | Gantry | GantryStruct | Contains all information pertaining to a gantry system. |
| VAR_INPUT | | | |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |

| | | | |
|---|----------------|------|--|
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

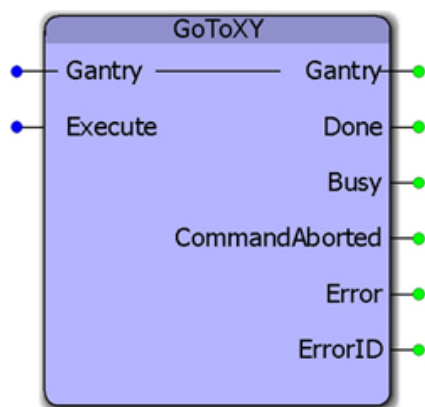
Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4642 | Direction does not correspond to a valid enumeration value. |
| 4658 | Velocity parameter is less than or equal to zero. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 10034 | Interpolation calculation error. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |

Example



GotoXY



This function block will perform an absolute move the X and Y axes to a specific location within the gantry coordinate system. The absolute X and Y positions must be specified in [GantryStruct](#) before executing this function block. This block calculates the required acceleration, deceleration and velocity for each axis and then executes an MC_MoveAbsolute function block simultaneously for each to create straight line motion at the tool point, however this is not considered an interpolated motion. If configured, no motion on the Z axis will occur.

Library

Gantry Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|------------------------------|--|
| VAR_IN_OUT | | | |
| V | Gantry | GantryStruct | Contains all information pertaining to a gantry system. |
| VAR_INPUT | | | |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |

| | | | |
|---|----------------|------|--|
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

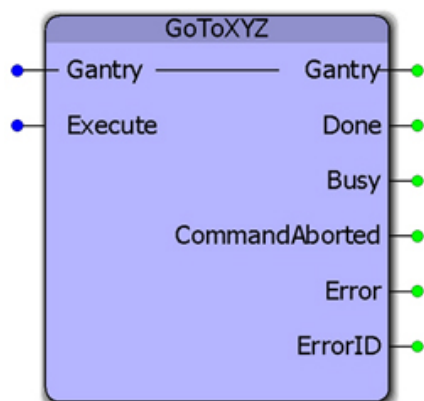
Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4642 | Direction does not correspond to a valid enumeration value. |
| 4658 | Velocity parameter is less than or equal to zero. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 10034 | Interpolation calculation error. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |

Example



GoToXYZ



This function block will perform an absolute move the X, Y, and Z axes to a specific location within the gantry coordinate system. The absolute positions must be specified in [GantryStruct](#) before executing this function block. This block calculates the required acceleration, deceleration and velocity for each axis and then executes an MC_MoveAbsolute function block simultaneously for each to create straight line motion at the tool point, however this is not considered an interpolated motion.

Library

Gantry Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|------------------------------|--|
| VAR_IN_OUT | | | |
| V | Gantry | GantryStruct | Contains all information pertaining to a gantry system. |
| VAR_INPUT | | | |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |

| | | | |
|---|----------------|------|---|
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

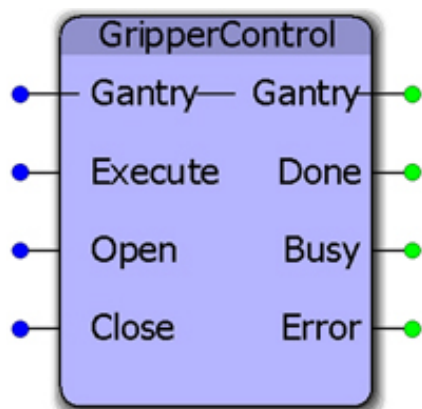
Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4642 | Direction does not correspond to a valid enumeration value. |
| 4658 | Velocity parameter is less than or equal to zero. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 10034 | Interpolation calculation error. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |

Example



GripperControl



This function block can operate a simple gripper device if the actuator can be controlled via a digital output. It will activate an output while waiting for confirmation that a corresponding input has changed state to indicate that the gripper has successfully opened or closed.

Library

Gantry Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|------------------------------|--|
| VAR_IN_OUT | | | |
| V | Gantry | GantryStruct | Contains all information pertaining to a gantry system. |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| V | Open | BOOL | Command to open the gripper |
| V | Close | BOOL | Command to close the gripper |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |

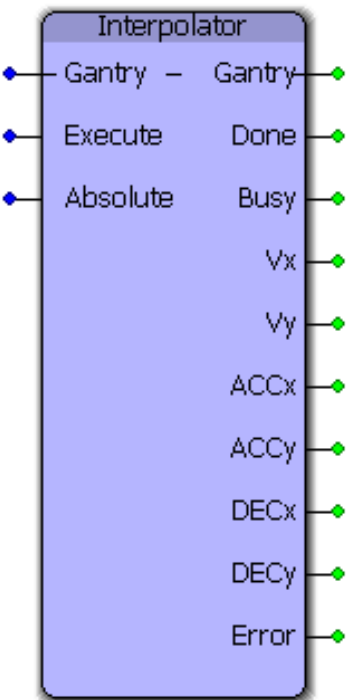
| | | | |
|---|-------|------|--|
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |

Error Description

| ErrorID | Meaning |
|-----------------------|---|
| 0 | No error. |
| 10035 | Gripper Close Error (Timeout). |
| 10036 | Latch Error. LatchReference was negative. This situation should never occur. Verify that the normal axis movement is in a positive direction. Use PLCopen Toolbox v340 which contains improved code for applications with registration marks near the end of the default move. DCR 1183 |



Interpolator



This function block calculates the required acceleration, deceleration, and velocity for both X and Y axes so that straight line motion can occur between any two points in the XY (two dimensional) coordinate system. This function block is used by the [GotoXY](#) function block.

Library

Gantry Toolbox

Parameters

| * | Parameter | Data Type | Description |
|------------|-----------|------------------------------|---|
| VAR_IN_OUT | | | |
| V | Gantry | GantryStruct | Contains all information pertaining to a gantry system. |
| VAR_INPUT | | | Default |

| | | | | |
|-------------------|---------|-------|--|-------|
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. | FALSE |
| VAR_OUTPUT | | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |
| V | Vx | LREAL | X axis component of gantry velocity | |
| V | Vy | LREAL | Y axis component of gantry velocity | |
| V | ACCx | LREAL | X axis component of gantry acceleration | |
| V | ACCy | LREAL | Y axis component of gantry acceleration | |
| V | DECx | LREAL | X axis component of gantry deceleration | |
| V | DECy | LREAL | Y axis component of gantry deceleration | |
| V | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |

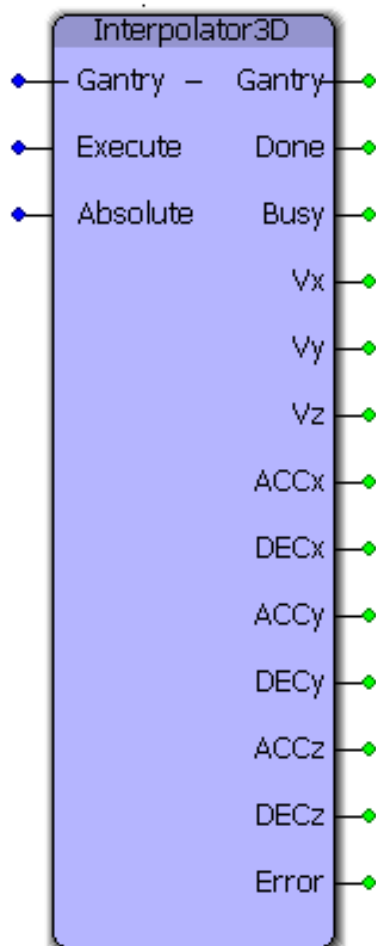
Error Description

| ErrorID | Meaning |
|-----------------------|----------------------------------|
| 0 | No error. |
| 10034 | Interpolation calculation error. |

Example



Interpolator3D



This function block calculates the required acceleration, deceleration, and velocity for X, Y and Z axes so that straight line motion can occur between any two points in three dimensional space within the gantry coordinate system. This function block is used by the [GotoXYZ](#) function block.

Library

Gantry Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|------------------------------|--|
| VAR_IN_OUT | | | |
| V | Gantry | GantryStruct | Contains all information pertaining to a gantry system. |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| B | Absolute | BOOL | FALSE |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| V | Vx | LREAL | X axis component of gantry velocity. |
| V | Vy | LREAL | Y axis component of gantry velocity. |
| V | Vz | LREAL | Z axis component of gantry velocity. |
| V | ACCx | LREAL | X axis component of gantry acceleration. |
| V | DECx | LREAL | X axis component of gantry deceleration. |
| V | ACCy | LREAL | Y axis component of gantry acceleration. |
| V | DECy | LREAL | Y axis component of gantry deceleration. |
| V | ACCz | LREAL | Z axis component of gantry acceleration. |
| V | DECz | LREAL | Z axis component of gantry deceleration. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |

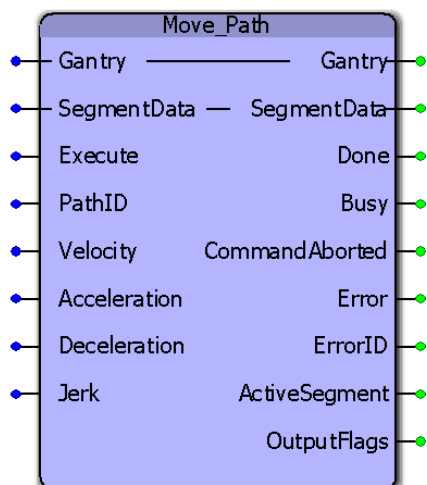
Error Description

| ErrorID | Meaning |
|-----------------------|----------------------------------|
| 0 | No error. |
| 10034 | Interpolation calculation error. |

Example



Move_Path



Based on the axes specified in the GantryStruct, this function block can move X,Y,Z and Tangent axes according to a path profile generated by the [PathGenerator](#) and specified in the [PathStruct](#) structure. This function block typically uses the output from the [PathGenerator](#) to operate. Inputs and outputs can be monitored and controlled along the path.

Library

Gantry Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-------------|-------------------------------|--|
| VAR_IN_OUT | | | |
| V | Gantry | GantryStruct | Contains all information pertaining to a gantry system. |
| V | SegmentData | SegmentStruct | Structure of data that contains the segment number, output code, and tool path endpoint for each segment in the motion path. |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| V | PathID | PathIDStruct | Structure containing data to be shared between PathGenerator and MovePath functions. |

| | | | | |
|-------------------|----------------|--------------|--|------------------|
| B | Velocity | LREAL | Absolute value of the velocity in user units/second. | LREAL#0.0 |
| B | Acceleration | LREAL | Value of the acceleration in user units/second ² (acceleration is applicable with same sign of torque and velocity) | LREAL#0.0 |
| B | Deceleration | LREAL | Value of the deceleration in user units/second ² (deceleration is applicable with opposite signs of torque and velocity.) | LREAL#0.0 |
| E | <i>Jerk</i> | <i>LREAL</i> | <i>Not supported; reserved for future use. Value of the jerk in [user units / second³].</i> | <i>LREAL#0.0</i> |
| VAR_OUTPUT | | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |
| V | ActiveSegment | INT | Indicates the active segment as the tool point moves along the path. | |
| V | OutputFlags | DWORD | Code which can be used to set up to 32 different outputs at various points along the motion path. | |

Notes

- The motion path described is relative to the start point of the move. The axes can be moved using other motion blocks prior to executing [Move_Path](#) to account for offsets required.
- The Gantry structure used with this function block must include a Virtual axis. Configure a virtual axis in the Hardware Configuration. The virtual axis must have the same units as the XYZ axes.
- Gantry Toolbox v204 has improved code to allow for changing the Velocity, Acceleration, and Deceleration on the fly, including zero speed velocity to pause a path in progress.
- See Yaskawa's YouTube channel for [more info](#), [details](#), and [examples](#).

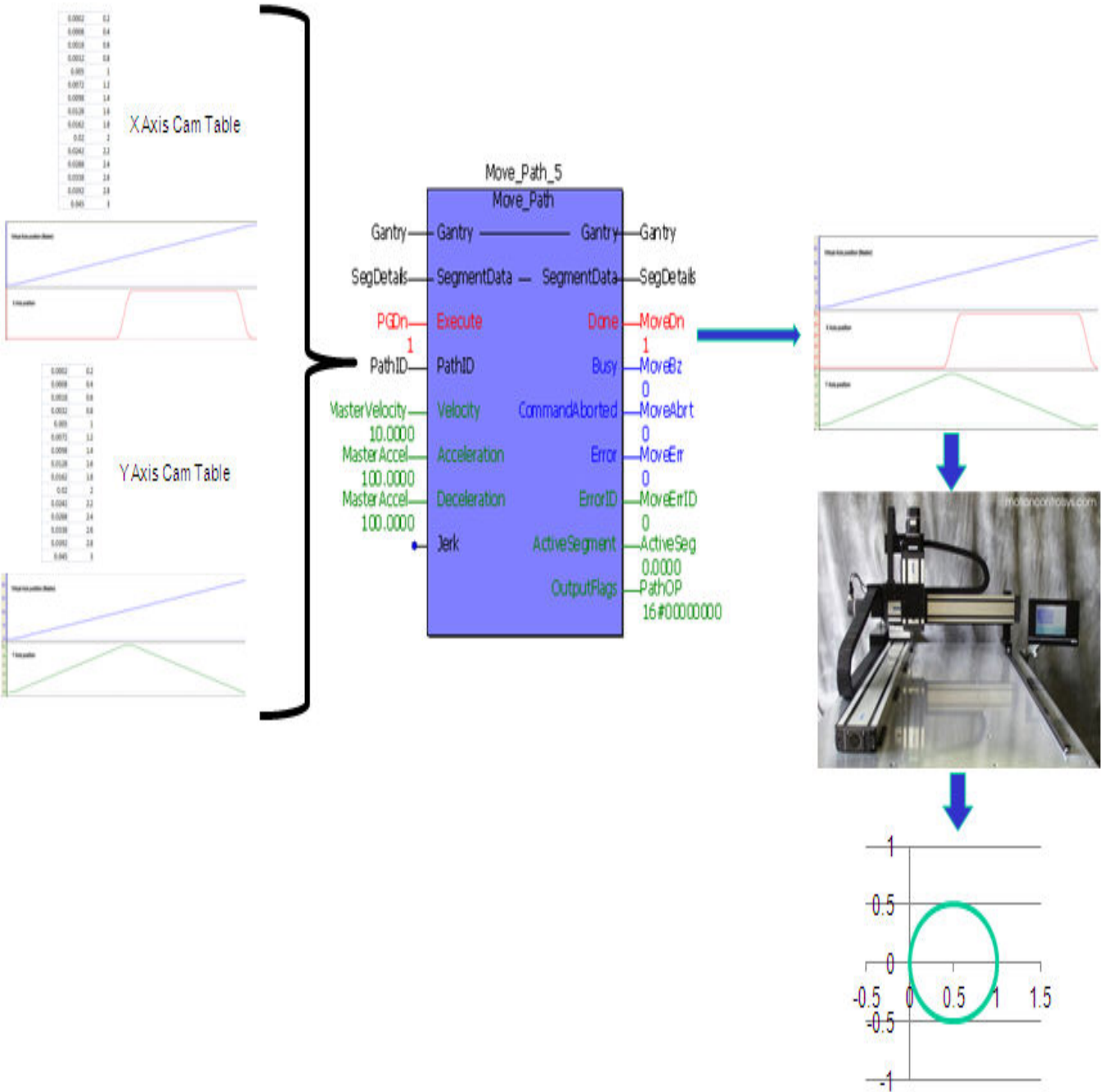
Error Description

| ErrorID | Meaning |
|----------------------|--|
| 0 | No error. |
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |

| | |
|-----------------------|--|
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4380 | MC_SetPosition cannot be executed while the axis is already moving. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4382 | When an axis is configured for rotary mode, and the MC_SetPosition tries to set a position that is equal to or greater than the MachineCycle, this error is generated, and the position is not set. |
| 4390 | Position cannot be defined while the axis is in a master / slave relationship. To redefine the position, use the MC_Stop function block for slave axis, then execute MC_SetPosition. If attempting the redefine a master position, execute MC_Stop for all slaves first. |
| 4394 | More than 10 Y_CamIn, Y_CamOut, or MC_GearInPos function blocks for a given axis are active at the same time. Most likely the application program is not coded correctly, and the Execute input is being fired too frequently. |
| 4395 | Window parameters are outside of the master axis' machine cycle. (0 to Prm 1502, the last master position in the active cam table.) |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4626 | The master / slave relationship is already defined. If a slave must follow a different master, use the MC_Stop block on the slave before executing the next Y_CamIn. If cascading master slaves, a maximum of two levels of cascaded master / slave relationships can be configured. |
| 4633 | Table size results in misaligned data. Refer to the help section "Internally Created Cam Data." A cam table will have a multiple of 16 bytes if created correctly. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4642 | Direction does not correspond to a valid enumeration value. |
| 4643 | Start mode does not correspond to a valid enumeration value. |
| 4646 | Mode does not correspond to a valid enumeration value or the enumeration is not supported. |
| 4658 | Velocity parameter is less than or equal to zero. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 4669 | Engage position is outside the cam table domain. |
| 4670 | Engage window is less than zero. |
| 4887 | CamTableID does not refer to a valid cam table. |
| 4891 | The slave axis can not be the same as the master axis. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 10059 | The axes got out of sync during the path motion. All Cam Slaves InSync output must be on or off at the same time, or this ErrorID is generated. |
| 57617 | Instance object is NULL. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |
| 57874 | Argument data is NULL. The EngageData input must be connected. |
| 61713 | This function block caused an internal error. Possible causes: MC_Power - Check if multiple instances of this block are executed for the same axis. Y_CamIn - Check in the cam table if the master values are the same for two datapoints or decreasing. Y_CamStructSelect - Y_MS_CAM_TABLE.Header.DataSize must not be zero. |

Example

Uses the profile described by the [PathStruct](#) data type and commands motion to the X, Y axes using a virtual axis as the master. This is shown in the figure below.



Consider the following contour:

```

VectorPath.Data[1].SegmentType:=TB_PatternType#Straightline;
VectorPath.Data[1].XCoord:=LREAL#0.0;
VectorPath.Data[1].YCoord:=LREAL#10.0;
VectorPath.Data[1].OutputFlags:=DWORD#1;

```

```

VectorPath.Data[2].SegmentType:=TB_PatternType#Arc;
VectorPath.Data[2].Radius:=LREAL#0.5;
VectorPath.Data[2].StartAngle:=LREAL#180.0;
VectorPath.Data[2].TraversedAngle:=LREAL#-180.0;
VectorPath.Data[2].Resolution:=REAL#0.05;

```

```

VectorPath.Data[3].SegmentType:=TB_PatternType#Straightline;
VectorPath.Data[3].XCoord:=LREAL#1.0;
VectorPath.Data[3].YCoord:=LREAL#0.0;
VectorPath.Data[3].OutputFlags:=DWORD#2;

```

```

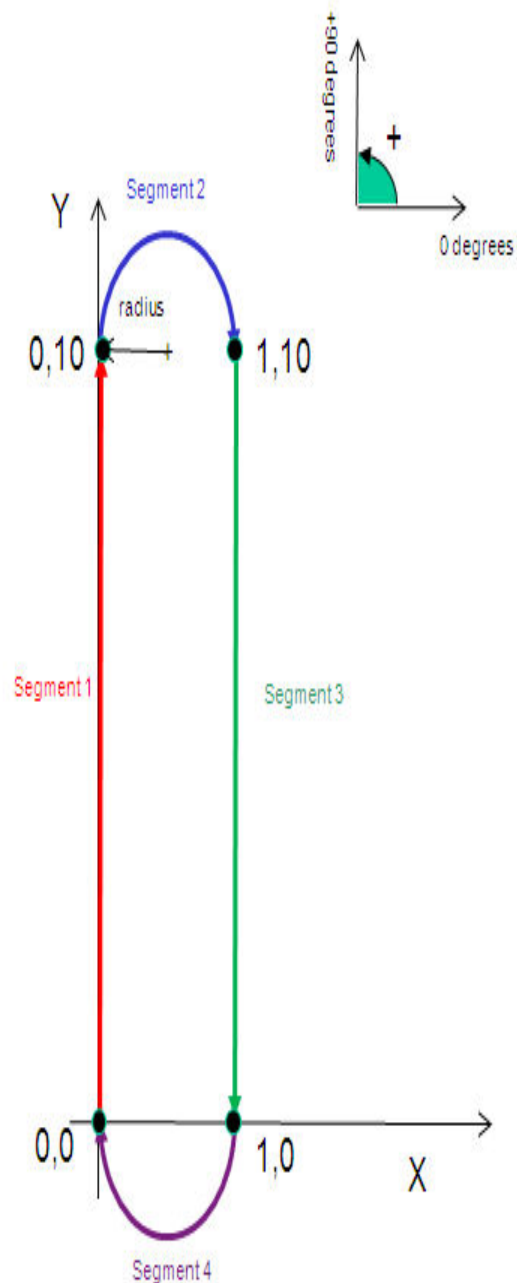
VectorPath.Data[4].SegmentType:=TB_PatternType#Arc;
VectorPath.Data[4].Radius:=LREAL#0.5;
VectorPath.Data[4].StartAngle:=LREAL#0.0;
VectorPath.Data[4].TraversedAngle:=LREAL#-180.0;
VectorPath.Data[4].Resolution:=REAL#0.05;

```

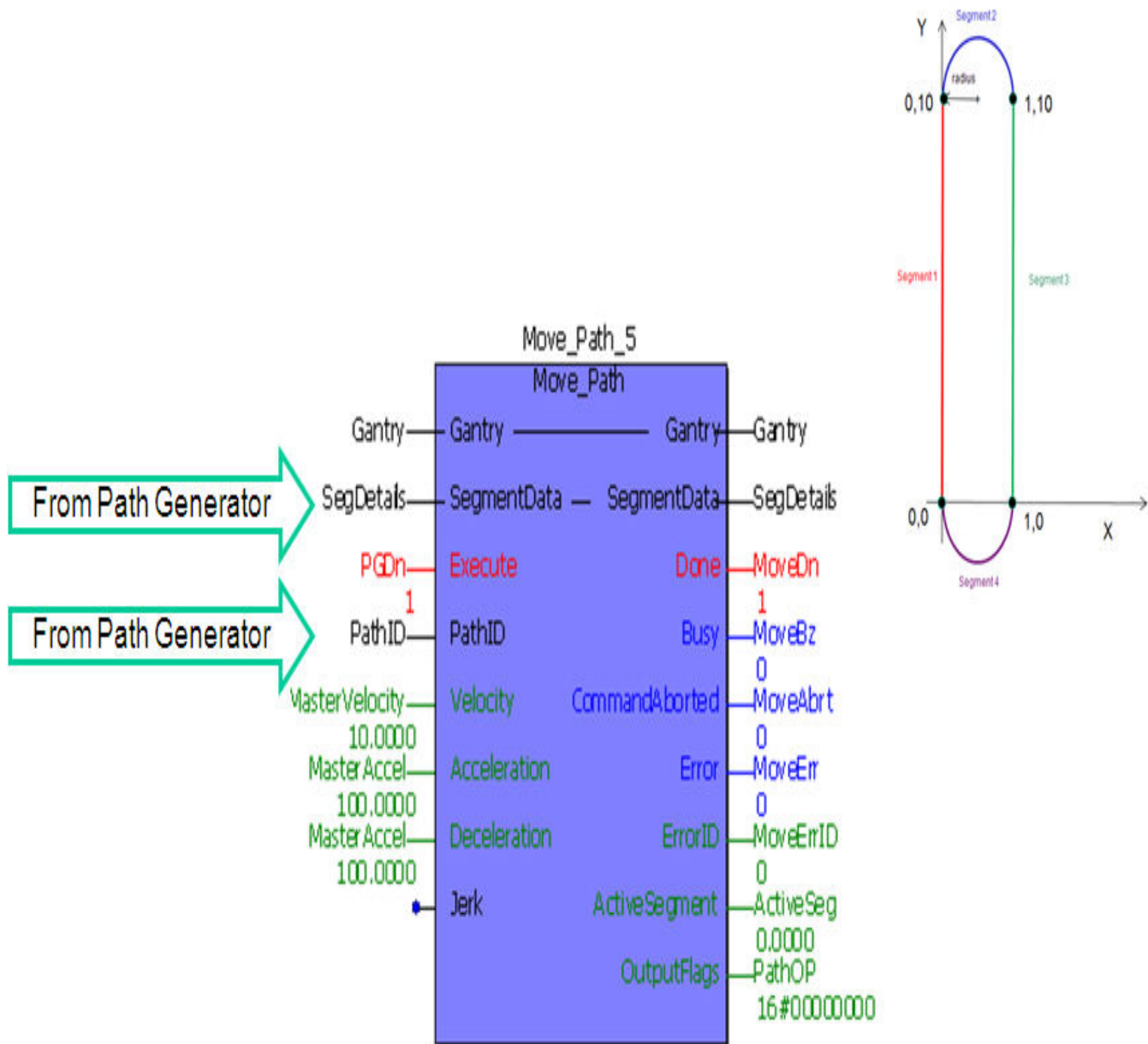
```

VectorPath.Segments:=INT#4;

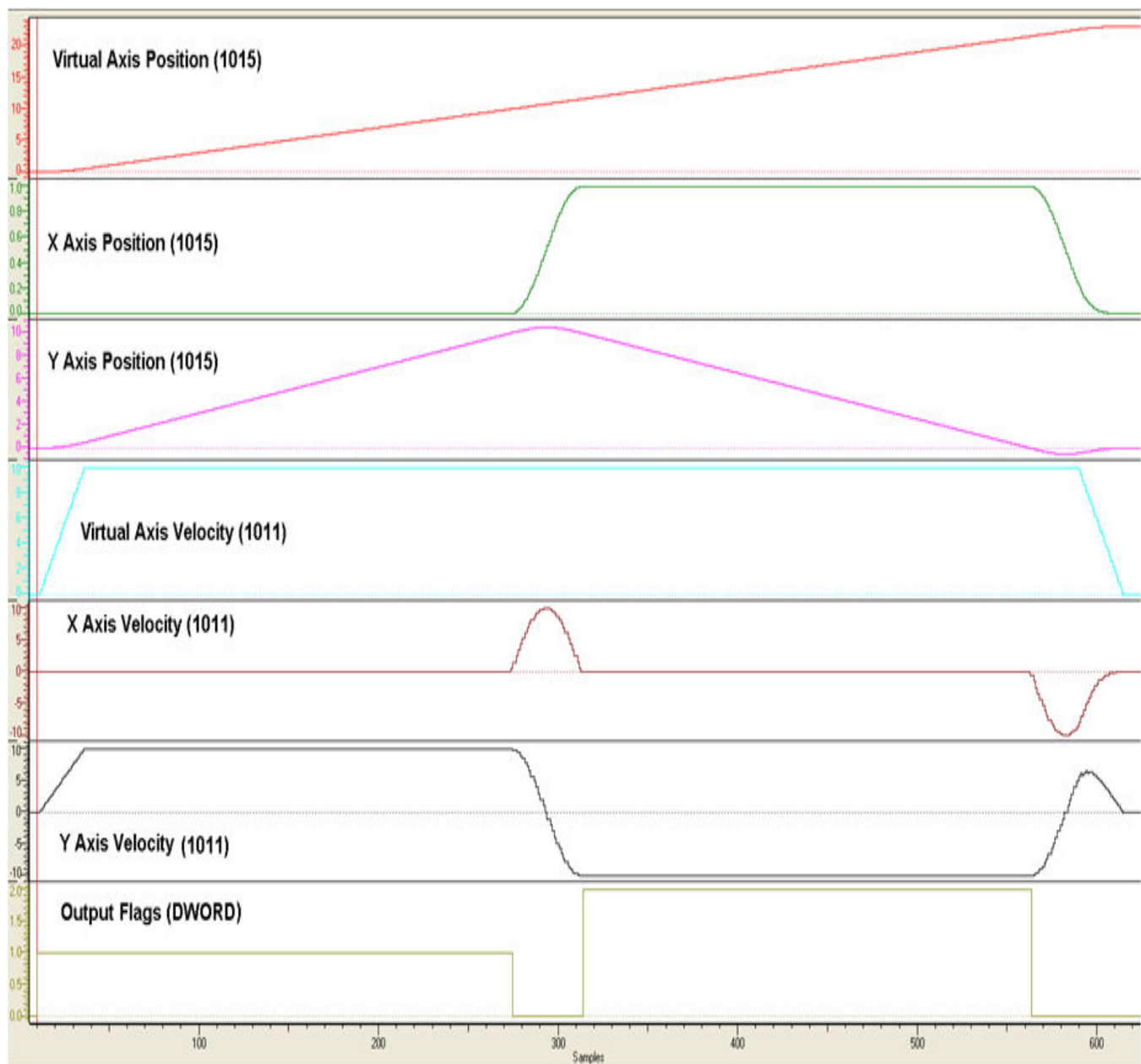
```



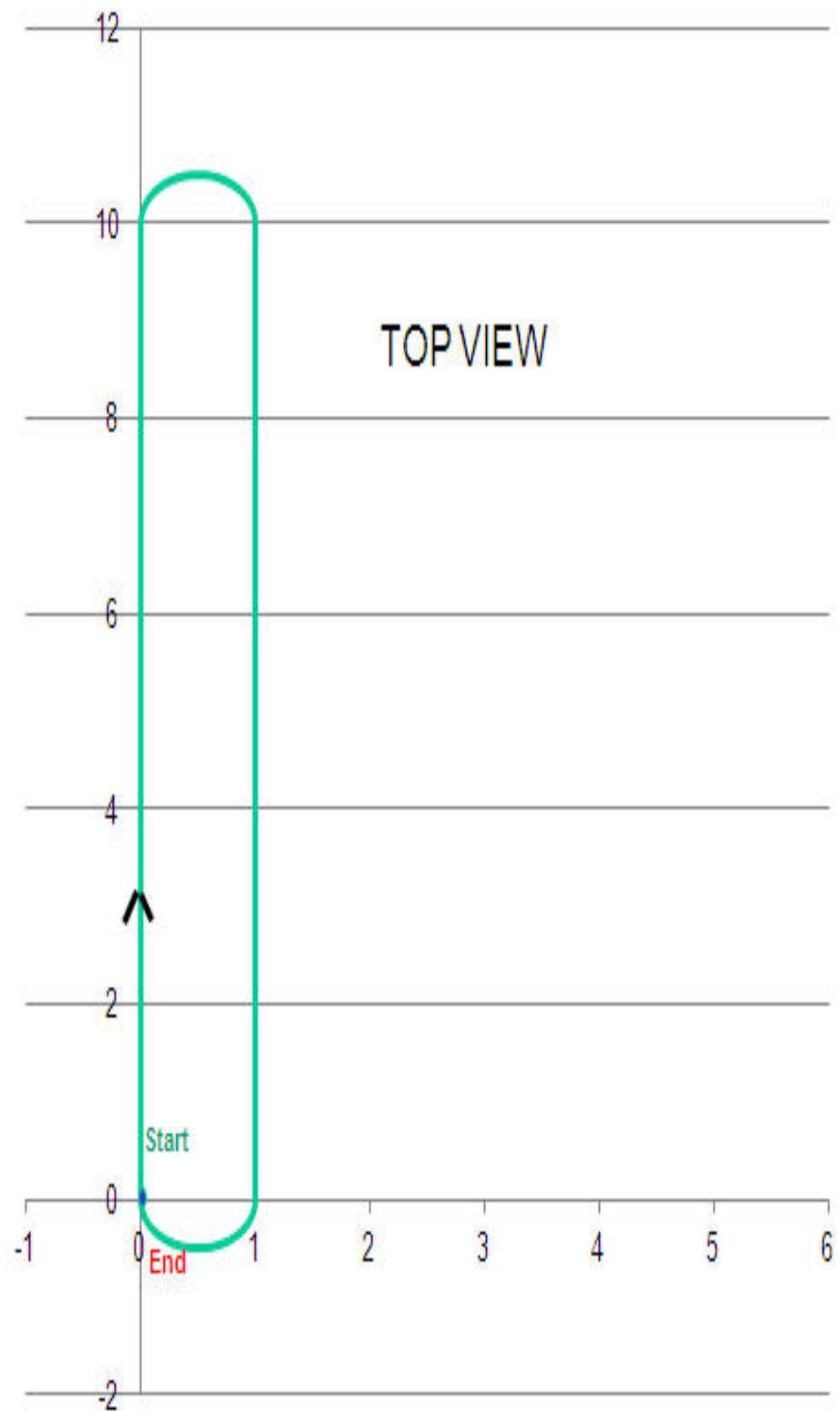
The MovePath function block uses SegmentData and PathID from the [PathGenerator](#) function block and executes moves on the X and Y axes. If a profile is made up of multiple segments (4 in the example below), the active segment output indicates which segment is being run. Output flags can be set from this function block to turn outputs on. This can be useful for applications like cutting, scoring or glue dispensing where digital outputs can be used to fire end effectors.



The logic analyzer plot of independent axis parameters from the above profile is given below. It can be seen that the outputs flags are set during segments 1 and 3. (defined in [PathStruct](#))



The actual profile plotted by the XY system is shown below



Code Example 2

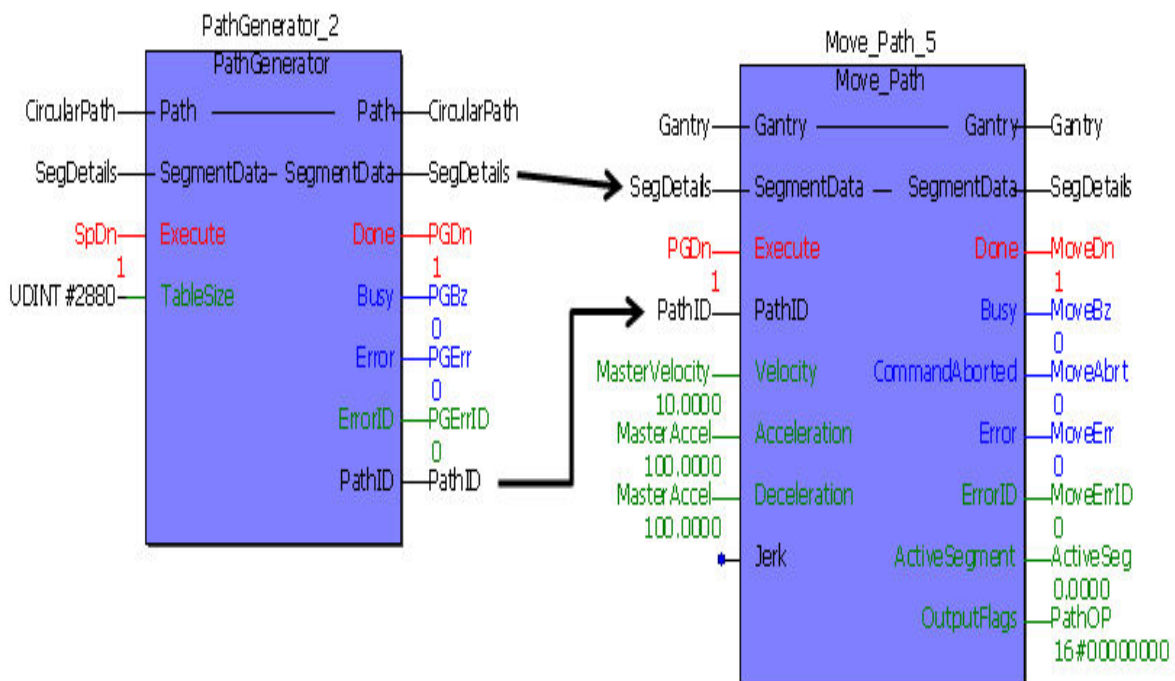
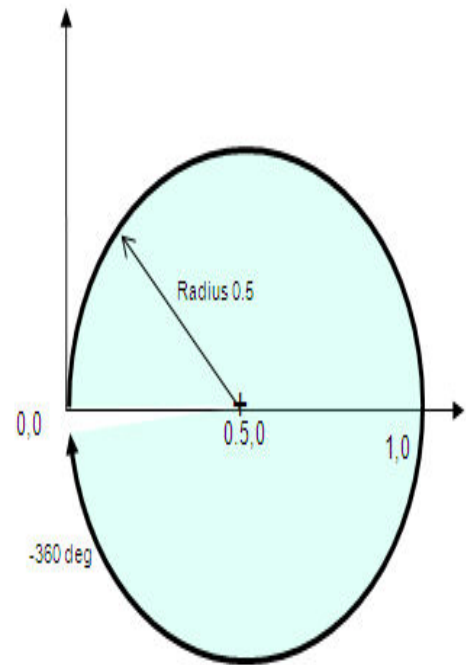
Consider the following circular profile

```

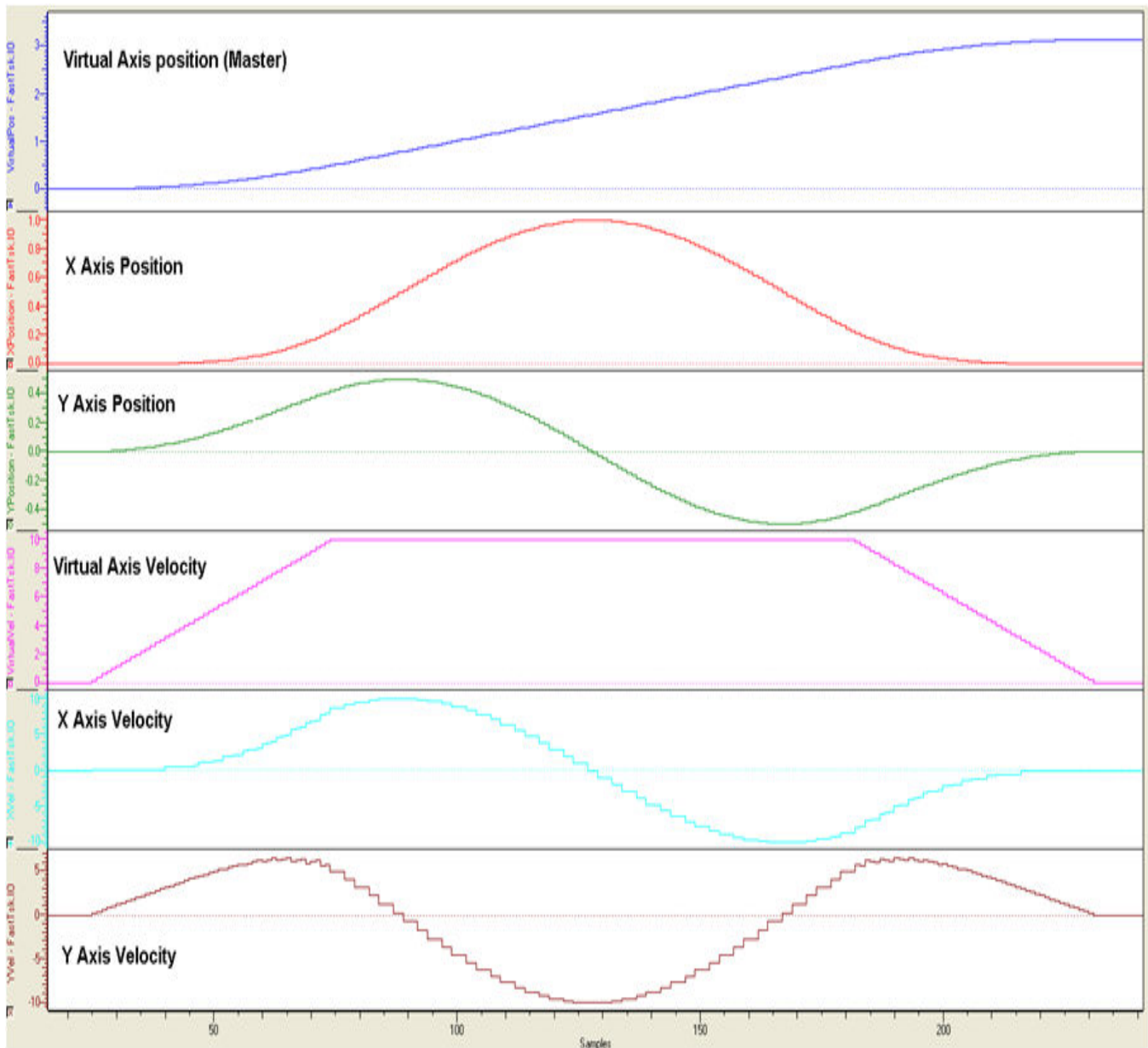
(* Circular path*)
(*=====*)
2 CircularPath.Data[1].SegmentType:=TB_PatternType#Arc;
0.5000 CircularPath.Data[1].Radius:=LREAL#0.5;
180.0000 CircularPath.Data[1].StartAngle:=LREAL#180.0;
-360.0000 CircularPath.Data[1].TraversedAngle:=LREAL#-360.0;
0.0500 CircularPath.Data[1].Resolution:=REAL#0.05;

1 CircularPath.Segments := INT#1;

```



The logic analyzer traces from individual axes while Move_Path was busy is shown in the plot below



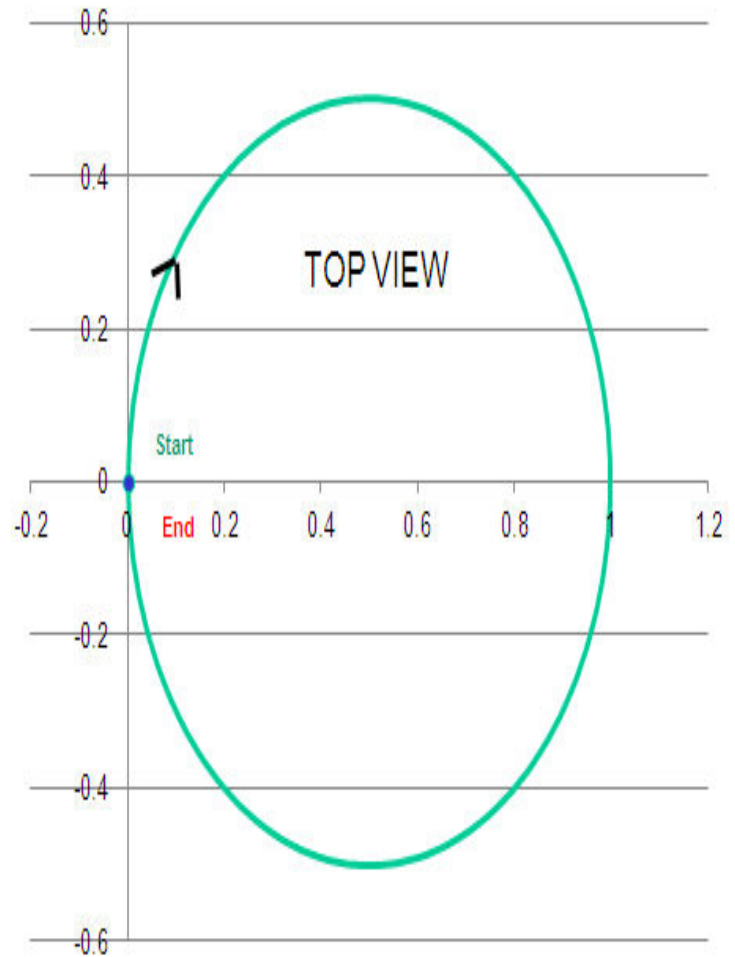
The actual profile plotted by the XY system is:

```

(* Circular path*)
(*=====*)
2 CircularPath.Data[1].SegmentType:=TB_PatternType#Arc;
0.5000 CircularPath.Data[1].Radius:=LREAL#0.5;
180.0000 CircularPath.Data[1].StartAngle:=LREAL#180.0;
-360.0000 CircularPath.Data[1].TraversedAngle:=LREAL#-360.0;
0.0500 CircularPath.Data[1].Resolution:=LREAL#0.05;

1 CircularPath.Segments := INT#1;

```



Application Example

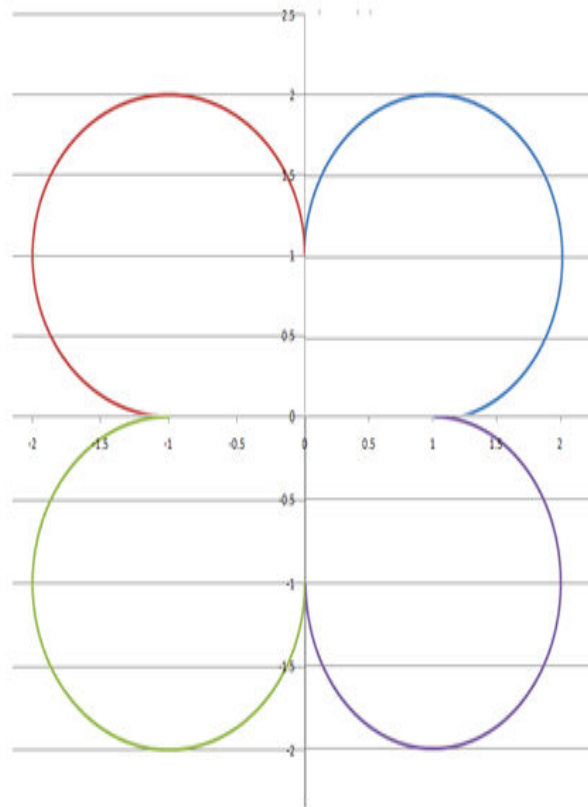
Step1: Using Calculate_Angles FB to calculate the Start and Traverse angles for the flower path shown below.

Calculate_Angles_1(Execute:=TRUE,ArcDefinitionMode:=INT#1,X1:=LREAL#-1.0,X2:=LREAL#0.0,Y1:=LREAL#0.0,Y2:=LREAL#1.0,Radius:=LREAL#-1.0,Direction:=FALSE);

Calculate_Angles_2(Execute:=TRUE,ArcDefinitionMode:=INT#1,X1:=LREAL#0.0,X2:=LREAL#1.0,Y1:=LREAL#1.0,Y2:=LREAL#0.0,Radius:=LREAL#-1.0,Direction:=FALSE);

Calculate_Angles_3(Execute:=TRUE,ArcDefinitionMode:=INT#1,X1:=LREAL#1.0,X2:=LREAL#0.0,Y1:=LREAL#0.0,Y2:=LREAL#-1.0,Radius:=LREAL#-1.0,Direction:=FALSE);

Calculate_Angles_4(Execute:=TRUE,ArcDefinitionMode:=INT#1,X1:=LREAL#0.0,X2:=LREAL#-1.0,Y1:=LREAL#-1.0,Y2:=LREAL#0.0,Radius:=LREAL#-1.0,Direction:=FALSE);

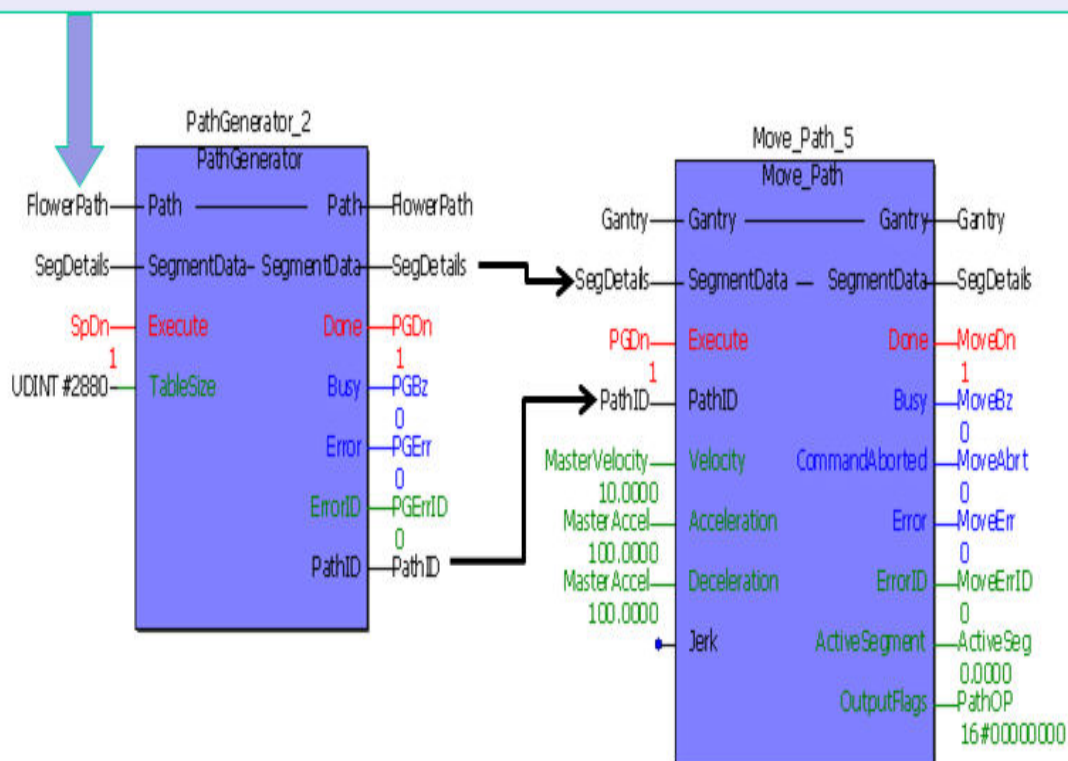


Step 2: Use the PathGenerator FB to create the path and the Move_Path FB to implement XY motion.

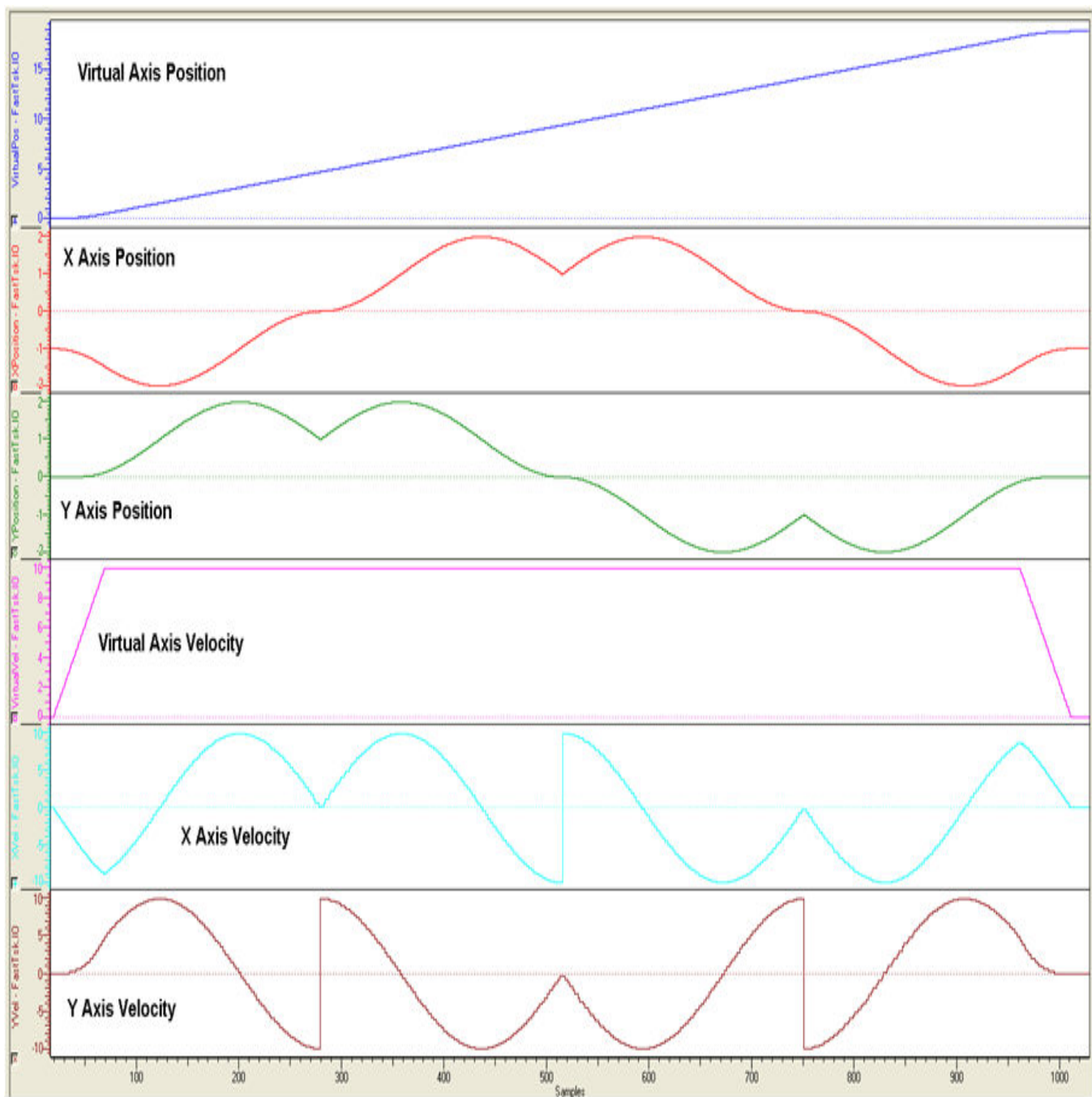

```

FlowerPath.Data[1].SegmentType:=TB_PatternType#Arc;
FlowerPath.Data[1].Radius:=LREAL#1.0;
Calculate_Angles_1(Execute:=TRUE,ArcDefinitionMode:=INT#1,X1:=LREAL#-1.0,X2:=LREAL#0.0,Y1:=LREAL#0.0,Y2:=LREAL#1.0,Radius:=LREAL#-1.0,Direction:=FALSE);
FlowerPath.Data[1].StartAngle:=Calculate_Angles_1.StartAngle;
FlowerPath.Data[1].TraversedAngle:=Calculate_Angles_1.TraversedAngle;
FlowerPath.Data[1].Resolution:=LREAL#0.05;

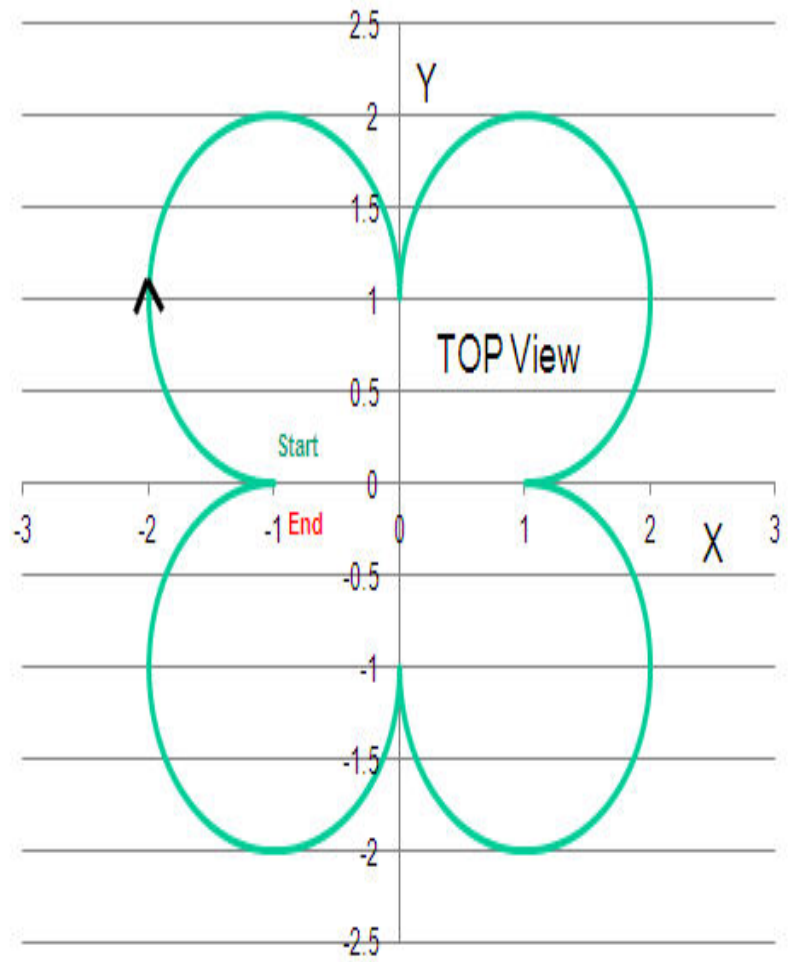
```



Step 3: Validation using logic analyzer.

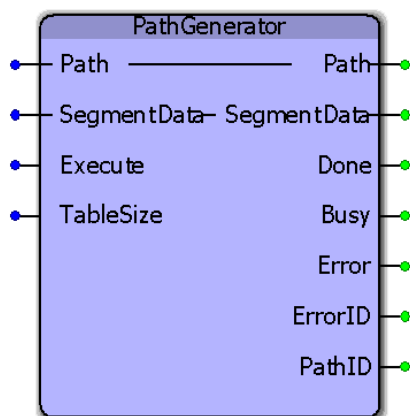


Step 4: Result on XY system.





PathGenerator



This function block pre processes path data to provide coordinated motion using the [Move_Path](#) function block. Support for X, XPrime, Y, Z, and a Tangent axis are provided.

Library

Gantry Toolbox

Parameters

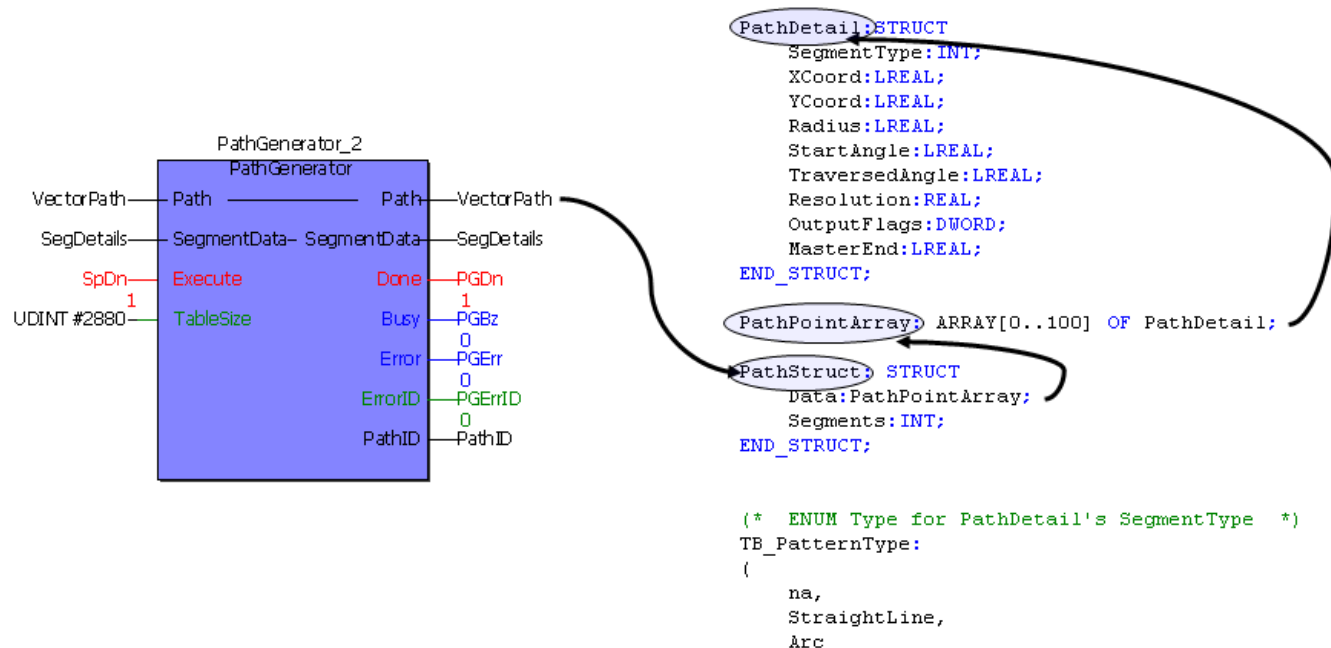
| * | Parameter | Data Type | Description |
|-------------------|-------------|-------------------------------|--|
| VAR_IN_OUT | | | |
| V | Path | PathStruct | Structure of data that describes a motion path containing straight line and arc segments, dwell, input and output instructions. |
| V | SegmentData | SegmentStruct | Structure of data that contains the segment number, output code, and tool path end-point for each segment in the motion path. |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| V | TableSize | UDINT | This value must be the same as the definition of the ARRAY size of the MS_Array_Type in the MotionInfo DataTypes folder of either the PLCopen or DataTypes Toolbox. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |

| | | | |
|---|---------|------------------------------|--|
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |
| V | PathID | PathIDStruct | For use by the Move_Path and PathIDManager function block. |

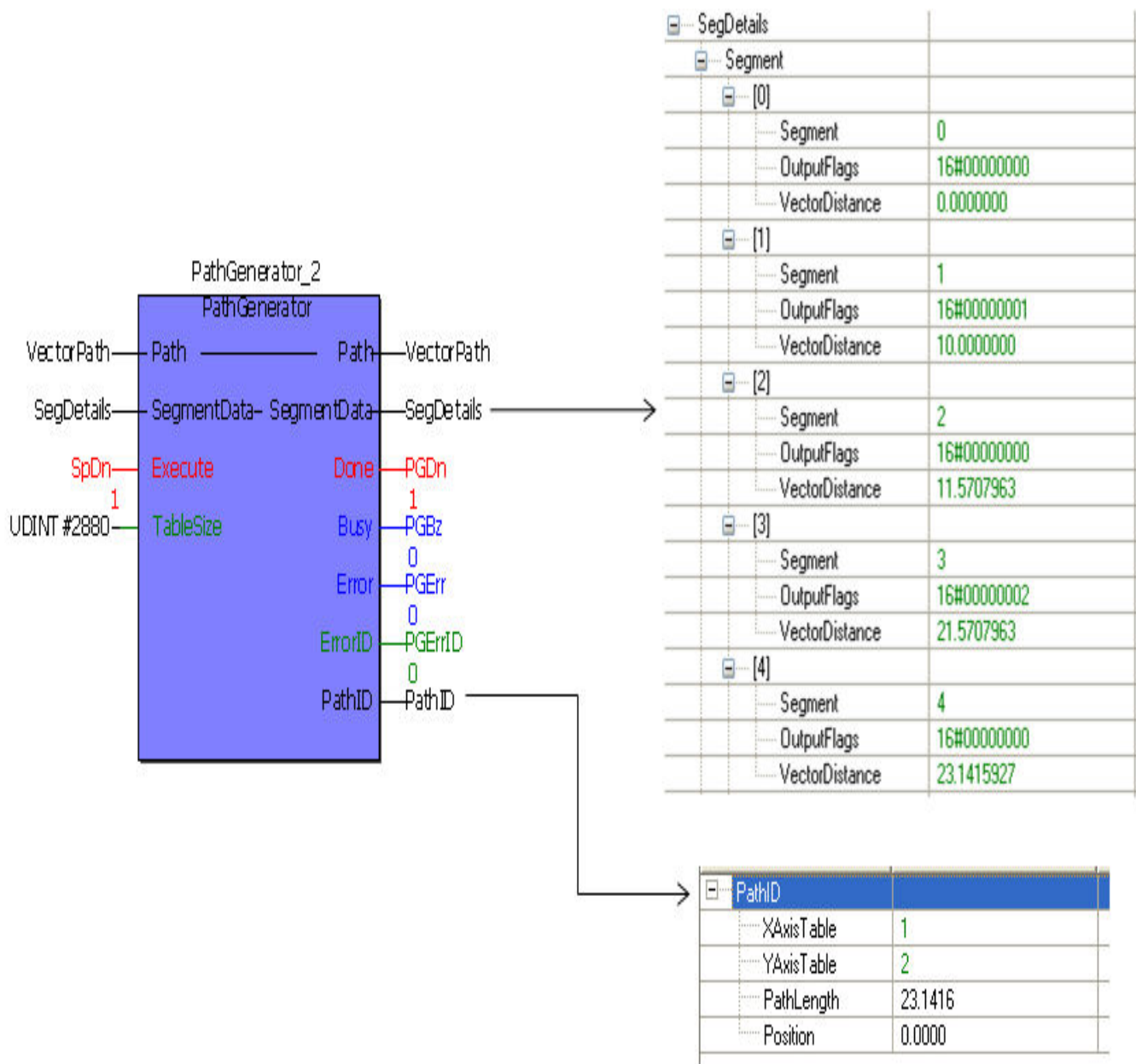
Notes

- The entire path must be specified and processed by the PathGenerator before motion can occur using the [MovePath](#) function block.
- If the PathGenerator will be executed multiple times because the application requires the ability to make a variable number of paths, you must use the [PathIDManager](#) function block to clear up the old cam memory in the motion engine layer.
- Do not use PathStruct element [0], start the path specification at element[1].

The inputs to the PathGenerator are shown below:



The outputs from the PathGenerator are shown below:



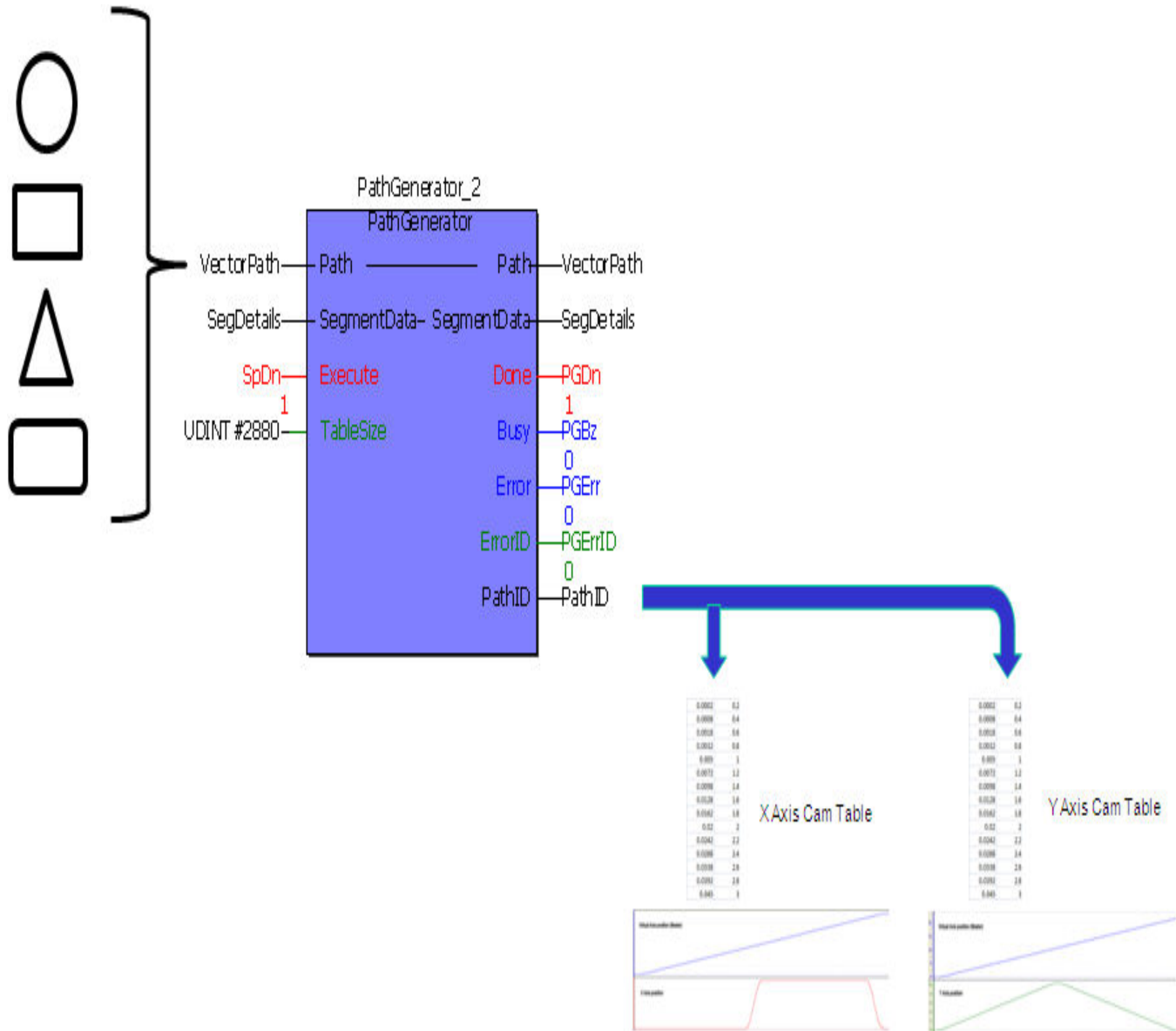
- See Yaskawa's Youtube channel for [more info](#), [details](#), and [examples](#).

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 10038 | CamData.LastSegment must be greater than 0 and less than 400, or whatever value has been declared as the ARRAY size in the CTB_Types file. |
| 10053 | DataPoint Error. |
| 10054 | One of the segments in the path has an invalid Segment Type. Valid Segments Types are defined in Group Toolbox GroupTypes file as enumeration GTB_SegmentType. |

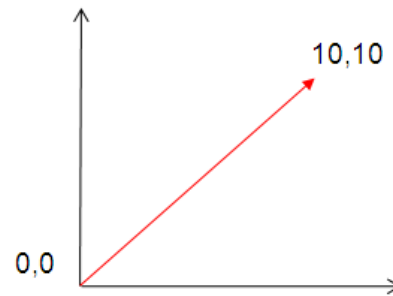
| | |
|-----------------------|--|
| 10055 | The absolute sum of the motion for all axes relative travel from the previous segment cannot be zero. One axis must always be in motion from segment to segment, otherwise the virtual master distance cannot be calculated. |
| 10056 | Arc Error. |
| 10057 | Point Error. |
| 10058 | The start angle must be a value from 0.0 to 360.0 degrees. |

Usage Example



PathStruct Example 1

Straight Line Path Example



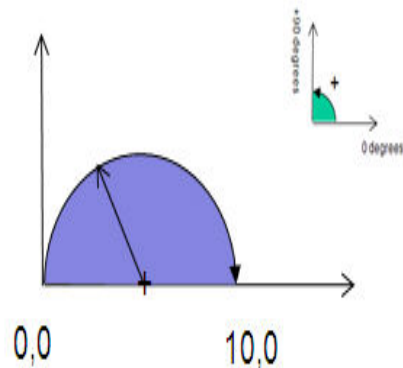
```
VectorPath.Data[1].SegmentType:=TB_PatternType#Straightline;  
VectorPath.Data[1].XCoord:=LREAL#10.0;  
VectorPath.Data[1].YCoord:=LREAL#10.0;
```

```
PathDetail:STRUCT  
  SegmentType:INT;  
  XCoord:LREAL;  
  YCoord:LREAL;  
  Radius:LREAL;  
  StartAngle:LREAL;  
  TraversedAngle:LREAL;  
  Resolution:REAL;  
  OutputFlags:DWORD;  
  MasterEnd:LREAL;  
END_STRUCT;  
  
PathPointArray: ARRAY[0..100] OF PathDetail;  
  
PathStruct: STRUCT  
  Data:PathPointArray;  
  Segments:INT;  
END_STRUCT;  
  
(* ENUM Type for PathDetail's SegmentType *)  
TB_PatternType:  
(  
  na,  
  StraightLine,  
  Arc
```

Gantry Datatypes

PathStruct Example 2

Arc Path Example



```

VectorPath.Data[2].SegmentType:=TB_PatternType#Arc;
VectorPath.Data[2].Radius:=LREAL#5.0;
VectorPath.Data[2].StartAngle:=LREAL#180.0;
VectorPath.Data[2].TraversedAngle:=LREAL#-180.0;
VectorPath.Data[2].Resolution:=REAL#0.05;
VectorPath.Data[2].OutputFlags:=DWORD#2

PathDetail:STRUCT
  SegmentType:INT;
  XCoord:LREAL;
  YCoord:LREAL;
  Radius:LREAL;
  StartAngle:LREAL;
  TraversedAngle:LREAL;
  Resolution:REAL;
  OutputFlags:DWORD;
  MasterEnd:LREAL;
END_STRUCT;

PathPointArray: ARRAY[0..100] OF PathDetail;

PathStruct: STRUCT
  Data:PathPointArray;
  Segments:INT;
END_STRUCT;

(* ENUM Type for PathDetail's SegmentType *)
TB_PatternType:
(
  na,
  StraightLine,
  Arc

```


PathStruct Example 3

Complex Path Example

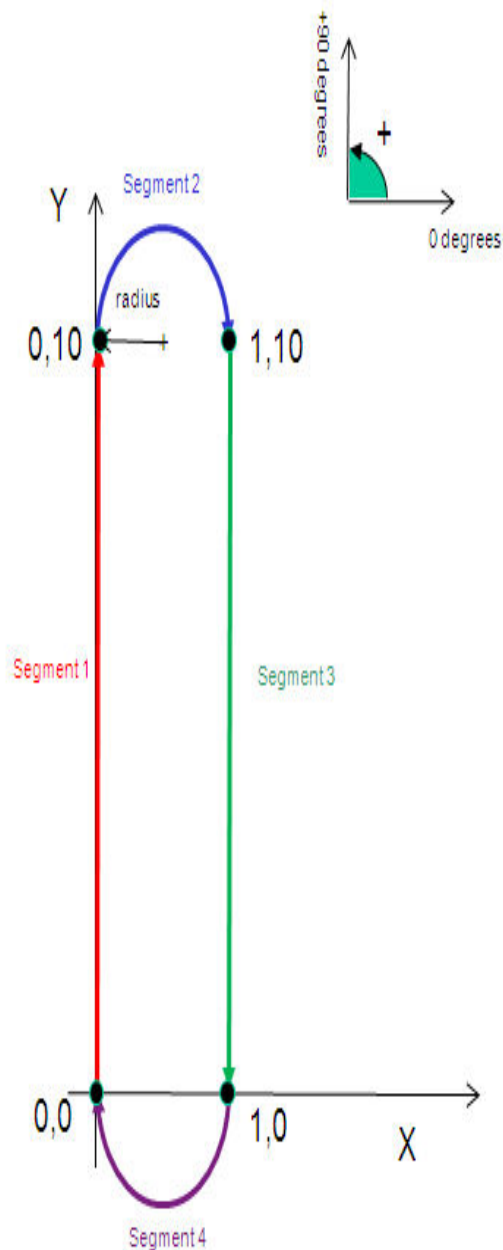
```
VectorPath.Data[1].SegmentType:=TB_PatternType#Straightline;  
VectorPath.Data[1].XCoord:=LREAL#0.0;  
VectorPath.Data[1].YCoord:=LREAL#10.0;  
VectorPath.Data[1].OutputFlags:=DWORD#1;
```

```
VectorPath.Data[2].SegmentType:=TB_PatternType#Arc;  
VectorPath.Data[2].Radius:=LREAL#0.5;  
VectorPath.Data[2].StartAngle:=LREAL#180.0;  
VectorPath.Data[2].TraversedAngle:=LREAL#-180.0;  
VectorPath.Data[2].Resolution:=REAL#0.05;
```

```
VectorPath.Data[3].SegmentType:=TB_PatternType#Straightline;  
VectorPath.Data[3].XCoord:=LREAL#1.0;  
VectorPath.Data[3].YCoord:=LREAL#0.0;  
VectorPath.Data[3].OutputFlags:=DWORD#2;
```

```
VectorPath.Data[4].SegmentType:=TB_PatternType#Arc;  
VectorPath.Data[4].Radius:=LREAL#0.5;  
VectorPath.Data[4].StartAngle:=LREAL#0.0;  
VectorPath.Data[4].TraversedAngle:=LREAL#-180.0;  
VectorPath.Data[4].Resolution:=REAL#0.05;
```

```
VectorPath.Segments:=INT#4;
```



Application example

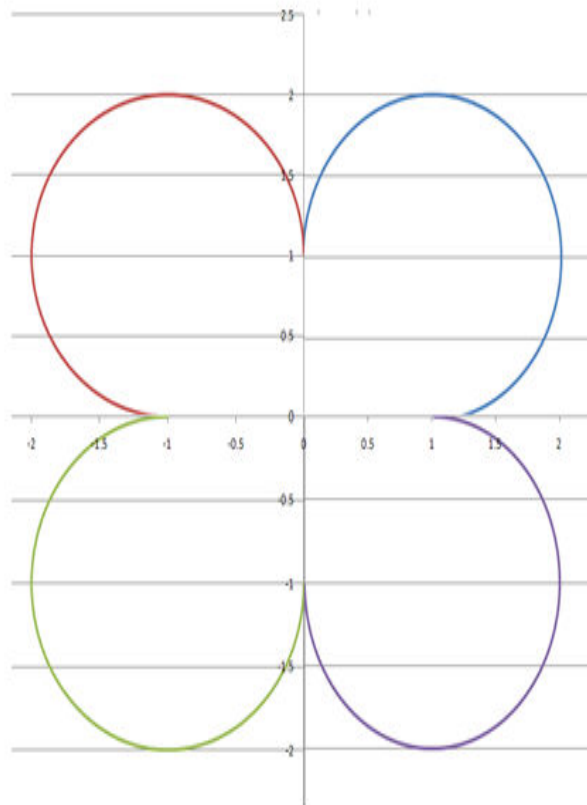
Step1: Using Calculate_Angles to calculate start and traverse angles for the flower path shown below

Calculate_Angles_1(Execute:=TRUE,ArcDefinitionMode:=INT#1,X1:=LREAL#-1.0,X2:=LREAL#0.0,Y1:=LREAL#0.0,Y2:=LREAL#1.0,Radius:=LREAL#-1.0,Direction:=FALSE);

Calculate_Angles_2(Execute:=TRUE,ArcDefinitionMode:=INT#1,X1:=LREAL#0.0,X2:=LREAL#1.0,Y1:=LREAL#1.0,Y2:=LREAL#0.0,Radius:=LREAL#-1.0,Direction:=FALSE);

Calculate_Angles_3(Execute:=TRUE,ArcDefinitionMode:=INT#1,X1:=LREAL#1.0,X2:=LREAL#0.0,Y1:=LREAL#0.0,Y2:=LREAL#-1.0,Radius:=LREAL#-1.0,Direction:=FALSE);

Calculate_Angles_4(Execute:=TRUE,ArcDefinitionMode:=INT#1,X1:=LREAL#0.0,X2:=LREAL#-1.0,Y1:=LREAL#-1.0,Y2:=LREAL#0.0,Radius:=LREAL#-1.0,Direction:=FALSE);

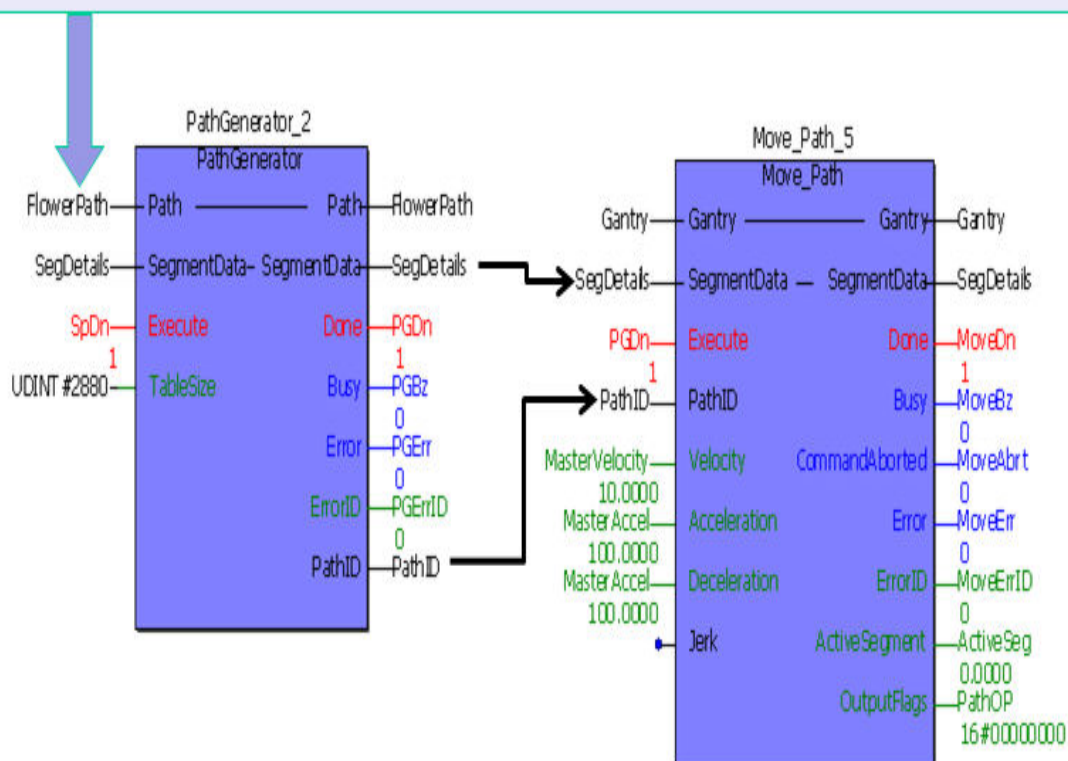


Step 2: Use PathGenerator create the path and Move_Path to implement XY motion

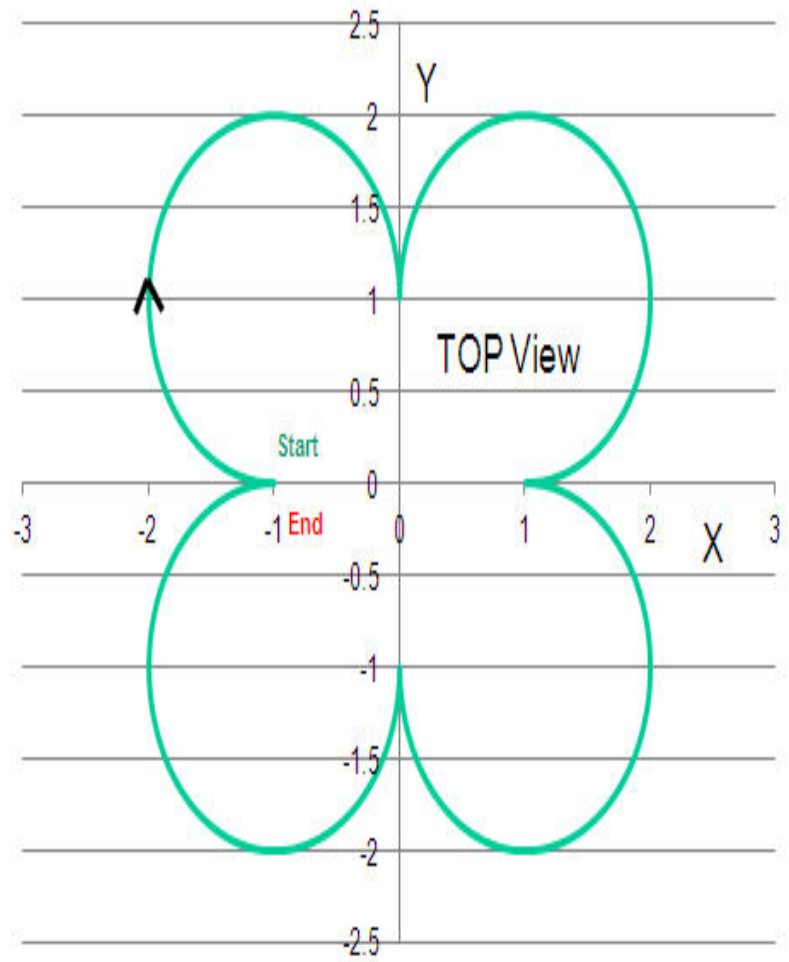
```

FlowerPath.Data[1].SegmentType:=TB_PatternType#Arc;
FlowerPath.Data[1].Radius:=LREAL#1.0;
Calculate_Angles_1(Execute:=TRUE,ArcDefinitionMode:=INT#1,X1:=LREAL#-1.0,X2:=LREAL#0.0,Y1:=LREAL#0.0,Y2:=LREAL#1.0,Radius:=LREAL#-1.0,Direction:=FALSE);
FlowerPath.Data[1].StartAngle:=Calculate_Angles_1.StartAngle;
FlowerPath.Data[1].TraversedAngle:=Calculate_Angles_1.TraversedAngle;
FlowerPath.Data[1].Resolution:=LREAL#0.05;

```

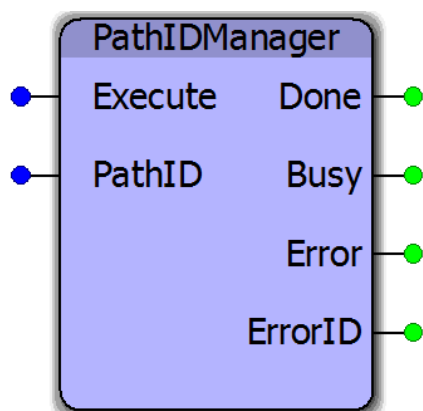


Step 3: Validation using logic analyzer





PathIDManager



This function block cleans up memory for applications which require many new paths during normal operation. This function block incorporates a FIFO buffer for PathIDs. It will delete memory used by the motion engine allocated to the oldest PathID by executing the Y_RemoveCamTable function block from the PLCopenPlus firmware library. A circular buffer of four PathIDs is maintained by the PathIDManager. When this function block is executed a fifth time, it releases the memory area of the oldest PathID. This function block does not affect the memory used in the IEC application layer, only the memory used at the motion engine layer for controller motion.

Library

Gantry Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|------------------------------|--|
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| V | PathID | PathIDStruct | The most recent PathID created by the PathGenerator function block. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |

| | | | |
|---|---------|------|--|
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

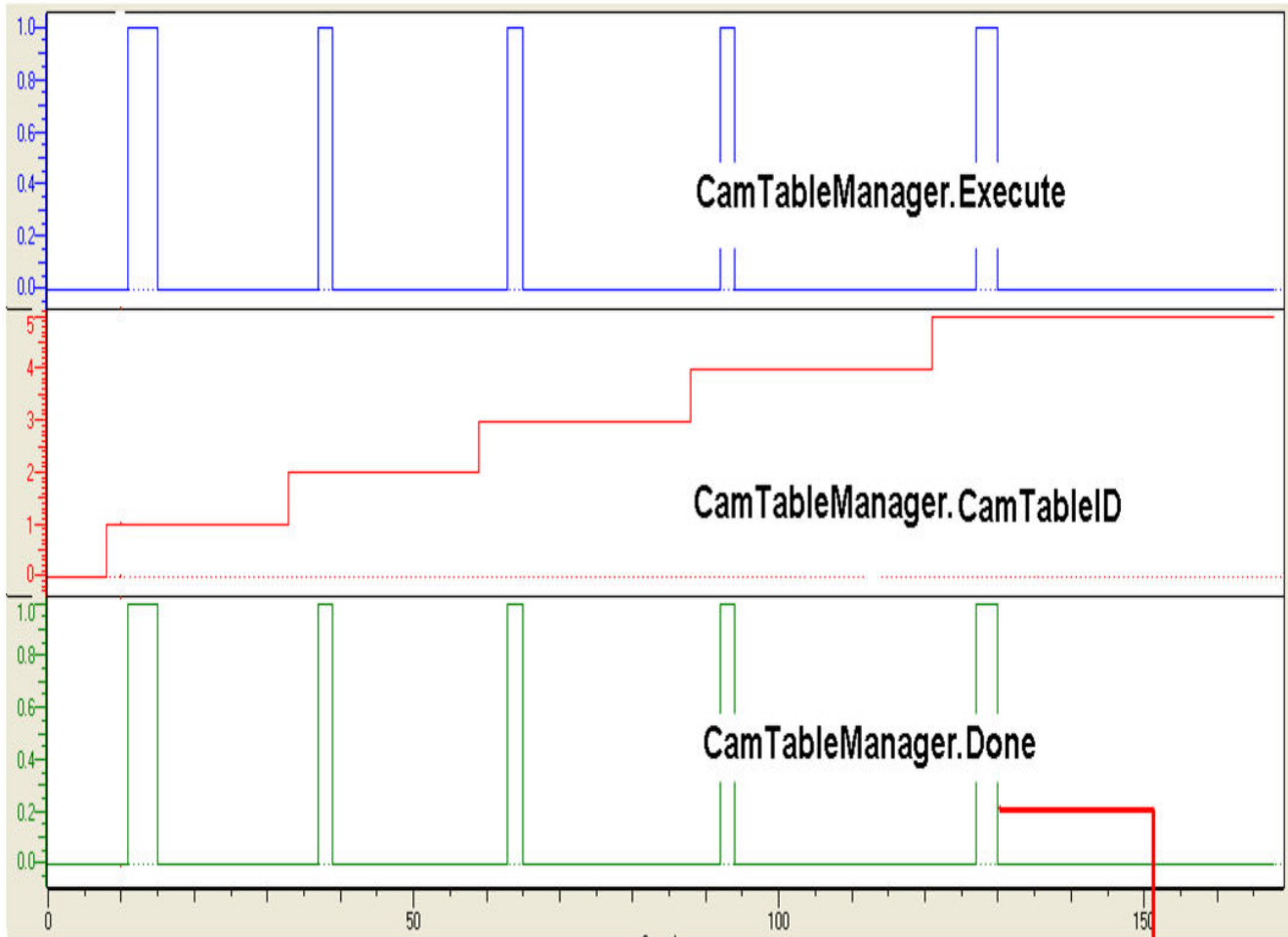
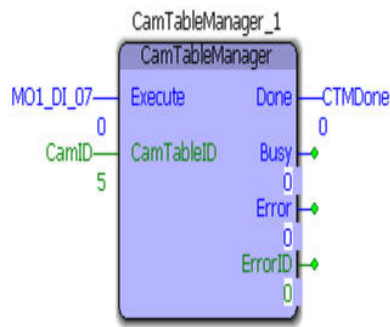
- Add the PathIDManager to the Done output of the PathGenerator. Feed it the PathID output from the PathGenerator. PathIDManager keeps a circular buffer of 4 PathIDs. When a PathID becomes the oldest in the buffer, the path is removed from the motion engine memory. This is the memory used by the controller to process motion, not the memory used the path data in the IEC application task.
- Even though the memory for cam tables has been released, the PathID values will continue to increase.
- If the PathGenerator is executed numerous times (dozens or hundreds) without cleaning up the motion engine memory, a "Memory Exhausted" controller alarm will result.
- This function block is unnecessary in applications which use a single, static PathID.

Error Description

| ErrorID | Meaning |
|----------------------|---|
| 0 | No error. |
| 4887 | CamTableID does not refer to a valid cam table. |

Example 1

An example of using the CamTableManager is shown below; it operates very similarly to the PathIDManager function block. On the fifth execute of the PathIDManager block, the memory for the oldest Path ID gets released. In the example shown below, the memory for PathID 1 gets released. The next execution of the PathIDManager will release the memory for PathID 2.



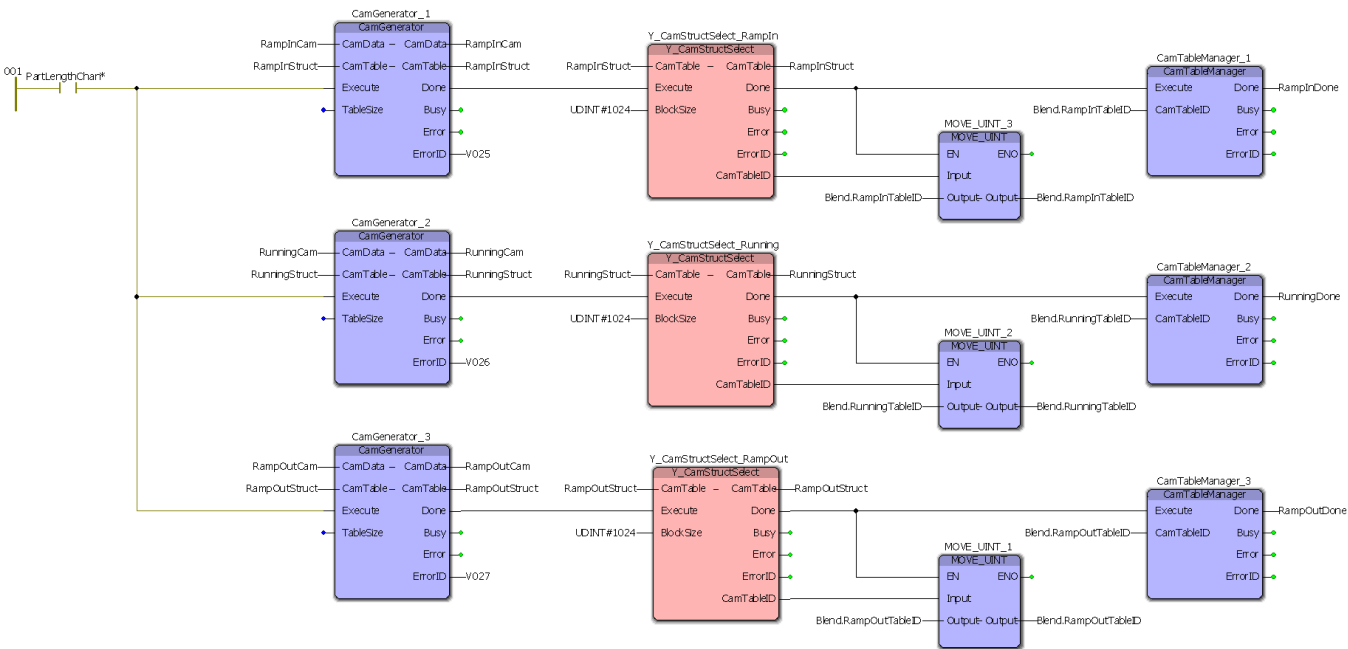
Watch Window

| Variable | Value | De |
|-----------|-------|----|
| CamTables | | |
| [0] | 1 | |
| [1] | 2 | |
| [2] | 3 | |
| [3] | 4 | |
| [4] | 5 | |

Watch 1 Watch 2 Watch 3 Watch 4 W

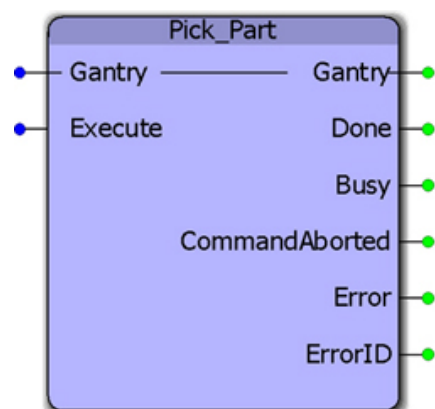
Memory for Cam ID 1 gets cleared

Application Example





Pick_Part



Assuming that a gripper actuator is empty and available to pick up a part in its mechanism, this function block initiates a series of actions that involves moving the XY axes to a specific location, opening a gripper actuator, moving the Z axis to a "Down" location, closing the gripper (to pick a part), and then finally moving the Z axis back to its "Up" position.

Library

Gantry Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|------------------------------|--|
| VAR_IN_OUT | | | |
| V | Gantry | GantryStruct | Contains all information pertaining to a gantry system. |
| VAR_INPUT | | | |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| | | | Default FALSE |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |

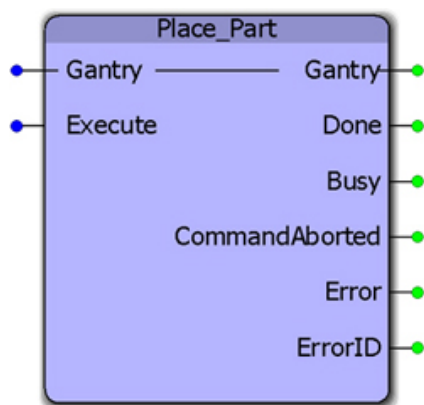
| | | | |
|---|----------------|------|---|
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4642 | Direction does not correspond to a valid enumeration value. |
| 4658 | Velocity parameter is less than or equal to zero. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 10034 | Interpolation calculation error. |
| 10035 | Gripper Close Error (Timeout). |
| 10036 | Latch Error. LatchReference was negative. This situation should never occur. Verify that the normal axis movement is in a positive direction. Use PLCopen Toolbox v340 which contains improved code for applications with registration marks near the end of the default move. DCR 1183 |
| 57617 | Instance object is NULL. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |



Place_Part



Given that a gripper actuator already has a part in its mechanism, this function block initiates a series of actions that involves moving the XY axes to a specific location, moving the Z axis to a "Down" location, opening the gripper (to place the part), and then finally moving the Z axis back to its "Up" position.

Parameters

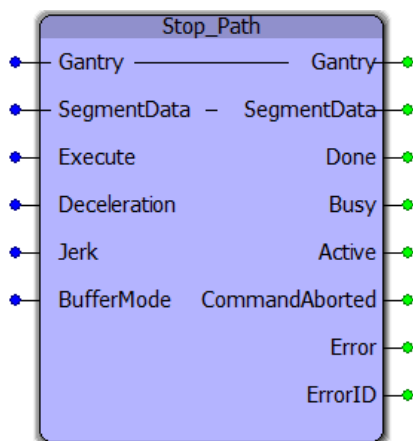
| * | Parameter | Data Type | Description |
|-------------------|----------------|------------------------------|--|
| VAR_IN_OUT | | | |
| V | Gantry | GantryStruct | Contains all information pertaining to a gantry system. |
| VAR_INPUT | | | |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4642 | Direction does not correspond to a valid enumeration value. |
| 4658 | Velocity parameter is less than or equal to zero. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 10034 | Interpolation calculation error. |
| 10035 | Gripper Close Error (Timeout). |
| 10036 | Latch Error. LatchReference was negative. This situation should never occur. Verify that the normal axis movement is in a positive direction. Use PLCopen Toolbox v340 which contains improved code for applications with registration marks near the end of the default move. DCR 1183 |
| 57617 | Instance object is NULL. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |



Stop_Path



This function block stops motion executed by the [Move_Path](#) function block.

Library

Gantry Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|--------------|---------------|--|
| VAR_IN_OUT | | | |
| V | Gantry | GantryStruct | Structure containing information about all the axes in the Gantry system. |
| V | SegmentData | SegmentStruct | Structure containing data about the path motion |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| B | Deceleration | LREAL | Value of the deceleration in user units/second ² (deceleration is applicable with opposite signs of torque and velocity.) |
| E | Jerk | LREAL | <i>Not supported; reserved for future use.</i> |

| | | | | |
|-------------------|----------------|----------------|--|------------------------|
| B | BufferMode | MC_Buffer-Mode | Defines the behavior of the axis - allowable modes are Aborting, Buffered, BlendingLow, BlendingPrevious, BlendingNext, and BlendingHigh. | MC_BufferMode#Aborting |
| VAR_OUTPUT | | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |
| B | Active | BOOL | For buffered modes, this output is set high at the moment the block takes control of the axis. For non buffered modes, the outputs Busy and Active have the same value. | |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

- This function block applies MC_Stop to the virtual axis of the Gantry specified.

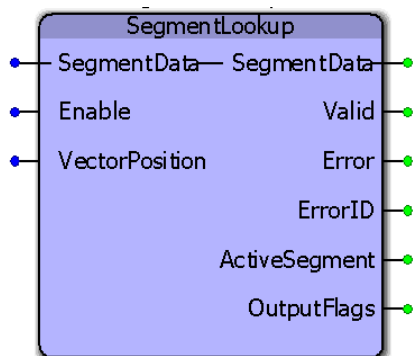
Error Description

| ErrorID | Meaning |
|----------------|--|
| 0 | No error. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4660 | Deceleration is less than or equal to zero. |
| 4983 | The specified external axis may not be used. A physical axis is required. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |

Example



SegmentLookup



This function block outputs the number of the segment currently active and also outputs the flags for the active segment.

Library

Gantry Toolbox

Parameters

| * | Parameter | Data Type | Description | |
|------------|----------------|-------------------------------|--|-----------|
| VAR_IN_OUT | | | | |
| V | Segmentdata | SegmentStruct | Structure of data that contains the segment number, output code, and tool path endpoint for each segment in the motion path. | |
| VAR_INPUT | | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. | FALSE |
| V | VectorPosition | LREAL | Position of the vector along the path relative to the start of the Move_Path function block. This value can be obtained from the virtual axis of the Gantry. | LREAL#0.0 |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |
| V | ActiveSegment | INT | The segment that corresponds to the current position of the vector relative to the start of the Move_Path function block. | |
| V | OutputFlags | DWORD | Outputs as a DWORD that can be used to control digital output patterns unique for each segment. | |

Error Description

| ErrorID | Meaning |
|-----------------------|---|
| 0 | No error. |
| 10140 | Must be greater than zero and less than 20. |

Example

Consider the profile shown below:

```

(*Racetrack path*)
(*=====*)

1 VectorPath.Data[1].SegmentType:=TB_PatternType#Straightline;
0.0000000 VectorPath.Data[1].XCoord:=LREAL#0.0;
10.0000000 VectorPath.Data[1].YCoord:=LREAL#10.0;
16#00000001 VectorPath.Data[1].OutputFlags:=DWORD#1;

2 VectorPath.Data[2].SegmentType:=TB_PatternType#Arc;
0.5000000 VectorPath.Data[2].Radius:=LREAL#0.5;
180.0000000 VectorPath.Data[2].StartAngle:=LREAL#180.0;
-180.0000000 VectorPath.Data[2].TraversedAngle:=LREAL#-180.0;
0.0500000 VectorPath.Data[2].Resolution:=REAL#0.05;

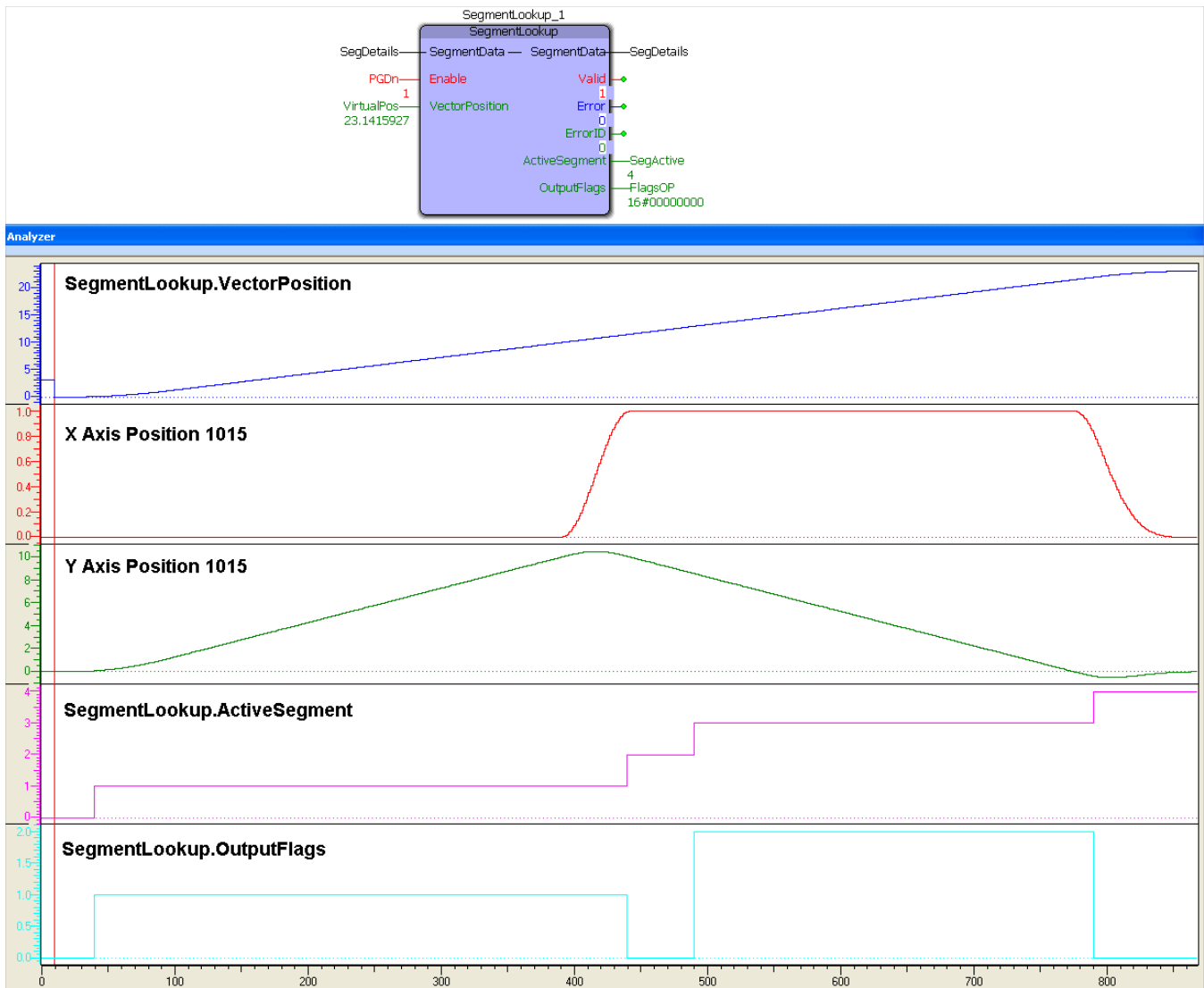
1 VectorPath.Data[3].SegmentType:=TB_PatternType#Straightline;
1.0000000 VectorPath.Data[3].XCoord:=LREAL#1.0;
0.0000000 VectorPath.Data[3].YCoord:=LREAL#0.0;
16#00000002 VectorPath.Data[3].OutputFlags:=DWORD#2;

2 VectorPath.Data[4].SegmentType:=TB_PatternType#Arc;
0.5000000 VectorPath.Data[4].Radius:=LREAL#0.5;
0.0000000 VectorPath.Data[4].StartAngle:=LREAL#0.0;
-180.0000000 VectorPath.Data[4].TraversedAngle:=LREAL#-180.0;
0.0500000 VectorPath.Data[4].Resolution:=REAL#0.05;

4 VectorPath.Segments := INT#4;

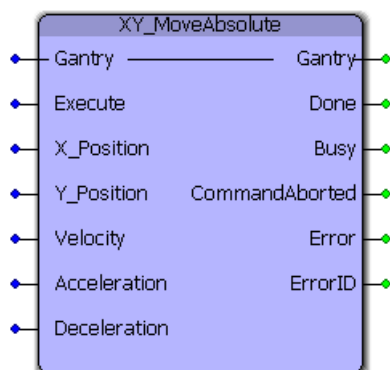
```

The output flags are set to DWORD#1 during segment 1 and set to DWORD#2 during segment 3. These can be seen in the logic analyzer plots from the SegmentLookup outputs.





XY_MoveAbsolute



This function block will perform an absolute move the X and Y axes to a specific location within the gantry coordinate system. The X and Y axes must be specified in [GantryStruct](#) before executing this function block. This block calculates the required acceleration, deceleration and velocity for each axis and then executes MC_MoveAbsolute function blocks simultaneously for each axis to create straight line motion at the tool point. This is not considered interpolated motion. If configured, no motion on the Z axis will occur.

Library

Gantry Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|--------------|------------------------------|--|
| VAR_IN_OUT | | | |
| V | Gantry | GantryStruct | Contains all information pertaining to a gantry system. |
| VAR_INPUT | | | |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| B | X_Position | LREAL | Target X coordinate of the vector. |
| B | Y_Position | LREAL | Target Y coordinate of the vector. |
| B | Velocity | LREAL | Velocity of the vector. |
| B | Acceleration | LREAL | Acceleration of the vector. |
| B | Deceleration | LREAL | Deceleration of the vector. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |

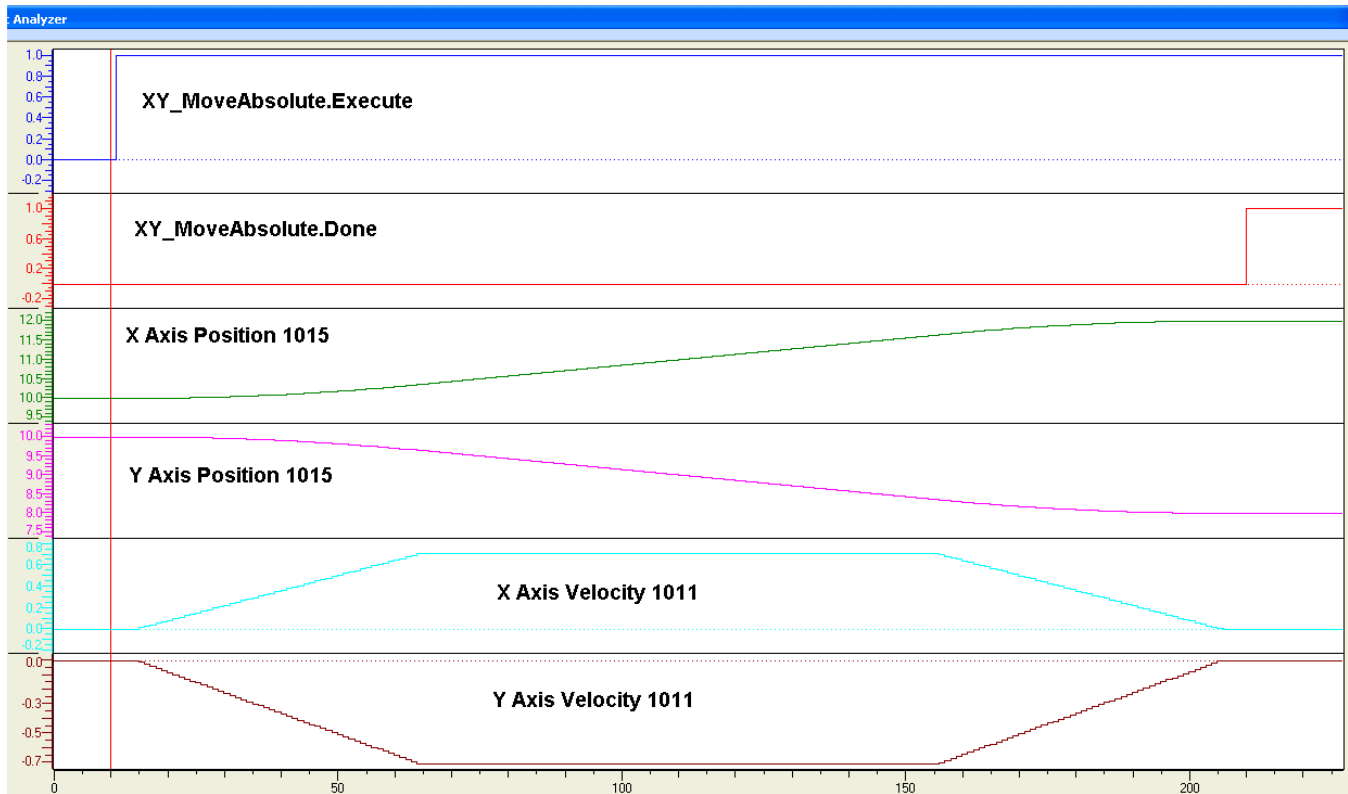
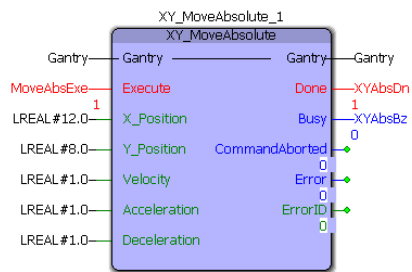
| | | | |
|---|----------------|------|--|
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4642 | Direction does not correspond to a valid enumeration value. |
| 4658 | Velocity parameter is less than or equal to zero. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 10034 | Interpolation calculation error. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |

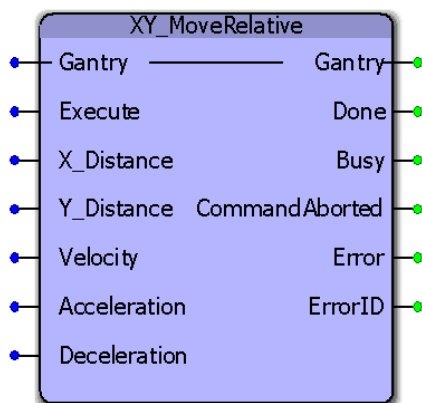
Example

In the example shown below, the XY gantry tooltip is at coordinate 10,10. The target coordinate is 12,8. On executing the XY_MoveAbsolute function block, the X, Y axes move such that the tooltip's final position is 12, 8. The velocities, accelerations and decelerations of the two axes are calculated (in XY_MoveAbsolute) such that the individual axes start and stop at the same time instant.





XY_MoveRelative



This function block will perform a relative move on the tooltip in a gantry coordinate system. The X and Y axes must be specified in [GantryStruct](#) before executing this function block. This block calculates the required acceleration, deceleration and velocity for each axis and then executes MC_MoveRelative function blocks simultaneously for each axis to create straight line motion at the tool point. This is not considered interpolated motion. If configured, no motion on the Z axis will occur.

Library

Gantry Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|--------------|------------------------------|--|
| VAR_IN_OUT | | | |
| V | Gantry | GantryStruct | Contains all information pertaining to a gantry system. |
| VAR_INPUT | | | |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| V | X_Distance | LREAL | X coordinate distance to be moved |
| V | Y_Distance | LREAL | Y coordinate distance to be moved |
| B | Velocity | LREAL | Velocity of the tool tip |
| B | Acceleration | LREAL | Acceleration of the tool tip |
| B | Deceleration | LREAL | Deceleration of the tool tip |
| VAR_OUTPUT | | | |

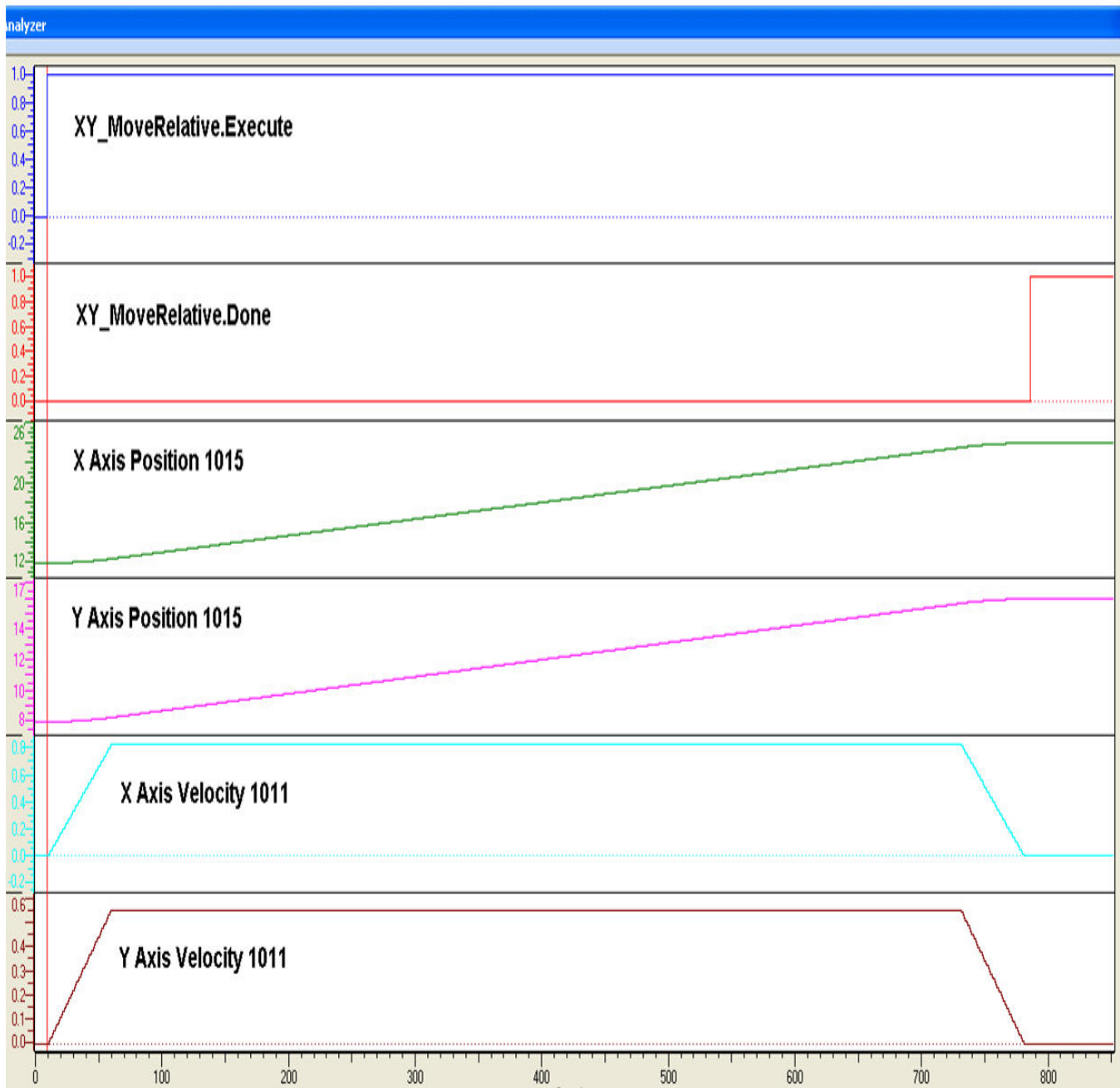
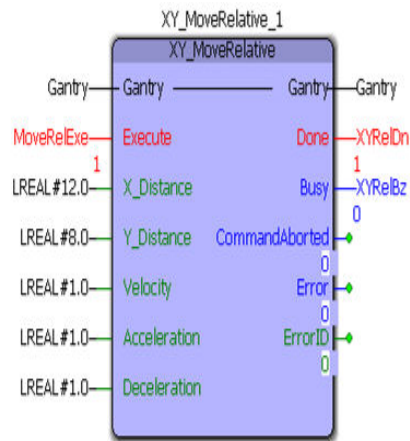
| | | | |
|---|----------------|------|--|
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4642 | Direction does not correspond to a valid enumeration value. |
| 4658 | Velocity parameter is less than or equal to zero. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 10034 | Interpolation calculation error. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |

Example

In the example shown below, the X Y coordinate of the tool tip is 12,8. On commanding an XY_MoveRelative move of 12, 8, the tool tip moves to coordinates 24, 16. The velocities, accelerations and decelerations of the two axes are calculated (in XY_MoveRelative) such that the individual axes start and stop at the same time instant.



Group_Toolbox

Toolbox Help Documentation

Help version created 1/31/2018

YASKAWA



Getting Started with Group Toolbox

The Group Toolbox is the successor to the Gantry Toolbox, which was created before the MPiec product officially supported interpolated motion for groups of axes. (PLCopen Part 4.) Group Toolbox is only supported on MP3000iec series controllers.

Requirements for v340

To use the Group Toolbox, your project must also contain the following:

Firmware libraries:

- YMotion
- YCoordinatedMotion
- Y_DeviceComm - only if using [Read_GCode_Stream](#).

User libraries:

The following User Libraries must be listed above the Group Toolbox and in the following order:

- DataTypes_Toolbox (v340 or higher)
- Math_Toolbox (v340 or higher)
- Yaskawa Toolbox (v340 or higher) **Note: The Yaskawa Toolbox provided in the Toolbox Installer February 2018 edition includes new StripSpaces function block (required.) Filename still indicates v340, but the project build number is 3.4.1.**
- PLCopen_Toolbox (v340 or higher)
- PLCopenPart4 supporting library, such as Group_stub_v340 or MLX200_v220a. MotionWorks IEC version 3.3.0 and higher can automatically manage this library when saving the Hardware Configuration.
- PLCopenPart4 (v340 or higher.) MotionWorks IEC version 3.3.0 and higher can automatically manage this library when saving the Hardware Configuration.
- FileRW Toolbox (v340 or higher) if using G Code function blocks.
- Comm Toolbox (v340 or higher) if using Read_GCode_Stream.

Requirements for v330

To use the Group Toolbox, your project must also contain the following:

Firmware libraries:

- YMotion
- YCoordinatedMotion
- Y_DeviceComm - if using [Read_GCode_Stream](#).

User libraries:

The following User Libraries must be listed above the Group Toolbox and in the following order:

- DataTypes_Toolbox (v330 or higher)
- Math_Toolbox (v331 or higher. **Note! This is one revision higher than the Math Toolbox released with MotionWorks IEC 3.3.0)**
- Yaskawa Toolbox (v330 or higher)
- PLCopen_Toolbox (v330 or higher)
- PLCopenPart4 supporting library, such as Group_stub_v330 or MLX200_v214a. MotionWorks IEC version 3.3.0 and higher can automatically manage this library when saving the Hardware Configuration.
- PLCopenPart4 (v330 or higher) MotionWorks IEC version 3.3.0 and higher can automatically manage this library when saving the Hardware Configuration.
- FileRW Toolbox (v302 or higher) - if using G Code function blocks.
- Comm Toolbox (v301 or higher) - if using [Read_GCode_Stream](#).

Background

Differences from Gantry Toolbox

- Gantry Toolbox included functions such as GantryPower, GantryStop, and XYMoveAbsolute. These functions treated individual axes as a group at the IEC application layer, and did not provide true interpolated motion calculated by the firmware.
- For path functions via PathGenerator and MovePath, Gantry Toolbox converted the path motion required into cam tables and used a virtual master to drive the vector path. Group Toolbox uses firmware interpolation and group support to provide motion for gantries and other mechanisms such as T-Bot, H-Bot, Delta robots and MLX200 hosted robots.
- Gantry toolbox did not support gantries with dual motors operating one joint. Through firmware support for groups with more than one motor on a given axis, more complex gantries are supported using Group Toolbox techniques.
- Gantry Toolbox could only make paths of finite lengths which must be completely specified before motion starts. Group Toolbox can make infinite path lengths and start motion before all the data has been processed.
- Both Toolboxes offer similar MovePath functions to build complex motion sequences, but Group toolbox takes advantage of the features of PLCopen Part 4, and provides support for blended paths, circles on any plane, and a potentially infinite path length.



Group Toolbox Revision History

Current Version:

(***** 2017-12-07 v340 released. firmware 3.4.0 or higher required. *****)

New Features and Improvements:

- 1) AlignPrimeAxis - New function block added. DCR 1053.
- 2) PlaneMeasurement - New function block added. DCR 1103.
- 3) GroupToHome - New function block added. DCR 1234.
- 4) MachineStruct - Added .MachineType to select milling, lathe, printer modes.
- 5) GroupControl - Added ability to execute MC_Reset on all axes configured in Group. DCR 1080 / 1090.
- 6) MC_MovePath - Improved handling of non colinear segments to avoid ErrorID 9000,9001,9002,9003. DCR 1012
- 7) MC_MovePath - Improved Segment tracking so path outputs can be operated accurately. DCR 1083.
- 8) Read_GCode_File - Added Abort input to cancel reading a file. DCR 1093.
- 9) Support G Code variables - DCR 1095.
- 10) Read_GCode_File - Improve scan time stability. Improvements to minimize scan time spikes caused when the function processes bytes into the PathStruct. DCR 1222.
- 11) MachineStruct.EmulationMode - Support for alternate way of setting vel and accel in units/sec.
- 12) MC_PATH_DATA_REF.StreamStatus - Added support for byte offset referencing for G Code so host can determine the live motion segment. DCR 1224.
- 13) Read_GCode_Stream - Expose ErrorRow and ErrorString as VAR_OUTPUT. DCR 1208.
- 14) MachineStruct - Added MaxAcceleration and MaxDeceleration. DCR 1239.
- 15) G Code - Added support for mathematical expressions and subprograms. DCR 1240.

Changes:

- 16) MC_MovePath - Some Outputs changed for clarity. Now label and segment are identified as 'Processed' and 'Executed'. DCR 1092.
- 17) MC_MovePath - changed VAR_INPUT VelocityOverride to VelocityScaler to differentiate from new MC_GroupSetOverride released in firmware v3.4.0. DCR 1238.

Bug Fixes:

- 18) MC_MovePath - Fix bug with total motion block count. Sometimes the value would go negative. DCR 1094.
- 19) G Code processing - Bug fix in ColinearityCheck for Line to Arc, Arc to Line cases. DCR 1283.
- 20) G Code - Processing of I,J,K registers for circle definition was not being properly scaled if required. DCR 1305.
- 21) GCode G04 was interpreting the P parameter in seconds but the G Code RS 274 specification indicates milliseconds. Now the P parameter is milliseconds, and the X parameter can be used to specify seconds. DCR 1382.

Previous Versions:

(***** 2017-01-07 v330 released *****)

This is the first release.



G Code Support

G Codes

| Command | Description | Support | Comment |
|---------|--|---------|---|
| G00 | Rapid positioning. (Max speed for each axis) | No | Requires firmware support for MC_MoveDirectAbsolute and MC_MoveDirectRelative. The G Code parser will interpret a G0 as a G1. Future support is planned. |
| G01 | Linear interpolation | Yes | |
| G02 | CCW circular interpolation | Yes | Use R for radius mode or I,J,K for circle center. |
| G03 | CW circular interpolation | Yes | Use R for radius mode or I,J,K for circle center. |
| G04 | Dwell | Yes | Time (in milliseconds) must be given in parameter P. |
| G05 | High-precision contour control (HPCC). | No | Uses a deep look-ahead buffer and simulation processing to provide better axis movement acceleration and deceleration during contour milling. |
| G06 | Non uniform rational B Spline machining. | No | Uses a deep look-ahead buffer and simulation processing to provide better axis movement acceleration and deceleration during contour milling. |
| G07 | Imaginary axis designation | No | Uses a deep look-ahead buffer and simulation processing to provide better axis movement acceleration and deceleration during contour milling. |
| G08 | | | |
| G09 | Exact Stop, non-modal. | Yes | Modal version is G61. |
| G10 | Select work coordinate and tool offsets. | Yes | Two modes of behavior based on MachineStruct.MachineType setting. 3D Printer Configuration: This code has different meaning if the MachineStruct is configured to operate a 3D Printer. If selected as a 3D Printer, this command retracts the extruder. |
| G11 | Data write cancel | No | |
| G12 | Full-circle clockwise interpolation | No | |
| G13 | Full-circle counterclockwise interpolation | No | |
| G17 | XY Plane Selection | No | This is the default |
| G18 | ZX Plane Selection | No | |
| G19 | YZ Plane Selection | No | |

| Command | Description | Support | Comment |
|---------|--|---------|---|
| G20 | Programming in inches | Yes | The Group Toolbox G_Code feature will default to the user units configured in the Hardware Configuration. If all G Code files will contain position data in the configured user units of the machine, G20 / G21 are not required. If G Code files may contain different user units, the application program must read parameter 1813 using the HC_ReadParameter function block to obtain the configured user units. Copy this parameter value into PathData.HC_UserUnits. This will allow the G_Code parser to convert positions in the G Code file to the configured units of the machine. |
| G21 | Programming in mm | Yes | The Group Toolbox G_Code feature will default to the user units configured in the Hardware Configuration. If all G Code files will contain position data in the configured user units of the machine, G20 / G21 are not required. If G Code files may contain different user units, the application program must read parameter 1813 using the HC_ReadParameter function block to obtain the configured user units. Copy this parameter value into PathData.HC_UserUnits. This will allow the G_Code parser to convert positions in the G Code file to the configured units of the machine. |
| G28 | Return to the Home Position | No | Return to the machine's reference position, sometimes called the zero position. That zero return position is where most programs begin. |
| G30 | Return to the Secondary Home Position | No | Takes a P address specifying which machine zero point is desired, if the machine has several secondary points (P1 to P4). |
| G31 | Skip Function | No | Used for probes and tool length measurement systems. |
| G32 | Single-point threading, longhand style | No | Similar to G01 linear interpolation, except with automatic spindle synchronization for single-point threading. |
| G33 | Constant-pitch threading | No | |
| G34 | Variable-pitch threading | No | |
| G40 | Tool radius compensation off | Yes | Turn off cutter radius compensation. Cancels G41 or G42. |
| G41 | Tool radius compensation left | Yes | Creates a Left Tool Compensation along the XY axis. Tool Data can be found in the Tool structure. |
| G42 | Tool radius compensation right | Yes | Creates a Right Tool Compensation along the XY axis. Tool Data can be found in the Tool structure. |
| G43 | Tool height offset compensation negative | No | Uses the H register as the tool length offset. The value is negative because it will be added to the gauge line position. |
| G44 | Tool height offset compensation positive | No | |
| G45 | Axis offset single increase | No | |
| G46 | Axis offset single decrease | No | |
| G47 | Axis offset double increase | No | |
| G48 | Axis offset double decrease | No | |
| G49 | Tool length offset compensation cancel | No | |
| G50 | Define the maximum spindle speed/Scaling function cancel | No | |
| G52 | Local Coordinate System. This is an offset from the current offset | No | |

| Command | Description | Support | Comment |
|---------|---|---------|--|
| G53 | Machine coordinate system. Takes absolute coordinates (X,Y,Z,A,B,C) with reference to machine zero rather than program zero. Can be helpful for tool changes. | Yes | Use Machine Coordinate System (MCS.) Unlike the G Code specification, this command is modal, meaning all future commands will use this coordinate system until changed to another using G54 ~ G59. |
| G54 | Work Coordinate System 1 | Yes | Selects the offsets in MachineStruct.CoordinateSystem.Offset [1]. Set the offsets using G10, or write to MachineStruct.CoordSystem.Offset directly. |
| G55 | Work Coordinate System 2 | Yes | Selects the offsets in MachineStruct.CoordinateSystem.Offset [2]. Set the offsets using G10, or write to MachineStruct.CoordSystem.Offset directly. |
| G56 | Work Coordinate System 3 | Yes | Selects the offsets in MachineStruct.CoordinateSystem.Offset [3]. Set the offsets using G10, or write to MachineStruct.CoordSystem.Offset directly. |
| G57 | Work Coordinate System 4 | Yes | Selects the offsets in MachineStruct.CoordinateSystem.Offset [4]. Set the offsets using G10, or write to MachineStruct.CoordSystem.Offset directly. |
| G58 | Work Coordinate System 5 | Yes | Selects the offsets in MachineStruct.CoordinateSystem.Offset [5]. Set the offsets using G10, or write to MachineStruct.CoordSystem.Offset directly. |
| G59 | Work Coordinate System 6 | Yes | Selects the offsets in MachineStruct.CoordinateSystem.Offset [6]. Set the offsets using G10, or write to MachineStruct.CoordSystem.Offset directly. G59.1 through G59.3 are also supported. |
| G61 | Exact stop check, modal. Can be canceled with G64. Non-modal version is G09. | Yes | |
| G62 | Automatic Corner Override | No | |
| G64 | Default cutting mode. Cancels G61 | Yes | |
| G70 | Fixed cycle, multiple repetitive cycle, for finishing (including contours) | No | |
| G71 | Fixed cycle, multiple repetitive cycle, for roughing (Z-axis emphasis) | Yes | For Lathe. |
| G72 | Fixed cycle, multiple repetitive cycle, for roughing (X-axis emphasis) | No | |
| G73 | Fixed cycle, multiple repetitive cycle, for roughing, with pattern repetition | No | |
| G74 | Tapping cycle for milling, left hand thread, M04 spindle direction | No | |
| G75 | Peck grooving cycle for turning | No | |
| G76 | Fine boring cycle for milling | No | |
| G78 | Tangent Motion Enable | Yes | Synchronizes a theta axis external to the AxesGroup to the XY plane of a path. The external axis must be defined as shown in the example for MC_MovePath . Requires Software and firmware 3.3.0. |
| G79 | Tangent Motion Disable | Yes | |
| G80 | Simple Drilling Cycle | No | |

| Command | Description | Support | Comment |
|---------|--|---------|---|
| G81 | Drilling Cycle with Dwell | No | |
| G83 | Peck Drilling cycle (full retraction from pecks) | No | |
| G84 | Tapping cycle, righthand thread, M03 spindle direction | No | |
| G83 | Peck Drilling cycle (full retraction from pecks) | No | |
| G84 | Tapping cycle, righthand thread, M03 spindle direction | No | |
| G90 | Absolute Positioning | Yes | |
| G90 | Lathe: Straight Cutting Cycle | Yes | If MachineStruct.MachineType is set to Lathe, G90 commands will use a Straight Cutting Cycle macro. |
| G91 | Incremental Positioning | Yes | |
| G96 | Constant surface speed (CSS) | No | Varies spindle speed automatically to achieve a constant surface speed. |
| G97 | Constant spindle speed | Yes | Takes an S address integer, which is interpreted as rev/min (rpm). |
| G98 | Absolute Programming | Yes | Only valid if MachineStruct.Emulation:=GTB_Emulation#Mode1 |
| G99 | Incremental Programming | Yes | Only valid if MachineStruct.Emulation:=GTB_Emulation#Mode1 |

M Codes

| Command | Description | Support | Comment |
|---------|--|---------|--|
| M00 | Non-optional Stop. Machine always stops here | No | |
| M01 | Optional Stop. Only stops if Optional stop button has been pressed | No | |
| M02 | End of Program | Yes | |
| M03 | Spindle On (clockwise rotation) | Yes | Supported as MC_MovePath.OutputFlag.X3 |
| M04 | Spindle On (counterclockwise rotation) | Yes | Supported as MC_MovePath.OutputFlag.X4 |
| M05 | Spindle Stop | Yes | Supported as MC_MovePath.OutputFlag.X3 and X4 |
| M06 | Automatic Tool Change | No | |
| M07 | Coolant On (mist) | Yes | Supported as MC_MovePath.OutputFlag.X0 |
| M08 | Coolant On (Flood) | Yes | Supported as MC_MovePath.OutputFlag.X1 |
| M09 | Coolant Off | Yes | Supported as MC_MovePath.OutputFlag.X0 and X1 |
| M10 | Pallet Clamp On | Yes | Supported as MC_MovePath.OutputFlag.X2 |
| M11 | Pallet Clamp Off | Yes | Supported as MC_MovePath.OutputFlag.X2 |
| M13 | Spindle on (clockwise rotation) and coolant on (flood) | Yes | Supported as MC_MovePath.OutputFlags X1 and X3 |
| M19 | Spindle Orientation | No | |
| M21 | Mirror, X-Axis | No | |
| M22 | Mirror, Y-Axis | No | |
| M23 | Mirror Off | No | |
| M24 | Thread gradual pullout off | No | |

| Command | Description | Support | Comment |
|---------|-------------------------------|---------|---|
| M26 | Axis Clamping | No | |
| M27 | Axis Clamping | No | |
| M30 | End of program | No | |
| M41 | Gear select 1 | No | |
| M42 | Gear select 2 | No | |
| M43 | Gear select 3 | No | |
| M44 | Gear select 4 | No | |
| M48 | Feedrate override allowed | No | |
| M49 | Feedrate override NOT allowed | No | |
| M52 | Unload last tool from spindle | No | |
| M62 | Set Digital Output On | Yes | The P parameter specifies the digital output number 1-32 (Bit of MC_MovePath.OutputFlags) |
| M63 | Set Digital Output Off | Yes | The P parameter specifies the digital output number 1-32 (Bit of MC_MovePath.OutputFlags) |
| M60 | Automatic Pallet change (APC) | No | |
| M66 | Wait for Input | Yes | Reference http://linuxcnc.org/docs/html/gcode/m-code.html#mcode:m66 . P parameter: 0 ~ 31 is mapped to MC_MovePath.InputFlags. P1 is bit 0, P2 is bit 1, and so on. E parameter: Not supported. L Parameter: Only Mode 4 is supported; MC_MovePath simply holds up sequencing until the required input conditions (bit flags) are met. If other input states are desired, connect the necessary logic to MC_MovePath.InputFlags. Q parameter: timeout in seconds. |
| M80 | | Yes | Cancel BreakOut and Head |
| M81 | | Yes | Set Head (Mapped to MC_MovePath. |
| M82 | | Yes | Set BreakOut (Mapped to MC_MovePath. |
| M98 | Subprogram call | Yes | 16 sub programs supported. Sub program must be within the same file as the main program. (MPiec G Code feature only supports one file at a time.) |
| M99 | Subprogram end | Yes | |
| M104 | Set Extruder Temperature | Yes | http://reprap.org/wiki/G-code#M104:_Set_Extruder_Temperature |
| M106 | Set Fan On (and speed) | Yes | http://reprap.org/wiki/G-code#M106:_Fan_On |
| M107 | Set Fan Off | Yes | http://reprap.org/wiki/G-code#M107:_Fan_Off |
| M140 | Set Bed Temperature | Yes | http://reprap.org/wiki/G-code#M140:_Set_Bed_Temperature_.28Fast.29 |
| M207 | Retract filament | Yes | http://reprap.org/wiki/G-code#M207:_Set_retract_length |

Parameters

| Command | Description | Support | Comment |
|---------|--|---------|--|
| A | Absolute or incremental position of A axis (rotational axis around X axis) | Yes | This is a Rotational position. (Rx) Actual implementation handled in firmware based on Hardware Configuration support for selected mechanisms. |

| Command | Description | Support | Comment |
|---------|---|---------|---|
| B | Absolute or incremental position of B axis (rotational axis around Y axis) | Yes | This is a Rotational position. (Ry) Actual implementation handled in firmware based on Hardware Configuration support for selected mechanisms. |
| C | Absolute or incremental position of C axis (rotational axis around Z axis) | Yes | This is a Rotational position. (Rz) Actual implementation handled in firmware based on Hardware Configuration support for selected mechanisms. |
| D | Defines diameter or radial offset used for cutter compensation. D is used for depth of cut on lathes. | No | |
| E | Lathe: Precision feedrate for threading on lathes | No | |
| E | Mode1 emulation: feedrate in units/sec | Yes | If MachineStruct.Emulation:=GTB_Emulation#Mode1 then the E register is used as feedrate in units/sec. This emulation mode is mutually exclusive with other modes such as 3D Printing, which user the E register as the Extruder position. |
| E | Extruder axis position for 3D Printing | Yes | Set MachineData.MachineType:=GTB_MachineType#Printer. |
| F | Feed rate | Yes | Specify in units / minute. If MachineStruct.Emulation:=GTB_Emulation#Mode1 then the E register is used as feedrate in units/sec. |
| H | Tool length offset | No | |
| I | Arc Center in X axis for G02 or G03 | Yes | This is the relative X distance to the center of the circle from the beginning of the arc. |
| J | Arc Center in Y axis for G02 or G03 | Yes | This is the relative Y distance to the center of the circle from the beginning of the arc. |
| K | Arc Center in Z axis for G02 or G03 | Yes | This is the relative Z distance to the center of the circle from the beginning of the arc. |
| L | Fixed cycle loop count | Yes | Use with M98. |
| N | Line number (optional) | Yes | If provided, this information is copied to PathData.Segment [].Label and is useful for troubleshooting. |
| O | Program Name | Yes | Use with M98. |
| P | Dwell time (G04), parameter for some canned cycles, and for jumps | Yes | This parameter has multiple functions based on the G code it is used with. |
| Q | Peck increment in canned cycles (G73 and G83) | No | |
| R | Radius of an arc | Yes | For use with G02 and G03. |
| S | Defines speed, either spindle speed or surface speed depending on mode | Yes | |
| T | Tool Selection | Yes | |
| U | Incremental X axis (Ignores G90 and G91) | No | |
| V | Incremental Y axis (Ignores G90 and G91) | No | |
| W | Incremental W axis (Ignores G90 and G91) | No | |
| X | X axis position | Yes | This is a Cartesian position within the working space of the mechanism. Actual implementation handled in firmware based on Hardware Configuration support for selected mechanisms. |
| Y | Y axis position | Yes | This is a Cartesian position within the working space of the mechanism. Actual implementation handled in firmware based on Hardware Configuration support for selected mechanisms. |

| Command | Description | Support | Comment |
|---------|-----------------|---------|--|
| Z | Z axis position | Yes | This is a Cartesian position within the working space of the mechanism. Actual implementation handled in firmware based on Hardware Configuration support for selected mechanisms. |



3D Printing

Some special configuration is required to enable 3D printing support.

Configure the Group in Hardware Configuration

Configure a 4D gantry. Consider the user units of the theta axis. This axis typically must extrude a specific amount of material based on the XY vector distance travelled.

The screenshot shows the 'Configuration' tab of the 'GantryDemo' mechanism. The 'Mechanism Type' is set to '4D Gantry' and the 'Machine Coordinate System' is 'XYZRz'. The 'Enable Global Group Data' checkbox is checked, and the 'I/O Task Assignment' is set to 'FastTask'. The 'Motion Queue Size' is 128. The 'Set Kinematics' button is visible.

| Label | Axis Name | Index |
|-------|-----------|-------|
| X | | 1 |
| X' | | 1 |
| Y | | 2 |
| Z | | 3 |
| Rz | | 4 |

Below the table, there are four buttons: 'Add Axis', 'Add Secondary Axis', 'Remove Axis', and 'Remove Secondary Axis'. A 3D model of the gantry mechanism is shown on the left, with axes X, Y, Z, and Rz indicated.

Configure the Extruder in MachineStruct

If the G Code data will contain extruder position / feed information as "E" axis data, use the following initialization code:

```
MyMachine.Extruder.Axis.AxisNum:=INT#7; (* The value is the AXIS_REF for the Rz axis. *)
```



Tangent Mode

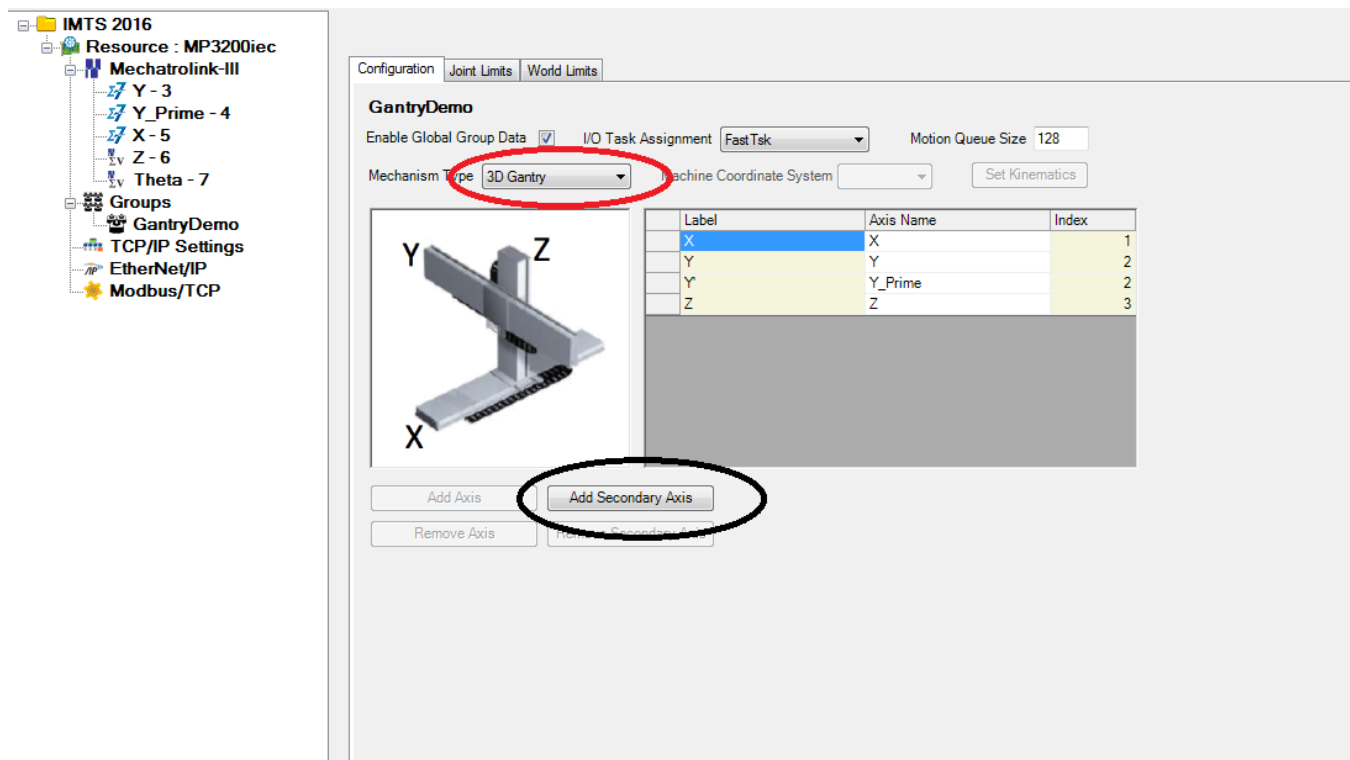
Tangent mode operates a theta axis tangent to the path and can be activated / deactivated using G78 and G79.

Configuring a System for Tangent operation

1) Configure all the axes using the Hardware Configuration.

| Parameter # | Parameters | Current Value | Units | Min | Max | Default Value |
|-------------|---------------------------------------|---------------|-----------|-----|-------|---------------|
| 1300 | Moving Average Filter 1 Enable | False | | | | False |
| 1301 | Moving Average Filter 1 Time Constant | 0.1 | s | 0 | 5 | 0.1 |
| 1807 | Load Type | Linear | | 0 | 1 | Linear |
| 1809 | Axis Name | Y | | | | |
| 1831 | Logical Axis Number | 3 | | 1 | 512 | 1 |
| 2028 | Enable Timeout | 300 | ms from | 5 | 10000 | 300 |
| Pn205 | Multi-Turn Limit Setting | 65535 | Revolutic | 0 | 65535 | 65535 |

2) Configure the Group. Add secondary axes as necessary. The tangent axis is operated externally to the group; do not include it in the Group configuration.



3) Create an Initialization POU.

Although the Theta axis is not officially part of the Group, manually add Theta's [AXIS_REF](#) to the AxesGroup.AxisRef structure as shown below on line 10. By this method, the Y_GroupPower / [GroupControl](#) function blocks will also operate the theta axis.

The initialization example below also shows how to add the AxisLabel 'ExternalTangent' to the AxesGroup structure. This is essential for the MC_MovePath function block to operate the Tangent axis correctly. It looks for the Axis Label spelled exactly as shown on line two below.

```

1  (* This method is being used to let the application determine which AXIS_REF belongs to the Tangent Axis. *)
2  AxisName:='ExternalTangent';
3  STRING_TO_BUF_1(REQ:=TRUE, BUF_FORMAT:=TRUE, BUF_OFFSET:=DINT#0, BUF_CNT:=INT_TO_DINT(LEN(AxisName)), SRC:=AxisName, BUFFER:=GantryDemo.Axis.Label[5]);
4  strDone:=STRING_TO_BUF_1.DONE;
5  strError:=STRING_TO_BUF_1.ERROR;
6  strStatus:=STRING_TO_BUF_1.STATUS;
7  AxisName:=STRING_TO_BUF_1.SRC;
8  GantryDemo.Axis.Label[5]:=STRING_TO_BUF_1.BUFFER;
9
10 GantryDemo.AxisRef[5].AxisNum:=UINT#7;

```

Group_DataTypes

Toolbox Help Documentation

Help version created 1/31/2018

YASKAWA



Data Type: MC_PATH_DATA_REF

Data structure used with the [Read_GCode_File](#), [Read_GCode_Stream](#), CP_PathGenerator, and [MC_MovePath](#) function blocks .

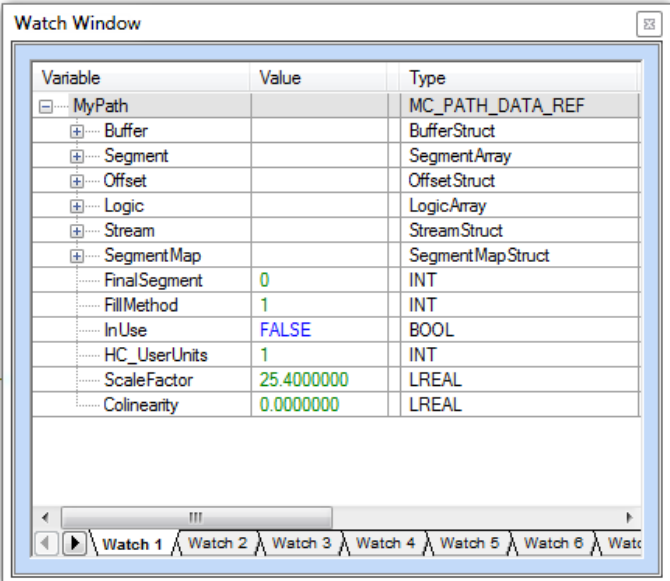
Data Type Declaration

The column that indicates whether the 'U'ser OR the 'C'ontroller write the data can be misleading for this data type, as there are function blocks available such as [Read_GCode_File](#) which act on behalf of the user to populate many of these values. In all cases, 'C' indicates that the user should not write to the value, as the [MC_MovePath](#) function block will update these elements. 'U' indicates that the User is in some way responsible for populating the data. This is especially important when creating a custom function block to load Segment data.

| * | Element | Data Type | Description | Usage |
|-----|--------------|----------------------------------|--|--|
| | MyPathStruct | MC_PATH_DATA_REF | | |
| C/U | Buffer | BufferStruct | Sub structure containing information for managing a circular buffer of Segment data. SegmentArray is defined as having 250 elements by default. Paths requiring an infinite number of segments can be processed due to the circular buffer technique. Mainly function blocks such as Read_GCode_File, Read_GCode_Stream and MC_MovePath manage the data in this sub structure. If writing a custom path generator function, it must set MyPathStruct.Buffer.StorePointer as it creates the path. | MyPathStruct.Buffer.StorePointer |
| U | Segment | SegmentArray | Contains all details required for each of the Segment in the path. | MyPathStruct.Segment[0].X |
| U | Logic | LogicStruct | For support of SegmentType LoopDecision. Up to 32 loops or jumps can be configured in PathData. Limitation: The entire path data must fit within the defined size of SegmentArray. Circular buffering and LoopDecision SegmentTypes can not be supported simultaneously. MC_MovePath monitors MyPathStruct.Buffer.Overwritten and will generate an error . | MyPathStruct.Logic[n].DecisionIndex |
| C | Stream | StreamStruct | For the Read_GCode_Stream function block. This customizable structure contains all relevant information required by the source sending path data via Ethernet socket. | MyPathStruct.Stream.PathStatus.PathSegment |
| C | SegmentMap | SegmentMapStruct | MC_MovePath uses this for tracking the relationship between MyPathStruct.Segment[n] and the unique motion segment ID used by | MyPathStruct.SegmentMap.Map[0][12].PathIndex |

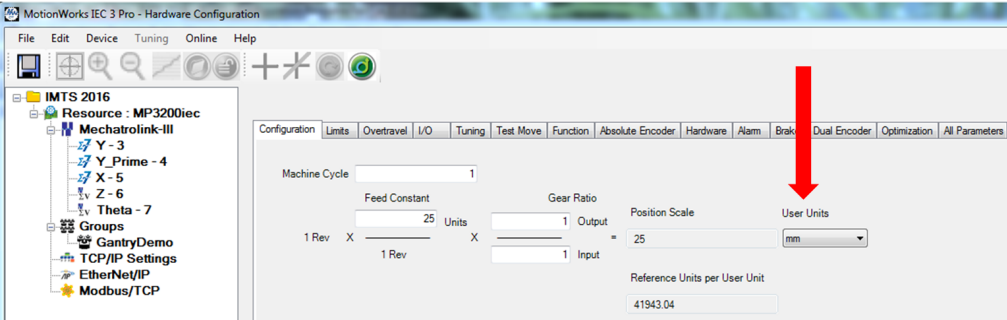
| * | Element | Data Type | Description | Usage |
|---|--------------|------------------------------|---|--|
| | | | the Motion Engine. Group parameters 2201 and 2202 are referenced to manage this mapping. This data is managed by MC_MovePath and the user does not need to reference it under normal circumstances. | |
| C | StreamStatus | StreamStruct | Data sent to the host application via UDP packets. | MyPathStruct.StreamStatus.TCPPacketCount |
| U | FinalSegment | INT | This value indicates the very last Segment in the path. For example, if the path is loaded 'by hand' in the Initialize POU, set this value. In this case, the StorePointer and UsePointer are not necessary. When Read_GCode_File encounters the end of file, it will set the value to the proper Segment. When an M30 command is detected, this value will be set to the proper Segment. | MyPathStruct.FinalSegment |
| U | FillMethod | INT | Specify whether the data comes from a File or a Stream. This will affect how MC_MovePath determines when it has reached the end of the data. If the data is being hard coded within the IEC application, this value must be set to n/a or zero. | MyPathStruct.FillMethod |
| C | InUse | BOOL | Written by MC_MovePath when the block is executing. This flag is monitored by functions such as Read_GCode_File to provide data integrity. Read_GCode_File will generate and error if upon the rising edge it detects that MC_MovePath is still using the data. | MyPathStruct.InUse |
| U | HC_UserUnits | INT | Stores the value/code of the user units set in the Hardware Configuration. 0 = inches 1 = millimeters 2 = microns | MyPathStruct.HC_UserUnits |
| U | ScaleFactor | LREAL | If data may come from a source providing user unit positions that differ from that of the Hardware Configuration, this ScaleFactor will convert the positions. See the example below for reading the User Units set in the Hardware Configuration. Read_GCode_File and Read_GCode_Stream can automatically set this value based on HC_UserUnits. If ScaleFactor is zero when either of the GCode processing blocks are started, it will be initialized to 1. This value can be preset to any ScaleFactor if necessary as long as the G Code data does not contain G20 or G21. | MyPathStruct.ScaleFactor |
| U | Colinearity | LREAL | Specify the angle between segments which must invoke an 'ExactStopCheck'. For example, when shape cutting, if multiple segments are nearly co linear (less than x degrees) and should be blended by inserting a small corner radius, but large angles such as when the tool moves vertically out of the material (90 degrees), a co linearity value of say 85 degrees can be detected, causing motion to stop before raising the tool. | MyPathStruct.Colinearity |

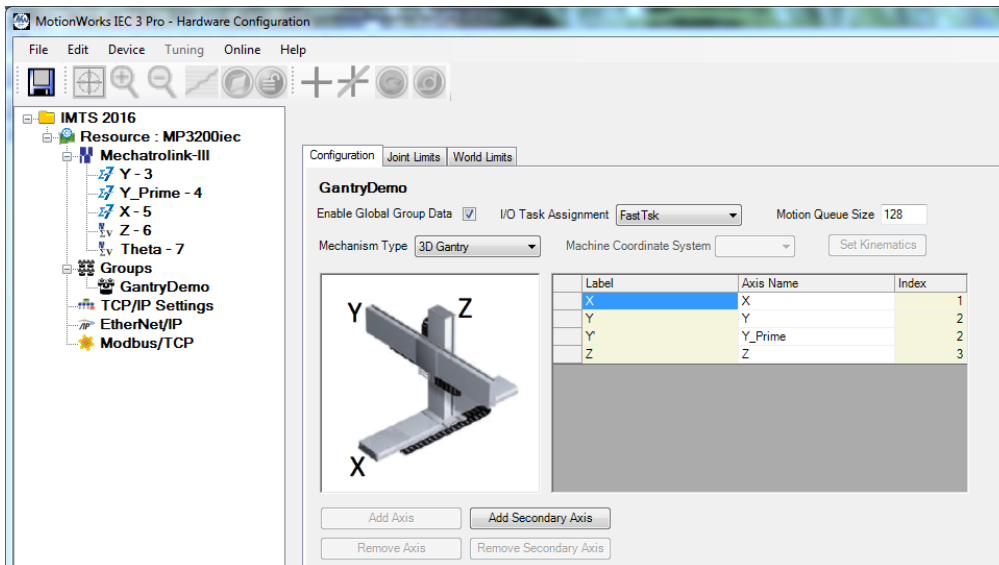
Watch Window Views



Example 1 - Basic motion

Example 2 - Determining Hardware Configuration User Units.



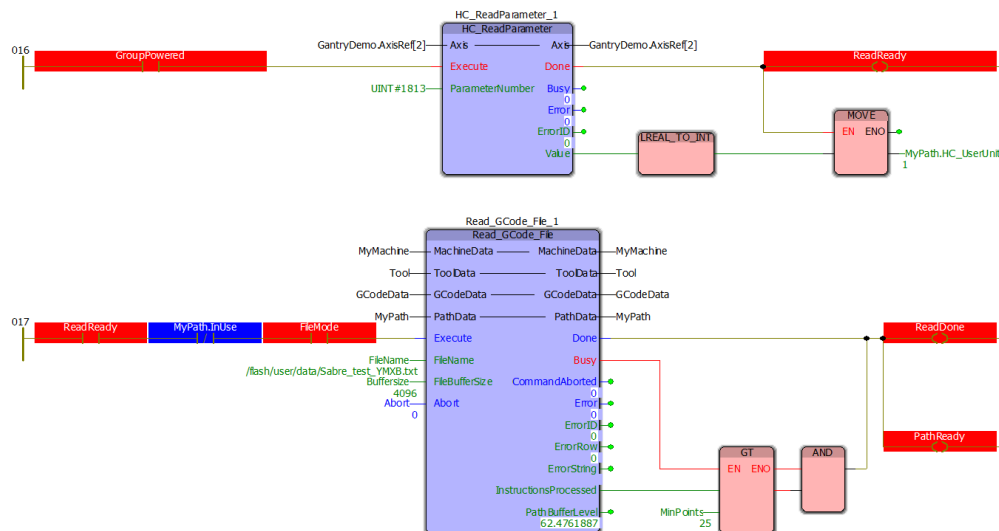


According to the Hardware Configuration and confirmed by the Watch Window, GantryDemo.AxisRef[2] will report the user units of the Y axis. We assume the units for X and Z are the same.

Watch Window

| Variable | Value | Type |
|------------|-------|----------------|
| GantryDemo | | AXES_GROUP_REF |
| Name | | STRING32 |
| Handle | 1 | UINT |
| Mechanism | | STRING32 |
| AxisRef | | AXIS_ARRAY |
| [1] | | AXIS_REF |
| [2] | | AXIS_REF |
| AxisNum | 3 | UINT |
| [3] | | AXIS_REF |
| [4] | | AXIS_REF |
| [5] | | AXIS_REF |
| [6] | | AXIS_REF |

HC_ReadParameter is located in the FileRW_Toolbox.





Data Type: BufferStruct

This is a sub structure of [MC_PATH_DATA_REF](#) which contains data about the circular buffer of Segments. The G Code function blocks manage and use this data without any intervention required by the application program, but this information may be useful to view in the Watch Window when debugging.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-----------------------------|---------------------|--|-------------------------------------|
| | MyPathStruct.Buffer. | BufferStruct | | |
| C | Size | INT | The Read_GCode_File or Read_GCode_Stream function blocks will set this value on the rising edge of operation by using the UPPER_BOUND function for MyPathStruct.Segment. | MyPathStruct.Buffer.Size |
| C | Segments | UDINT | The total number of segments in the path. | MyPathStruct.Buffer.Segments |
| C | StorePointer | INT | Used by Read_GCode_File and Read_GCode_Stream to manage the next available location for segment data. | MyPathStruct.Buffer.StorePointer |
| C | UsePointer | INT | Used by MC_Move_Path to manage the next segment to execute. | MyPathStruct.Buffer.UsePointer |
| C | FillCount | INT | Reports the number of Segment between StorePointer and UsePointer. | MyPathStruct.Buffer.FillCount |
| C | FillPercent | REAL | Reports the percentage of MC_PATH_DATA_REF that is filled and waiting to be processed. | MyPathStruct.Buffer.FillPercent |
| C | OverWritten | BOOL | Indicates that the Segment buffer has written to the end, and started writing over the segment data at the beginning again. When this occurs, is not possible to re execute MC_MovePath to make another move sequence. The path data must be re processed, such as by Read_GCode_File or Read_GCode_Stream. Small paths which do not exceed the buffer size of MyPathStruct.Segment can be re run without re processing the original data. | MyPathStruct.Buffer.Overwritten |
| C | MotionAvailable | DINT | Populated in MC_MovePath for the StreamStruct if the Read_GCode_Stream method is used. This pertains to the firmware level motion buffer and is identical to AxesGroup.Status.FreeMotionSegments. | MyPathStruct.Buffer.MotionAvailable |
| C | MotionPercent | REAL | Populated in MC_MovePath for the StreamStruct if the Read_GCode_Stream method is used. This pertains to the firmware level motion buffer and is identical to AxesGroup.Status.FreeMotionSegments. | MyPathStruct.Buffer.MotionPercent |



Data Type: SegmentDetails

A supporting structure for [MC_PATH_DATA_REF](#). This is an array of SegmentDetails, each of which contains the necessary information for the Segment based on the SegmentType. This list of elements in this structure is comprehensive; note that elements are only used for specific SegmentTypes as detailed below.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|---------------|------------------|--|---------------------------------------|
| | MyPathStruct | MC_PATH_DATA_REF | | |
| | Segment | SegmentDetails | Data structure used with the MC_MovePath function block. | |
| U | SegmentType | INT | See GTB_SegmentType . | MyPathStruct.Segment[n].SegmentType |
| U | LineNumberRef | DINT | Typically function blocks which parse source data and load the MC_PATH_DATA_REF will populate this with data from the source for debugging purposes. For example, if a G Code file contains lines numbers with the code N344, the value 344 will be copied to this element. | MyPathStruct.Segment[n].LineNumberRef |
| U | Label | YTB_STRING16 | For debugging purposes, short descriptive labels can be added. When MC_MovePath is executing, it will display the value as a STRING(16) at the VAR_OUTPUT 'SegmentLabel.' | MyPathStruct.Segment[n].Label |
| U | X | LREAL | If SegmentType is StraightLine, Arc, or Direct, this is the absolute or relative coordinate [based on the AbsoluteMode element] of the X axis within the CoordSystem specified. For moves in ACS, this value corresponds to Joint #1. For other SegmentTypes, this data is ignored. | MyPathStruct.Segment[n].X |
| U | Y | LREAL | If SegmentType is StraightLine, Arc, or Direct, this is the absolute or relative coordinate [based on the AbsoluteMode element] of the Y axis within the CoordSystem specified. For moves in ACS, this value corresponds to Joint #2. For other SegmentTypes, this data is ignored. | MyPathStruct.Segment[n].Y |
| U | Z | LREAL | If SegmentType is StraightLine, Arc, or Direct, this is the absolute or relative coordinate [based on the AbsoluteMode element] of the Z axis within the CoordSystem specified. For moves in ACS, this value corresponds to Joint #3. For other SegmentTypes, this data is ignored. | MyPathStruct.Segment[n].Z |
| U | Rx | LREAL | If SegmentType is StraightLine, Arc, or Direct, this is the absolute or relative coordinate [based on the AbsoluteMode element] of the Rx axis within the CoordSystem specified. For moves in ACS, this value corresponds to Joint #4. For other SegmentTypes, this data is ignored. | MyPathStruct.Segment[n].Rx |
| U | Ry | LREAL | If SegmentType is StraightLine, Arc, or Direct, this is the absolute or relative coordinate [based on the AbsoluteMode element] of the Ry axis within the CoordSystem specified. For moves in ACS, this value corresponds to Joint #5. For other SegmentTypes, this data is ignored. | MyPathStruct.Segment[n].Ry |
| U | Rz | LREAL | If SegmentType is StraightLine, Arc, or Direct, this is the absolute or relative coordinate [based on the AbsoluteMode element] of the Rz axis within the CoordSystem specified. For moves in ACS, this value corresponds to Joint #6. For other SegmentTypes, this data is ignored. | MyPathStruct.Segment[n].Rz |

| * | Element | Data Type | Description | Usage |
|---|----------------|---------------------|---|--|
| | MyPathStruct | MC_PATH_DATA_REF | | |
| | Segment | SegmentDetails | Data structure used with the MC_MovePath function block. | |
| | | | is ignored. | |
| U | E | LREAL | For 3D printing applications. The MachineStruct must be configured with an Extruder axis. See these instructions for configuring an Extruder axis . | MyPathStruct.Segment[n].E |
| U | AxesFlags | DWORD | For use with G Code applications using G92 to Set Position. These flags identify which axes the command applies to. | MyPathStruct.Segment[n].AxesFlags |
| U | VarFlags | DWORD | For use with G Code applications. Each bit in the DWORD corresponds to a register letter, bit 0 for A, bit 1 for B, etc. . For example, if the data is specified as G1 X#3 Y#4, the values in MyPath.Segment[n].X and MyPath.Segment[n].Y are not the actual position to be used, but are pointers to variables. The values point to the position values to be referenced from the VarData struct connected to MC_MovePath. | MyPathStruct.Segment[n].VarFlags |
| U | AbsoluteMode | BOOL | If SegmentType is StraightLine, Arc, or Direct, this specifies whether the coordinates in this Segment are Absolute or Relative within the specified CoordSystem. For other SegmentTypes, this data is ignored. | MyPathStruct.Segment[n].AbsoluteMode |
| U | CoordSystem | MC_CoordinateSystem | If SegmentType is Linear, Direct, or Circular, this specifies the Coordinate System and will be copied to the corresponding PLCopen Part 4 function block. For other SegmentTypes, this data is ignored. | MyPathStruct.Segment[n].CoordSystem |
| U | FeedRate | REAL | If SegmentType is StraightLine, Arc, or Direct, this value is scaled by the VelocityOverride input to MC_MovePath and copied to the Input of the corresponding PLCopen Part 4 function block. For other SegmentTypes, this data is ignored. | MyPathStruct.Segment[n].FeedRate |
| U | ExactStopCheck | BOOL | If SegmentType is Linear, Direct, or Circular and there are several contiguous motion Segments, ExactStopCheck will cause MC_MovePath to wait for motion to come to a stop when reaching the position specified in this Segment before executing additional motion segments. | MyPathStruct.Segment[n].ExactStopCheck |
| U | TransitionMode | INT | If SegmentType is StraightLine, Arc, or Direct, this value is mapped to motion blocks 'TransitionMode' VAR_INPUT. For other SegmentTypes, this data is ignored. | MyPathStruct.Segment[n].TransitionMode |
| U | TransitionPrm | LREAL | If SegmentType is Linear, Direct, or Circular, this value is mapped to motion blocks 'TransitionParameter' VAR_INPUT. For other SegmentTypes, this data is ignored. | MyPathStruct.Segment[n].TransitionPrm |
| U | Radius | LREAL | If SegmentType is Arc, this value may be used by Path generating function blocks such as Read_GCode_File or Read_GCode_Stream to convert the necessary circle information for use the MC_MoveCircularAbsolute. | MyPathStruct.Segment[n].Radius |
| C | StartAngle | LREAL | If SegmentType is Arc, this value is updated by Path generating function blocks such as Read_GCode_File or Read_GCode_Stream. For debugging purposes only. | MyPathStruct.Segment[n].StartAngle |
| C | TraversedAngle | REAL | If SegmentType is Arc, this value is updated by Path generating function blocks such as Read_GCode_File or Read_GCode_Stream. For debugging purposes only. | MyPathStruct.Segment[n].TraversedAngle |
| U | PathChoice | INT | If SegmentType is Arc, this value is mapped to MC_MoveCircularAbsolute's 'PathChoice' VAR_INPUT. | MyPathStruct.Segment[n].PathChoice |
| U | CircleMode | INT | If SegmentType is Arc, this value is mapped to MC_MoveCircularAbsolute's 'CircMode' VAR_INPUT. | MyPathStruct.Segment[n].CircleMode |
| U | CenterXCoord | LREAL | If SegmentType is Arc, this value is mapped to MC_MoveCircularAbsolute's 'AuxPoint' VAR_INPUT and used based on PathChoice and CircleMode. For other SegmentTypes, this data is ignored. | MyPathStruct.Segment[n].CenterXCoord |
| U | CenterYCoord | LREAL | If SegmentType is Arc, this value is mapped to MC_MoveCircularAbsolute's 'AuxPoint' VAR_INPUT and used based on PathChoice and CircleMode. For other SegmentTypes, this data is ignored. | MyPathStruct.Segment[n].CenterYCoord |
| U | CenterZCoord | LREAL | If SegmentType is Arc, this value is mapped to MC_MoveCircularAbsolute's 'AuxPoint' VAR_INPUT and used based on PathChoice and CircleMode. For other SegmentTypes, this data is | MyPathStruct.Segment[n].CenterZCoord |

| * | Element | Data Type | Description | Usage |
|---|--------------------|------------------|--|--|
| | MyPathStruct | MC_PATH_DATA_REF | | |
| | Segment | SegmentDetails | Data structure used with the MC_MovePath function block. | |
| | | | ignored. | |
| U | AuxXCoord | LREAL | If SegmentType is Arc, this value is mapped to MC_MoveCircularAbsolute's 'AuxPoint2' VAR_INPUT and used based on PathChoice and CircleMode. For other SegmentTypes, this data is ignored. | MyPathStruct.Segment[n].AuxXCoord |
| U | AuxYCoord | LREAL | If SegmentType is Arc, this value is mapped to MC_MoveCircularAbsolute's 'AuxPoint2' VAR_INPUT and used based on PathChoice and CircleMode. For other SegmentTypes, this data is ignored. | MyPathStruct.Segment[n].AuxYCoord |
| U | AuxZCoord | LREAL | If SegmentType is Circular, this value is mapped to MC_MoveCircularAbsolute's 'AuxPoint2' VAR_INPUT and used based on PathChoice and CircleMode. For other SegmentTypes, this data is ignored. | MyPathStruct.Segment[n].AuxZCoord |
| U | InputConditions | DWORD | Used only if SegmentType is 'WaitForInputs', 'LoopDecision', 'BranchDecision', 'NonBlockingInputCheck', 'NonBlockingLoopDecision', or 'NonBlockingBranchDecision'. Set the InputConditions required to advance to the next Segment. | MyPathStruct.Segment[n].InputConditions |
| U | InputTimeout | TIME | Used only if the SegmentType is 'WaitForInputs'. This is the TIME that MC_MovePath will wait for (InputConditions = InputFlags). If the machine must wait forever when the InputConditions are unsatisfied, then use 0 TIME. If the InputTimeout value is non zero, MC_MovePath will advance to the next Segment after the InputTimeout. Typically the next Segment would be 'LoopDecision' or 'BranchDecision' with the same InputConditions to permit the desired behavior in the event that the InputConditions have not been met. Specify TIME in standard IEC61131 syntax. | MyPathStruct.Segment[n].InputTimeout |
| U | StandStillDuration | TIME | Used only if the SegmentType is 'StandStill'. This is the TIME that MC_MovePath will do nothing during this segment. Specify TIME in standard IEC61131 syntax. | MyPathStruct.Segment[n].StandStillDuration |
| U | TangentActive | BOOL | <p>This flag designates segments for which an axis operating tangent to the vector path must be synced. MC_MovePath will execute the functions Y_SyncTangentAxisToGroup and MC_Stop using the AXIS_REF supplied in the MachineStruct.</p> <p>The MachineStruct must be configured to operate a tangent axis outside of the group configuration. If the tangent axis is not aligned with the upcoming vector path, the PathData can optionally pre align the tangent axis using the Rz value with the proper pre alignment angle. The MC_MovePath can determine that Rz values are for the external tangent by referencing the MachineStruct information and use the MC_MoveAbsolute function block to pre align the tangent axis using rotational velocity and acceleration as specified in the MachineStruct.</p> | MyPathStruct.Segment[n].TangentActive |
| U | OutputFlags | DWORD | The MC_MovePath function block's VAR_OUTPUT 'OutputFlags' will be set to this value when this Segment is active. If motion is ongoing, the OutputFlags corresponding to this segment is verified by using Group Parameters 2201 and 2202 to account for the processing of buffered motion segments. When there is no motion, such as during SegmentType 'StandStill' or 'WaitForInputs', the OutputFlags are set immediately. | MyPathStruct.Segment[n].OutputFlags |
| U | LogicIndex | INT | Used only if the SegmentType is 'LoopDecision.' This is a pointer (array index) in the LogicArray information corresponding to this Segment. | MyPathStruct.Segment[n].LogicIndex |

Not all elements are used for each SegmentType. The SegmentType element dictates the data which will be referenced for a given Segment[]. The following chart outlines the relationship between SegmentType and its relevant information.

Example 1

If designing a custom path generating algorithm, it is useful to know which elements of the PathData.Segment[] are applicable based on the SegmentType specified. Refer to the following chart for usage by [MC_MovePath](#).

| Attribute Segment Type | | | | | | | | | | | | | | |
|---------------------------|---------------|-----|-------------|-----------------|-------------|--------|---------------|-----------------|--------------|------------------|-------------|----------------|--------------|--------------|
| | Straight Line | Arc | Stand Still | Wait For Inputs | Set Tangent | Direct | Jump Decision | Branch Decision | Non Blocking | Input Look Ahead | Input Check | Move To Origin | Set Position | Non Blocking |
| Line Number Ref | | | | | | | | | | | | | | |
| Label | | | | | | | | | | | | | | |
| X | | | | | | | | | | | | | | |
| Y | | | | | | | | | | | | | | |
| Z | | | | | | | | | | | | | | |
| Rx | | | | | | | | | | | | | | |
| Ry | | | | | | | | | | | | | | |
| Rz | | | | | | | | | | | | | | |
| E | | | | | | | | | | | | | | |
| Axes Flags | | | | | | | | | | | | | | |
| Absolute Mode | | | | | | | | | | | | | | |
| Coordinate System | | | | | | | | | | | | | | |
| Feed Rate | | | | | | | | | | | | | | |
| Exact Stop Check | | | | | | | | | | | | | | |
| Transition Mode | | | | | | | | | | | | | | |
| Transition Pm | | | | | | | | | | | | | | |
| Radius | | | | | | | | | | | | | | |
| Start Angle | | | | | | | | | | | | | | |
| Traversed Angle | | | | | | | | | | | | | | |
| Path Choice | | | | | | | | | | | | | | |
| Circle Mode | | | | | | | | | | | | | | |
| Center X Coord | | | | | | | | | | | | | | |
| Center Y Coord | | | | | | | | | | | | | | |
| Center Z Coord | | | | | | | | | | | | | | |
| Aux X Coord | | | | | | | | | | | | | | |
| Aux Y Coord | | | | | | | | | | | | | | |
| Aux Z Coord | | | | | | | | | | | | | | |
| Input Conditions | | | | | | | | | | | | | | |
| Input TimeOut | | | | | | | | | | | | | | |
| Stand Still Duration | | | | | | | | | | | | | | |
| Tangent Active | | | | | | | | | | | | | | |
| Output Flags | | | | | | | | | | | | | | |
| Logic Event | | | | | | | | | | | | | | |



Data Type: LogicStruct

A sub structure of [MC_PATH_DATA_REF](#) which contains data for managing paths with looping or jumping events.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|--------------------|------------------|--|---------------------------------------|
| | MyPathPairs | PathPairs | | |
| C | Event | LogicArray | An array of LogicData | |
| C | Stack | StackArray | An array of 16 INT to manage nested Logic Events | Y_SyncAxisToTangent and GCode G78/G79 |
| C | Events | INT | To determine which LogicData in LogicArray have already been allocated. | |
| C | StackPointer | INT | Points to the next location in the stack to hold the next event encountered. | |



Data Type: SegmentMapStruct

This structure is used by MC_MovePath to keep track of buffered motion segments. It is necessary to control the OutputFlags in synchronization with the motion specified. Motion Segments may be executed some time before they are actually causing motion based on the number of motion blocks buffered.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|---------------------|-------------------------|--|--------------------------------------|
| | MySegmentMap | SegmentMapStruct | | |
| C | Map | MapArray | Stores the relationship between a PachStruct.Segment and the ID of the motion function executed / queued by the motion engine. | MySegmentMap.Map[0] [134].PathIndex |
| C | Buffer | SegmentBuffer | AXIS_REF of axis to be used for tangent motion. | MySegmentMap.Buffer [1].StorePointer |
| C | ActiveStoreMap | INT | Flag [0 or 1] which indicates the MapArray to which data is being stored. | MySegmentMap.ActiveStoreMap |
| C | ActiveUseMap | INT | Flag [0 or 1] which indicates the MapArray from which data is being read. | MySegmentMap.ActiveUseMap |



Data Type: StreamStruct

This is a substructure within MC_PATH_DATA_REF. It holds data for reporting to a host application via Ethernet. A DLL is available which will connect to the MPiEC controller running the Read_GCode_Stream function block and receive this StreamStatus information. Search for AN.MPIEC.24 on www.yaskawa.com.

The first four bytes of the structure always contains the version number of the structure.

Version information

| | version | | |
|--------------|---------|------------|---------------|
| Release Date | DLL | UDP Packet | Group Toolbox |
| January 2018 | 3.4.1.0 | 20180103 | v340 |

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|---------|-----------|-------------|-------|
|---|---------|-----------|-------------|-------|

| | MyPath.StreamStatus | StreamStruct | | |
|---|---------------------|--------------------|--|------------------------------------|
| C | Version | UDINT | Identifier for packet structure content. The GCodeComm DLL uses this information to confirm the data contents. | MyPath.StreamStatus.Version |
| C | TCPPacketCount | UDINT | Total packets received since a connection was made to the Read_GCode_Stream function block. | MyPath.StreamStatus.TCPPacketCount |
| C | MCSPosition | LREALArray6 | Array of 6 world space positions in User Units as declared in the Hardware Configuration. | MyPath.StreamStatus.MCSPosition[3] |
| C | PCSPosition | LREALArray6 | Array of 6 world space positions in User Units as declared in the Hardware Configuration. | MyPath.StreamStatus.PCSPosition[3] |
| C | TCPVelocity | REAL | Velocity of the TCP in User Units as declared in the Hardware Configuration. | MyPath.StreamStatus.MCSPosition[3] |
| C | Velocity | LREALArray6 | Array of 6 world space velocities in User Units as declared in the Hardware Configuration. | MyPath.StreamStatus.Velocity[1] |
| C | Torque | LREALArray6 | Reserved for future use. | |
| C | PathStatus | PathStatusStruct | Data pertaining to the path such as segments processed, current path segment. | See below |
| C | Buffer | BufferStatusStruct | Data pertaining to the three buffers involved with processing data: ByteBuffer, PathBuffer, and MotionBufer. | See below |
| C | FB | FBStatusStruct | Provides the Read_GCode_Stream and MC_MovePath function block outputs to a host application. | See below |

PathStatusStruct

| * | Element | Data Type | Description | Usage |
|---|---------|-----------|-------------|-------|
|---|---------|-----------|-------------|-------|

| | MyPath.StreamStatus.Path | PathStatusStruct | | |
|---|--------------------------|------------------|---|--|
| C | InUse | BOOL | Set TRUE by the MC_MovePath function block any time it is Busy. This prevents a function that loads data into MC_PATH_DATA_REF from initializing the data while it is being accessed to provide motion. | MyPath.StreamStatus.Path.InUse |
| C | ByteOffset | UDINT | Provides a way to link back to the source data. In a G Code application, ByteOffset refers to the first character of the G Code block (line) which is currently providing motion. If there is an alarm or fault on the machine, it is referring to the last motion block attempted. This can be used by upper level software systems to provide motion recovery and resume a path already in progress. | MyPath.StreamStatus.Path.ByteOffset |
| C | Segment | UDINT | The UsePointer of the Segment causing motion. This can be used to resume a path already in progress if there was a fault which stopped the machine. To do this, write IEC Application code to store and copy the last Segment into the MC_MovePath.StartSegment. Some limitations exist, so test for applicability. The Path data must be small enough to fit within MC_PATH_DATA_REF without overwriting itself. | MyPath.StreamStatus.Path.Segment |
| C | SegmentsProcessed | UDINT | Total number of segments processed since the Read_GCode_File or Read_GCode_Stream function block was executed. These blocks reset the counter when started. | MyPath.StreamStatus.Path.SegmentsProcessed |

BufferStatusStruct

| * | Element | Data Type | Description | Usage |
|---|----------------------------|---------------------|--|--|
| | MyPath.StreamStatus.Buffer | Buffer-StatusStruct | | |
| C | BytePercent | REAL | Indicates the percentage (0.0 to 100.0%) of the CircularByteBuffer that is filled with data. This information can be used by a host application such as GCodeComm.DLL to throttle the data | MyPath.StreamStatus.Buffer.BytePercent |

| | | | | |
|---|------------------|------|---|---|
| | | | being streamed to the Read_GCode_Stream function block. | |
| C | BytesAvailable | DINT | Number of bytes available to be filled in the CircularByteBuffer (typically for streaming applications.) | MyPath.StreamStatus.Buffer-BytesAvailable |
| C | BytesUtilization | REAL | A performance metric which indicates the number of scans as a percentage (0.0 to 100.0%) of which the Read_GCode_Stream function block actually processes data in the CircularByteBuffer. The goal is some midpoint value, say between 30 and 40%. | MyPath.StreamStatus.Buffer-BytesUtilization |
| C | PathPercent | REAL | Indicates the percentage (0.0 to 100.0%) of the PathData.Segment[] array that is filled with data. Filled means new data has been written, but the MC_MovePath function block has not accessed it yet. This can be useful for debugging and performance analysis. | MyPath.StreamStatus.Buffer.PathPercent |
| C | PathAvailable | DINT | Number of Segments in MC_PATH_DATA_REF that are available to be filled. | MyPath.StreamStatus.Buffer.PathAvailable |
| C | UnderRunWarning | BOOL | This bit will be set if (Motion has started) AND (PathData.FinalSegment=Undetermined) AND (PathData.Buffer-StorePointer = PathData.Buffer-UsePointer) AND (AxesGroup.Status.NumMotionSegments=0) This situation should never occur, and means the system is starved for data, or the end of a G Code file was not properly specified with an M30 command. | MyPath.StreamStatus.Buffer-UnderRunWarning |
| C | MotionPercent | REAL | Indicates the percentage (0.0 to 100.0%) of the firmware layer motion queue that has a function block waiting to provide motion. | MyPath.StreamStatus.Buffer-MotionPercent |
| C | MotionAvailable | DINT | Availability in the firmware layer motion queue. This is AxesGroup.Status.FreeMotionSegments. | MyPath.StreamStatus.Buffer-MotionAvailable |

FBStatusStruct

| * | Element | Data Type | Description | Usage |
|---|-----------------------------------|-----------------------|--|------------------------------------|
| | MyPath.StreamStatus.FB.ReadStream | ReadGCodeStreamStatus | | |
| C | ErrorID | UINT | The ErrorID reported by the Read_GCode_Stream function block. | MyPath.StreamStatus.FB.ErrorID |
| C | ErrorRow | UDINT | If applicable, the line number from the G Code data which corresponds to the ErrorID. | MyPath.StreamStatus.FB.ErrorRow |
| C | ErrorString | YTB_STRING16 | If applicable, the string value of the command in the G Code data which caused the processing error. In some cases | MyPath.StreamStatus.FB.ErrorString |

| | | | | |
|---|--|-----------------------------|---|--|
| | | | when there is more than one command per line, this string may be inaccurate. | |
| C | InstructionsProcessed | UDINT | The total number of instructions processed since processing began. | MyPath.StreamStatus.FB.InstructionsProcessed |
| | MyPath.StreamStatus.FB.MovePath | MovePathStatusStruct | | |
| C | InputFlagsRequired | DWORD | Reports the input conditions that MC_MovePath is checking to advance to the next segment | MyPath.StreamStatus.FB.InputFlagsRequired |
| C | OutputFlags | DWORD | Reports the outputs that are being set based on the currently executing segment. | MyPath.StreamStatus.FB.OutputFlags |
| C | ErrorID | UINT | The ErrorID reported by the MC_Movepath function block. | MyPath.StreamStatus.FB.ErrorID |
| C | ProcessedLabel | YTB_STRING16 | If populated, reports PathData.Segment[p].Label, where [p] points to the segment information that is being referenced in order to execute a motion or other sequence related instruction. | MyPath.StreamStatus.FB.ProcessedLabel |
| C | ExecutedLabel | YTB_STRING16 | If populated, reports PathData.Segment[e].Label, where [e] points to the segment that is currently providing motion or other sequence related instruction. | MyPath.StreamStatus.FB.ExecutedLabel |
| C | ProcessedTotal | UDINT | The total number of segments evaluated and processed. | MyPath.StreamStatus.FB.ProcessedTotal |
| C | ExecutedTotal | UDINT | The total number of segments completed (motion was satisfied or other sequence related activity was successful.) | MyPath.StreamStatus.FB.ExecutedTotal |



Data Type: MachineStruct

Contains important configuration and other application specific data used by [MC_MovePath](#), [Read_GCode_File](#), [Read_GCode_Stream](#) and other user specific functionality as required by the application.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|------------------|----------------------------------|---|---|
| | MyMachine | | | |
| U | MachineType | GTB_MachineType | Specify: GTB_MachineType#Milling, GTB_MachineType#Lathe, or GTB_MachineType#Printer to allow the G Code processor to handle specific G Codes appropriately based on the specific Machine Type. Default is Milling. | MyMachine.MachineType |
| U | Emulation | GTB_Emulation | Specify is a special emulation mode should be applied. Supported Modes include: GTB_Emulation#Mode1 = Interpret E register as +/- acceleration in units/sec ² and F as velocity in units/sec. Default is no Emulation mode selected. | MyMachine.Emulation |
| U | Origin | MC_CARTESIAN_REF | The home position of the machine. Used in conjunction with G Code 28. | MyMachine.Origin[x] |
| U | CoordinateSystem | OffsetStruct | Holds up to 9 offsets, corresponding to G54 through G59.3. Important: If the offset values will be written to this structure from an HMI or other method within the IEC application program, they MUST be entered in the user units of the machine as defined in the Hardware Configuration, not the user units of a G Code file. If a G 10 Code is processed, the G Code processor will convert the offset values into the native units of the group when storing to the MachineStruct. | MyMachine.CoordinateSystem.Offset[x] |
| U | Prms | MotionParameters | User configurable parameters such as max velocity and max acceleration. | MyMachine.Prms.MaxVelocity |
| U | Printer | PrinterStruct | Special data for operating a 3D Printer. This data is typically collected from the G Code stream and populated here for access by the IEC application program, which must be customized as required for the application. | MyMachine.Printer.Extruder.Axis.AxisNum |
| U | ExternalTangent | AXIS_REF | AXIS_REF of axis configured for tangent motion. This axis is not part of the group configuration. | MyMachine.ExternalTangent.AxisNum |
| U | Spindle | SpindleStruct | Contains data specific to operation of a Spindle axis which is externally operate (Not part of the AxesGroup) | MyMachine.Spindle.RPM |

Example Initialization

```
13 MyMachine.ExternalTangent.AxisNum:=UINT#7;
14 MyMachine.Prms.MaxVelocity:=LREAL#300.0;          (* In configured group units / sec *)
15 MyMachine.Prms.MaxDirectVelocity:=LREAL#2000.0;   (* In configured group units / sec *)
16 MyMachine.Prms.MaxRotationalVelocity:=LREAL#15000.0; (* In configured group units / sec *)
17 MyMachine.Prms.MaxSegmentsPerScan:=INT#16;
18 MyMachine.Prms.MaxAcceleration:=LREAL#2000.0;     (* In configured group units / sec2 *)
19 MyMachine.Prms.MaxDeceleration:=LREAL#2000.0;     (* In configured group units / sec2 *)
20 MyMachine.Prms.Acceleration:=LREAL#600.0;         (* In configured group units / sec2 *)
21 MyMachine.Prms.Deceleration:=LREAL#600.0;         (* In configured group units / sec2 *)
22
23 MyMachine.Prms.RotationalVelocity := LREAL#3000.0; (* For Rz or Tangent axis when aligning to the next required tangent vector *)
24 MyMachine.Prms.RotationalAcceleration := LREAL#7000.0; (* For Rz or Tangent axis when aligning to the next required tangent vector *)
25 MyMachine.Prms.TransitionMode:=INT#3;             (* Blending Mode - Corner Radius *)
26 MyMachine.Prms.TransitionParameter[3]:=LREAL#0.25; (* 0.25 mm radius corner blending *)
```




Data Type: OffsetStruct

Sub structure of the [MachineStruct](#) which holds data related to the work coordinate offsets. When a G10 command is processed, the [Read_GCode_File](#) or [Read_GCode_Stream](#) function block will populate the appropriate Offset with the data received. Alternatively, Offset data can be loaded from any other source, such as a host PC or HMI. When a G Code G54 through G59.3 is received, the subsequent position commands will be offset accordingly.

Important: All data in the MachineStruct are in the user units of the configured group. For example, if the G Code data sent to the MPiec is in inches (G20), but the group mechanism is configured for millimeters, the Work Coordinate Offsets **MUST** be entered in millimeters. When G code G10 is received the G Code processor will convert the offset values to the proper units for the MachineStruct if necessary.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-------------------------|---------------------|--|---|
| | CoordinateSystem | OffsetStruct | | |
| U | Offset | OffsetArray | ARRAY[1..9] OF MC_CARTESIAN_REF. | MyMachine.CoordinateSystem.Offset[2].Rx |
| U | Selected | INT | The Coordinate System Offset currently used. | MyMachine.CoordinateSystem.Selected |

Example



Data Type: MotionParameters

Sub struct of MachineStruct which holds configuration data used in [MC_MovePath](#), [Read_GCode_File](#), and [Read_GCode_Stream](#).

If the FeedRate is not specified for a PathData.Segment, the MC_MovePath function block will default to using the appropriate maximum velocity from the MachineStruct.Prms.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-----------------------|-----------------|--|---|
| | MachineStruct.Prms | MotionParameter | | |
| U | MaxVelocity | LREAL | <p>Max velocity in Cartesian units/sec for a linear (G1) / Cartesian move. If the feed rate provided in the G Code data exceeds this value, it will be limited to this value.</p> <p>You must set this value to the maximum safe velocity that the mechanism can tolerate.</p> <p>G Code users: Units are those of the group as configured in the Hardware Configuration!</p> <p>MC_MovePath will never set a velocity higher than this value, even if the MC_MovePath.ScaleFactor input would result in excessive velocity.</p> | MachineStruct.Prms.MaxVeloccity |
| U | MaxDirectVelocity | LREAL | <p>Max velocity in Cartesian units/sec for a direct (G0) / Cartesian move. If the feed rate provided in the G Code data exceeds this value, it will be limited to this value.</p> <p>You must set this value to the maximum safe velocity that the mechanism can tolerate.</p> <p>G Code users: Units are those of the group as configured in the Hardware Configuration!</p> <p>MC_MovePath will never set a velocity higher than this value, even if the MC_MovePath.ScaleFactor input would result in excessive velocity.</p> | MachineStruct.Prms.MaxDirectVeloccity |
| U | MaxRotationalVelocity | LREAL | <p>Max velocity in rotational units/sec when a motion segment contains a rotational change but no Cartesian motion.</p> <p>You must set this value to the maximum safe velocity that the mechanism can tolerate.</p> <p>G Code users: Units are those of the group as configured in the Hardware Configuration!</p> <p>MC_MovePath will never set a velocity higher than this value, even if the MC_</p> | MachineStruct.Prms.MaxRotationalVeloccity |

| | | | | |
|---|------------------------|-------|---|---|
| | | | MovePath.ScaleFactor input would result in excessive velocity. | |
| U | MaxAcceleration | LREAL | <p>Acceleration in Cartesian units/sec2 applied to linear (G1) and direct Cartesian motion.</p> <p>You must set this value to the maximum safe acceleration that the mechanism can tolerate.</p> <p>G Code users: Units are those of the group as configured in the Hardware Configuration!</p> <p>MC_MovePath will never set an acceleration higher than this value, even if the MC_MovePath.ScaleFactor input would result in excessive acceleration.</p> | MachineStruct.Prms.Acceleration |
| U | MaxDeceleration | LREAL | <p>Deceleration in Cartesian units/sec2 applied to linear (G1) and direct Cartesian motion.</p> <p>You must set this value to the maximum safe acceleration that the mechanism can tolerate.</p> <p>G Code users: Units are those of the group as configured in the Hardware Configuration!</p> <p>MC_MovePath will never set an acceleration higher than this value, even if the MC_MovePath.ScaleFactor input would result in excessive deceleration.</p> | MachineStruct.Prms.Deceleration |
| U | Acceleration | LREAL | <p>Acceleration in Cartesian units/sec2 applied to linear (G1) and direct Cartesian motion. Typically this can be set to the same value as the MaxAcceleration, however, if MC_MovePath.VelocityScaler is used, the acceleration is also scaled by the square of the velocity, and could become limited to MaxAcceleration.</p> | MachineStruct.Prms.Acceleration |
| U | Deceleration | LREAL | <p>Deceleration in Cartesian units/sec2 applied to linear (G1) and direct Cartesian motion. Typically this can be set to the same value as the MaxAcceleration, however, if MC_MovePath.VelocityScaler is used, the deceleration is also scaled by the square of the velocity, and could become limited to MaxDeceleration.</p> | MachineStruct.Prms.Deceleration |
| U | Jerk | LREAL | Not supported. | |
| U | DirectAcceleration | LREAL | <p>Acceleration in Cartesian units/sec2 applied direct (G0) Cartesian motion. Typically this can be set to the same value as the MaxAcceleration, however, if MC_MovePath.VelocityScaler is used, the acceleration is also scaled by the square of the velocity, and could become limited to MaxAcceleration.</p> | MachineStruct.Prms.DirectAcceleration |
| U | DirectDeceleration | LREAL | <p>Deceleration in Cartesian units/sec2 applied to direct (G0) Cartesian motion. Typically this can be set to the same value as the MaxAcceleration, however, if MC_MovePath.VelocityScaler is used, the acceleration is also scaled by the square of the velocity, and could become limited to MaxDeceleration.</p> | MachineStruct.Prms.DirectDeceleration |
| U | DirectJerk | LREAL | Not Supported. | |
| U | RotationalVelocity | LREAL | <p>Velocity for purely rotational moves on Rx, Ry, or Rz, and when pre aligning a Tangent axis in the units configured for the external tangent axis.</p> | MachineStruct.Prms.RotationalVelocity |
| U | RotationalAcceleration | LREAL | <p>Acceleration used when pre aligning a Tangent axis in the units configured for the external tangent axis.</p> | MachineStruct.Prms.RotationalAcceleration |

| | | | | |
|---|---------------------|------------------------|--|--|
| U | MaxSegmentsPerScan | INT | <p>The maximum number of similar motion functions that will be executed in the same scan. (Similar means Linear, Circular, and Direct.) For example, if MC_PATH_DATA_REF contains 100 linear motion segments with no other command type in between, and MaxSegmentsPerScan is set to 8, it would take 13 scans to load all the motion segments, provided the motion queue can accommodate all the segments, or that they are being consumed at a fast rate.</p> <p>For applications with fewer, longer segments, setting MaxSegmentsPerScan to 1 is adequate.</p> <p>See the "Motion Queue Size" in the Hardware Configuration under the Group item in the configuration tree.</p> | MachineStruct.Prms.MaxSegmentsPerScan |
| U | TransitionMode | INT | This will be the default Transition mode used as the input to PLCopen Part 4 motion blocks. See Transition Mode in the PLCopen Motion Function Blocks help manual. | MachineStruct.Prms.TransitionMode |
| U | TransitionParameter | VECTOR | This will be the default TransitionParameter used as the input to PLCopen Part 4 motion blocks. See Transition Mode in the PLCopen Motion Function Blocks help manual. | MachineStruct.Prms.TransitionParameter |

Special Notes for G Code Applications:

All data in the MachineStruct are in the user units of the configured group. For example, if the G Code data presented to the MPiec is in inches, but the group mechanism is configured for millimeters, the Work Coordinate Offsets must always be entered in millimeters.

Note that even if the same units are provided in the G Code data, (say millimeters) there is still a difference to be accounted for. Native units on the MPiec controller are mm/sec for velocity, mm/sec² for acceleration. Native G Code convention specifies feedrate in mm/minute. Take this difference into account when configuring the Maximums in the MachineStruct.

Example

This data is typically initialized in a Warm Start system task.

```

13 MyMachine.ExternalTangent.AxisNum:=UINT#7;
14 MyMachine.Prms.MaxVelocity:=LREAL#300.0;          (* In configured group units / sec *)
15 MyMachine.Prms.MaxDirectVelocity:=LREAL#2000.0;   (* In configured group units / sec *)
16 MyMachine.Prms.MaxRotationalVelocity:=LREAL#15000.0; (* In configured group units / sec *)
17 MyMachine.Prms.MaxSegmentsPerScan:=INT#16;
18 MyMachine.Prms.MaxAcceleration:=LREAL#2000.0;    (* In configured group units / sec2 *)
19 MyMachine.Prms.MaxDeceleration:=LREAL#2000.0;    (* In configured group units / sec2 *)
20 MyMachine.Prms.Acceleration:=LREAL#600.0;        (* In configured group units / sec2 *)
21 MyMachine.Prms.Deceleration:=LREAL#600.0;        (* In configured group units / sec2 *)
22
23 MyMachine.Prms.RotationalVelocity := LREAL#3000.0; (* For Rz or Tangent axis when aligning to the next required tangent vector *)
24 MyMachine.Prms.RotationalAcceleration := LREAL#7000.0; (* For Rz or Tangent axis when aligning to the next required tangent vector *)
25 MyMachine.Prms.TransitionMode:=INT#3;            (* Blending Mode - Corner Radius *)
26 MyMachine.Prms.TransitionParameter[3]:=LREAL#0.25; (* 0.25 mm radius corner blending *)

```



Data Type:PrinterStruct

Contains information for 3D printing applications, specifically for externally operated devices, such as extruders, heaters, and fans.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|----------------|-------------------|---|--------------------------------------|
| | MyTools | ToolStruct | | |
| U | BedTempActual | YTB_RealArray32 | The user application can write the actual bed temperatures back to this structure if desired, but they are not used by any function in the Group Toolbox. | MyMachine.Printer.BedTempActual [x] |
| U | BedTempSetting | YTB_RealArray32 | When receiving an M140 command, bed temperatures are stored in this structure for use by IEC application program. | MyMachine.Printer.BedTempSetting [x] |
| U | Fan | BOOL | Flag which can be used by the application program to control the Fan. This is set by M106 and M107 commands. | MyMachine.Printer.Fan |
| U | FanSpeed | REAL | The fan speed as received from an M106 command. | MyMachine.Printer.FanSpeed |
| U | Extruder | ExtruderStruct | Length of a tool in the groups Cartesian user units from the Hardware Configuration | MyMachine.Printer.Extruder.Offset |



Data Type:SpindleStruct

Contains information specific for use by externally operated Spindles (not configured as part of the AxesGroup).

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|----------------|-------------------|---|--------------------------------|
| | MyTools | ToolStruct | | |
| U | RPM | REAL | When G96 or G97 is received, the S register is used to populate this value. | MyMachine.Spindle.RPM |
| U | MaxRPM | REAL | | MyMachine.Spindle.MaxRPM |
| U | SurfaceSpeed | REAL | | MyMachine.Spindle.SurfaceSpeed |
| U | UnitCode | INT | When G96 is received, UnitCode is set to 0 to indicate 'Surface Speed' Mode When G97 is received, UnitCode is set to 1 to indicate 'Feet Per Minute' Mode. | MyMachine.Spindle.UnitCode |
| U | Direction | INT | Same as M03 (Clockwise Rotation), M04 (CounterClockwise Rotation). | MyMachine.Spindle.Direction |



Data Type:GCodeStruct

GCodeStruct contains internal working information used by the G Code Processor and is made available as a VAR_IN_OUT by [Read_GCode_File](#) and [Read_GCode_Stream](#) mainly for debugging purposes. There are four main sub structures:

1. GCode Modal Modes
2. Block Update Flags
3. Registers
4. Variables

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|-----|--------------------|--------------------|--|------------------------------------|
| | MyGCodeData | GCodeStruct | | |
| C | Mode | GCodeModalModes | Various modes of operation, such as ExactStopCheck, Tangent | MyGCodeData.Mode.Tangent |
| C | BlockUpdate | BlockUpdateFlags | Flags to indicate that a certain operation must be performed. | MyGCodeData.BlockUpdate.PathStruct |
| C | Register | GCodeRegister | All G Code registers A through Z. This information contains the last received values from the G Code source. This register list is initialized upon rising edge of either Read_GCode_File or Read_GCodeStream. | MyGCodeData.Register._G |
| C/U | Variables | VariableArray | Only used if the G Code registers being processed contain variables. In such applications, connect GCodeData.Variables to MC_MovePath | MyGCodeData.Variables[300] |



Data Type: ToolStruct

Contains Tool information used in [Read_GCode_File](#), and [Read_GCode_Stream](#).

ToolData is typically populated by the application program via an HMI or other source. It must be provided in the user units of the machine. There is support for G Code data to be provided in alternate user units (G20 = inches, G21 = mm) but the data will be scaled to that of the user unit configuration of the group before Tool Compensation is applied.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|----------------|-------------------|---|--------------------|
| | MyTools | ToolStruct | | |
| U | Radius | LREAL | Radius of a tool in the groups Cartesian user units from the Hardware Configuration | MyTools [2].Radius |
| U | Length | LREAL | Length of a tool in the groups Cartesian user units from the Hardware Configuration | MyTools [4].Length |



Enumerated Types for Group Toolbox

Some blocks accept an enumerated type (ENUM), which is a keyword (or constant) representing a value which will configure the operation of the function block. Enumerated types are equivalent to zero-based integers (INT). Therefore, the first value equates to zero, the second to 1, etc. The format for enumerated types is as follows: ENUM:(0, 1, 2...) as displayed in the example below (MC_BufferMode#Aborting).

Enumerated Types Declaration

| Enumerated Type | #INT Value | Enum Value | Description |
|-----------------|----------------------|---|--|
| GTB_SegmentType | ENUM for SegmentType | | |
| | 0 | n/a | Not a valid SegmentType. |
| | 1 | StraightLine | Straight line motion between two coordinate locations. |
| | 2 | Arc | Arc or circular path. |
| | 3 | StandStill | Pause between segments for a specified delay time. |
| | 4 | WaitForInputs | Path processing will wait until the specified input conditions are met. MC_MovePath will compare this segments InputConditions to the MC_MovePath.InputFlags. |
| | 5 | SetTangent | Preparation move for a tangent axis to track a tangent path relative to the XY vector path. |
| | 6 | Direct | Non linear motion between two coordinate locations. |
| | 7 | JumpDecision | Jump to another non sequential Segment (either forward or backward) based on InputConditions. |
| | 8 | BranchDecision | End the path early based on InputConditions. MC_MovePath.Done will come on, the application can check MC_MovePath.ProcessedLabel to determine if the path completed prematurely. |
| | 9 | NonBlockingInputCheck | Don't wait to process future Segments if the input conditions are already met. For example, consider Segment types (1,1,1,1,1,9,1,1,1,1.) StraightLine segments will be executed / buffered to the motion queue until a non motion segment type is encountered. When segment type 9 is encountered, the Segments InputConditions are compared to MC_MovePath.InputFlags. As soon as they are satisfied, processing of the segments after type 9 resumes. This differs from Segment type 4 because if the path sequence contains SegmentTypes (1,1,1,1,1,4,1,1,1,1) the inputs specified are not evaluated until after the first series of linear motions has been executed and the motion completed. |
| | 10 | InputLookAhead | Reserved for future use. |
| | 11 | MoveToOrigin | Reserved for future use. |
| | 12 | SetPosition | Set the position of an extruder axis. (3D Printing support) |
| | 13 | NonBlockingJumpDecision | Similar to SegmentType 7, but processing does not wait until any previously buffered motion has completed. |
| | 14 | NonBlockingBranchDecision | Similar to SegmentType 8, but processing does not wait until previously buffered motion has completed. |
| | 15 | SubCall | Designed for use by G Code "IF" and "M98" commands, this segment can switch program flow to a non sequential segment. A companion sub structure PathData.Logic.Event, linked via PathData.Segment[p].LogicEvent, must be loaded with the proper data to satisfy the required logical operation of the Sub call. |
| | 16 | SubReturn | MC_MovePath refers to PathData.Logic.Event[p].ReturnSegment to set the next segment to run after the sub call is complete. |
| | 17 | SetFrameOffset | MC_MovePath executes Y_GroupSetFrameOffset to set the PCS relationship to the MCS. If ThisSegment.AxesFlags <> DWORD#0, then the Segment X,Y,Z,Rx,Ry,Rz values are used, otherwise, the offsets are references from MachineData.CoordinateSystem.Offset. Use ThisSegment.CircleMode to act as the index pointer to the coordinate system. |
| | 18 | Expression | Designed for use by G Code "IF" and variable assignments such as #3=100. |
| 19 | SetOutput | Designed for use by G Code G62 and G63 commands. If outputs must be set in between motion commands, this special Segment Type can be used. Normally, outputs are set to coincide with a motion segment, or remain in a certain state for other segments. If a G63 command exists on a line by itself (single instruction block) then no other segment type will be associated with the output setting. In these cases, the G Code processor will automatically set this segment type, forcing the output to be set. | |



Data Type: Tool

Holds tool data for use with any compensation (G41,G42,G43,G44) G-code commands. ToolStruct is an array of 21 different Tool structures.

Data Type Declaration

| | * | Element | Data Type | Description | Usage |
|--|---|--------------------|------------------|--------------------|-------|
| | | MyPathPairs | PathPairs | | |
| | U | Radius | LREAL | Radius of the tool | |
| | U | Length | LREAL | Height of the tool | |

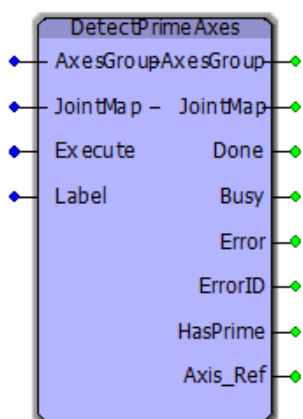
Group_FBs

Toolbox Help Documentation
Help version created 1/31/2018

YASKAWA



DetectPrimeAxes



This function block searches the AxesGroup structure to determine if the joint specified at the Label input was configured with additional prime axes. The boolean output HasPrime will indicate if additional axes are configured for the Joint. This function will supply the Jointmap for the group, and an Axis_Ref is output which contains the AXIS_REF values for all axes pertaining to the specified Joint (Label.)

Library

Group Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|--------------------------------|--|
| VAR_IN_OUT | | | |
| B | AxesGroup | AXES_GROUP_REF | A logical reference to a group of axes, which contains several additional substructures pertaining to the group. |
| V | JointMap | JointMap | Structure of data that holds information for Joint Index, Label and AXIS_REF. |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| V | Label | STRING | Specify the name of the group's Joint Label as configured in the Hardware Configuration. Example: STRING#'Y' |
| VAR_OUTPUT | | | |

| | | | |
|---|----------|------|--|
| B | Done | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |
| V | HasPrime | BOOL | Boolean which indicates if additional prime axes are configured. |
| V | Axis_Ref | | Structure containing AXIS_REFS for all axes configured for the Joint |

Notes

- This block only supports Mechatrolink groups.

Error Description

This function block will not generate any errors, even if the AxesGroup is invalid.

Example

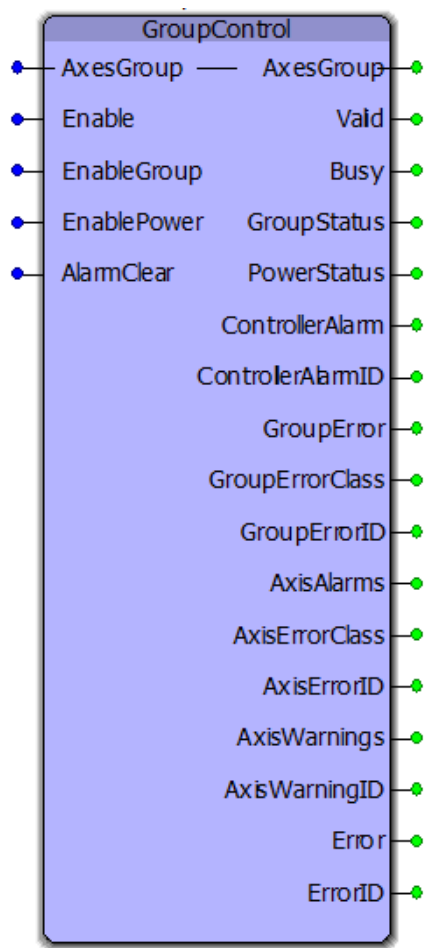
This example is taken from State machine logic using a CASE statement.

```

93      2: (* Look for DOF with prime axes, make sure they are aligned to avoid error when doing MC_GroupEnable *)
94      DetectPrimeAxes_1(AxesGroup:=AxesGroup, JointMap:=JointMap, Execute:=iActive AND NewState, Label:=JointMap[j].Label);
95      AxesGroup:=DetectPrimeAxes_1.AxesGroup;
96      JointMap:=DetectPrimeAxes_1.JointMap;
97      Axis_Ref:=DetectPrimeAxes_1.Axis_Ref;
98      IF DetectPrimeAxes_1.Busy THEN
99          NewState:=FALSE;
100      ELSIF DetectPrimeAxes_1.Done THEN
101          IF DetectPrimeAxes_1.HasPrime THEN
102              6      State:=State + INT#1;                                (* *)
103          ELSE
104              j:=j + INT#1;
105              IF (JointMap[j].AxisRef = UINT#0) THEN
106                  6      State:=INT#4;                                (* Move on to homing phase *)
107                  END_IF;                                           (* Otherwise re run this State for next label *)
108              END_IF;
109              NewState:=TRUE;
110          ELSE
111              0      a:=a;                                           (* Assume an error has occurred *)
112              Output[State].Error:=TRUE;
113              Output[State].ErrorID:=DetectPrimeAxes_1.ErrorID;
114          END_IF;

```

GroupControl



This function block operates and monitors several PLCopen Part 4 group related functions including MC_GroupEnable, MC_GroupDisable, MC_GroupReadError, MC_GroupReset, Y_GroupPower and other functions such as Y_ReadAlarms, Y_ClearAlarm.

Library

Group Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-------------------|--------------------------------|--|
| VAR_IN_OUT | | | |
| B | AxesGroup | AXES_GROUP_REF | A logical reference to a group of axes, which contains several additional substructures pertaining to the group. |
| VAR_INPUT | | | |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | EnableGroup | BOOL | If TRUE, the MC_GroupEnable function block will be executed. If FALSE, the MC_GroupDisable function block will be executed. |
| V | EnablePower | BOOL | If TRUE, all the axes belonging to the AxesGroup will be powered. All axes are first checked for alarms, and if any alarms are present, no axes are powered. If FALSE, all of the axes belonging to the group will be powered down (servo off). NOTE: This level sensitive input will retry to achieve the requested condition every 2 seconds if there is an error preventing its success. |
| V | AlarmClear | BOOL | Executes MC_GroupReset, MC_Reset, and Y_ClearAlarms based on the current alarms related to the AxesGroup. |
| VAR_OUTPUT | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| V | GroupStatus | BOOL | Indicates if the group is enabled. |
| V | PowerStatus | BOOL | Indicates that all axis in the group are powered. |
| V | ControllerAlarm | BOOL | Indicates a controller side axis alarm. |
| V | ControllerAlarmID | UDINT | Indicates the controller alarm ID number, such as 3302 0018. (shown in hex.) Refer to the Controller AlarmID list in the PLCopenPlus manual for troubleshooting. |
| V | GroupError | BOOL | Indicates a group alarm. |
| V | GroupErrorClass | UINT | The error class indicates the source of the error. For more information, refer to the Controller Alarm ID List . |
| V | GroupErrorID | UINT | Indicates the group alarm ID number. Refer to the Controller Alarm ID list . |
| V | AxisAlarms | BOOL | Indicates an axis alarm. |
| V | AxisErrorClass | UINT | Indicates the axis alarm ID number. See notes for more information. |
| V | AxisErrorID | UINT | Indicates the axis alarm ID number. See MC_ReadAxisError in the PLCopenPlus help manual for more information. |
| V | AxisWarnings | BOOL | Indicates an axis warning. |
| V | AxisWarningID | UINT | Indicates the axis warning ID number. See notes for more information. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes:

- If ErrorClass = 16#3504 (13572 decimal) then the source of the error is the MLX200. Refer to the [MLX AlarmID List](#) for MLX200 GroupErrorIDs.
- If ErrorClass = 16#3302, 16#3303, 16#4302, or 16#4403, then the source of the error (alarm) is the ServoPack. Sigma alarms are documented in the Sigma Series user manuals. Please refer to the following manuals for details regarding servo amplifier errors to look up the alarm code shown at AxisErrorID output:
- Sigma-7 Mechatrolink-III: [SIEPS8000128](#), see Section 12.2
- Sigma-5 Mechatrolink-III with rotary motor: [SIEPS8000064](#), see Section 9.1
- Sigma-5 Mechatrolink-III with linear motor: [SIEPS8000065](#), see Section 8.1
- Sigma-5 Mechatrolink-II with rotary motor: [SIEPS8000046](#), see Section 9.1
- Sigma-5 Mechatrolink-II with linear motor: [SIEPS8000048](#), see Section 8.1
- If ErrorClass is some value other than 16#3302, 16#3303, 16#3504, 16#4302, or 16#4403, the source of the error is on the MPiec controller side. Refer to the [Controller Alarm ID List](#).
- There is no distinction between Alarms and Errors; they have the same meaning.

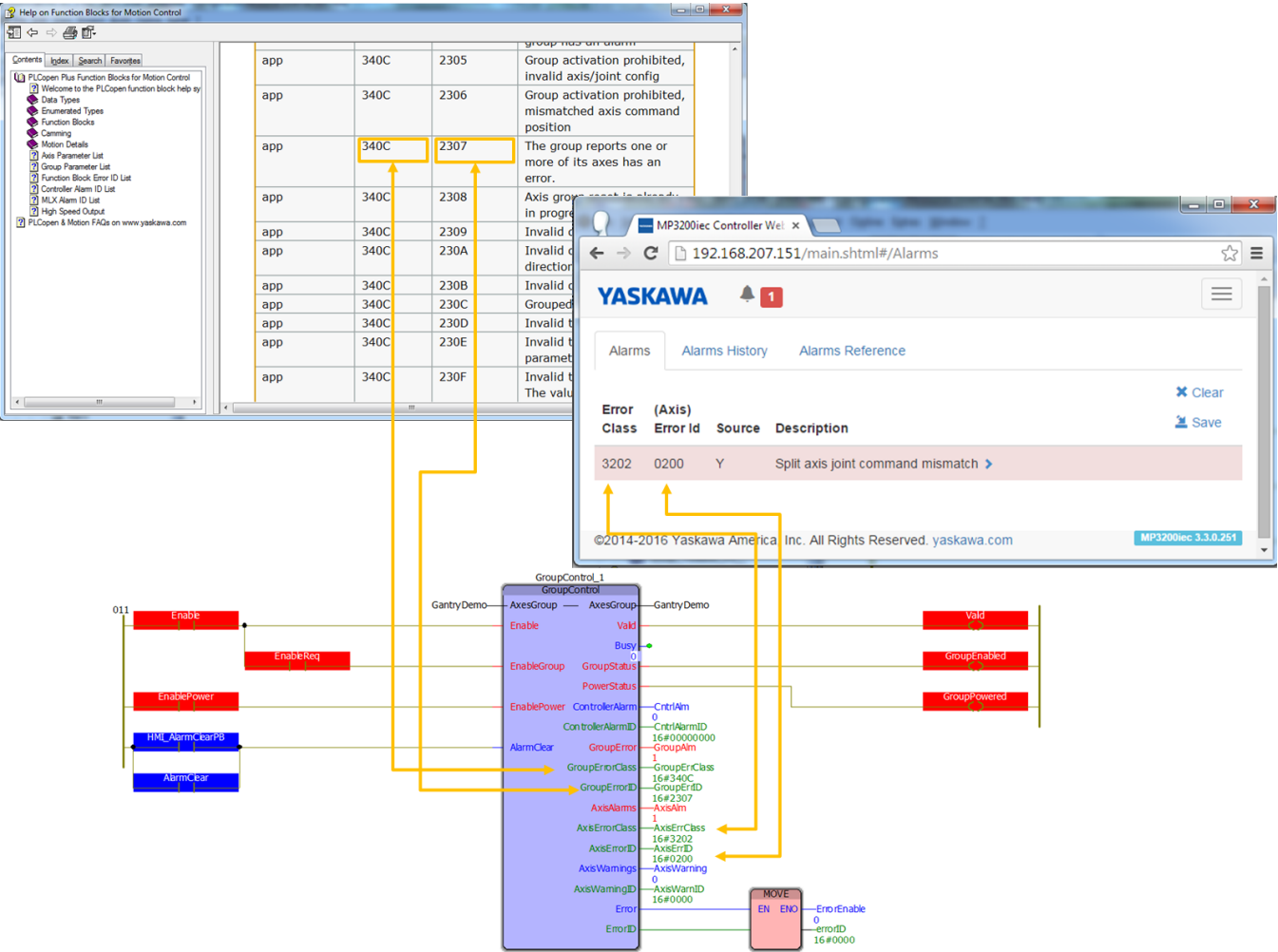
Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 4412 | Parameter not supported for the specified axis or group. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 8960 | Invalid axes group. Confirm that the AxesGroup variable has the correct %M address as automatically assigned by the Hardware Configuration. Be sure the AxesGroup variable is global, and that if the group has been recently defined, the controller was rebooted. |
| 8961 | An axis is already owned by another group. |
| 8962 | Group activation is blocked. Ownership can not be changed while Mechatrolink reset is in progress. |
| 8965 | Group activation prohibited, invalid axis/joint config. |
| 8966 | Group activation prohibited, mismatched axis command position for split axis. Example: X and X Prime sharing the same load. |
| 8968 | Axis group reset is already in progress. |
| 9216 | Invalid Host_ID. Supported Host_IDs are (0 = MECHATROLINK group, 1 = MLX hosted group) |
| 9217 | Invalid Interface_ID. Supported Interface_IDs are (0..7) |
| 9218 | Invalid Device_ID. Device_ID must be 0. |
| 9219 | The groups motion engine generated an error. Use the MC_GroupReadError function block to obtain the GroupErrorID. |
| 9220 | Group is not enabled. Enable the group using MC_GroupEnable. |
| 9221 | EtherNet/IP communication between the MPiec and the MLX robot interface was lost. |
| 45332 | Sending clear alarms command to servo drive failed. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |
| 60909 | This function block is not supported for the AxesGroup specified. |

Example

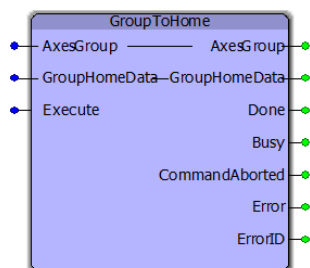
This example shows an error condition when the group has two axes which operate the same joint (Y axis) on a gantry. The commanded position of both axes must be identical before the group can be enabled, otherwise, the alarm condition shown

below will result.





GroupToHome



This function block moves a group to its home location in MCS in a sequence specified by the HomeData struct. Prepare the HomeData to indicate the required sequence of operation for safe motion to the home position to avoid obstacles, if required, as well as the home position.

Library

Group Toolbox

Parameters

| * | Parameter | Data Type | Description |
|------------|----------------|--------------------------------|--|
| VAR_IN_OUT | | | |
| B | AxesGroup | AXES_GROUP_REF | A logical reference to a group of axes, which contains several additional substructures pertaining to the group. |
| V | HomeData | HomeStruct | Structure of data that holds information for how the group will be sent to zero. |
| VAR_INPUT | | | |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| C | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| C | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. |

| | | | |
|---|---------|------|---|
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

- This block will detect if a groups joint has a prime axis, and will pre align the axes prior to starting the home sequence. If pre alignment must be performed, this block will execute MC_GroupDisable, , and MC_GroupEnable prior to starting the home sequence.
- This function block takes advantage of the HomeStruct from the PLCopen toolbox, designed for single axis homing and contains other values which are not used by GroupToHome. Only the information shown in the example below is required.

Error Description

| ErrorID | Meaning |
|----------------------|--|
| 0 | No error. |
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4654 | Invalid Speed Unit setting in Y_MoveOptions.ProfileUnit. Select 0 for Absolute units, or 1 for % of maximum. |
| 4658 | Velocity parameter is less than or equal to zero. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 8960 | Invalid axes group. Confirm that the AxesGroup variable has the correct %M address as automatically assigned by the Hardware Configuration. Be sure the AxesGroup variable is global, and that if the group has been recently defined, the controller was rebooted. |
| 8961 | An axis is already owned by another group. |
| 8962 | Group activation is blocked. Ownership can not be changed while Mechatrolink reset is in progress. |
| 8963 | Specified Coordinate System is not supported. Possible causes: If a custom group is specified, only the ACS Coordinate System is applicable. |
| 8964 | Move prohibited because group has an alarm. |
| 8965 | Group activation prohibited, invalid axis/joint config. |
| 8966 | Group activation prohibited, mismatched axis command position for split axis. Example: X and X Prime sharing the same load. |
| 8967 | The group reports one or more of its axes has an error. |
| 8973 | Invalid transition mode. |
| 8974 | Invalid transition parameter. |

| ErrorID | Meaning |
|-----------------------|--|
| 8975 | Invalid transition geometry. The values for the acceleration, deceleration, and/or velocity of the transition yield an invalid geometry. Given the limits of accel/decel, velocity, and length of the segment, can't create the corner geometry to meet the specification. |
| 8978 | Infinite velocity constraint. The resolved velocity limit for the move was infinite. If there is no Cartesian motion, and a rotational change only, use the MoveOptions input to specify the VelocityUnits as "UseRotationalScalars." Or - There is a non zero value in the position VECTOR for a degree of freedom that the AxesGroup does not support. |
| 8979 | Infinite acceleration constraint. The resolved acceleration limit for the move was infinite. |
| 8980 | Infinite deceleration constraint. The resolved acceleration limit for the move was infinite. |
| 9000 | The specified blending transition is not possible based on the two moves in the buffer to be blended. For example, Move 1 is a line and Move 2 is an arc, and they are not in the same plane. |
| 9001 | The specified blending transition required exact corner distance or deviation, but insufficient distance remained in the segment to satisfy the transition geometry. |
| 9002 | The position was unreachable due to inverse kinematics limitations . Try a direct move instead of a linear move. |
| 9003 | Specified blending transition for the function block could not be realized due to blending parameter restrictions. Typically due to accel limit too low or segment length too short, relative to transition velocity. |
| 9216 | Invalid Host_ID. Supported Host_IDs are (0 = MECHATROLINK group, 1 = MLX hosted group) |
| 9217 | Invalid Interface_ID. Supported Interface_IDs are (0..7) |
| 9218 | Invalid Device_ID. Device_ID must be 0. |
| 9219 | The groups motion engine generated an error. Use the MC_GroupReadError function block to obtain the GroupErrorID. |
| 9220 | Group is not enabled. Enable the group using MC_GroupEnable. |
| 9221 | EtherNet/IP communication between the MPiec and the MLX robot interface was lost. |
| 9222 | State Transition Error. Refer to MC_GroupReadError for further details. |
| 9223 | Trajectory Shape Error. The value passed to MoveOptions.TrajectoryShape is invalid Valid trajectory types are 0 = Trapezoid and 1 = S-Curve. |
| 9224 | Profile Unit Error. The value passed to MoveOptions.ProfileUnit is invalid. Valid values are 0 (% of maximum) or 1 (Absolute units). |
| 9225 | Invalid Control Mode. The group is set for Jogging or Manual mode, and an MC_MoveLinear or similar function block was executed, or Y_GroupJog or similar function block was called while the group was set for Automatic mode. |
| 9240 | Calculation leads to a singularity. Calculated output coordinates is in a singular or gimbal lock configuration. |
| 9249 | The Group's E-Stop input is preventing motion. |
| 9250 | The Group's guard circuit input is preventing motion. |
| 9251 | One of the Group's interference zones is violated. |
| 9252 | The Group's liveman switch is preventing manual mode operation. |
| 9253 | The Group's Safety circuit is preventing motion. |
| 10115 | XML Tag not found. Possibly the file is corrupt or the schema is not compatible with this function block. |
| 10120 | File could not be opened. Check for accurate directory path and use of "/" |
| 10122 | Row Error. The data is out of sync with the expected row / column arrangement expected. |
| 10125 | Conversion Error. Check the ErrorRow and ErrorCol / ErrorMessage outputs for details. |
| 10127 | TooManyRecords - DataType is not large enough. |
| 10138 | The positions of the main and prime axes are outside the specified Allowance to permit motion on the prime axis. |
| 10165 | CommandString length is too long or command delimiter not found. |
| 10632 | Joint Not Configured. Could not find a Degree of Freedom in the HomeData. For Example, in HomeData.Sequence[1].DOF[1] := 'Z', 'Z' was not found in the AxesGroup configuration. |

Example

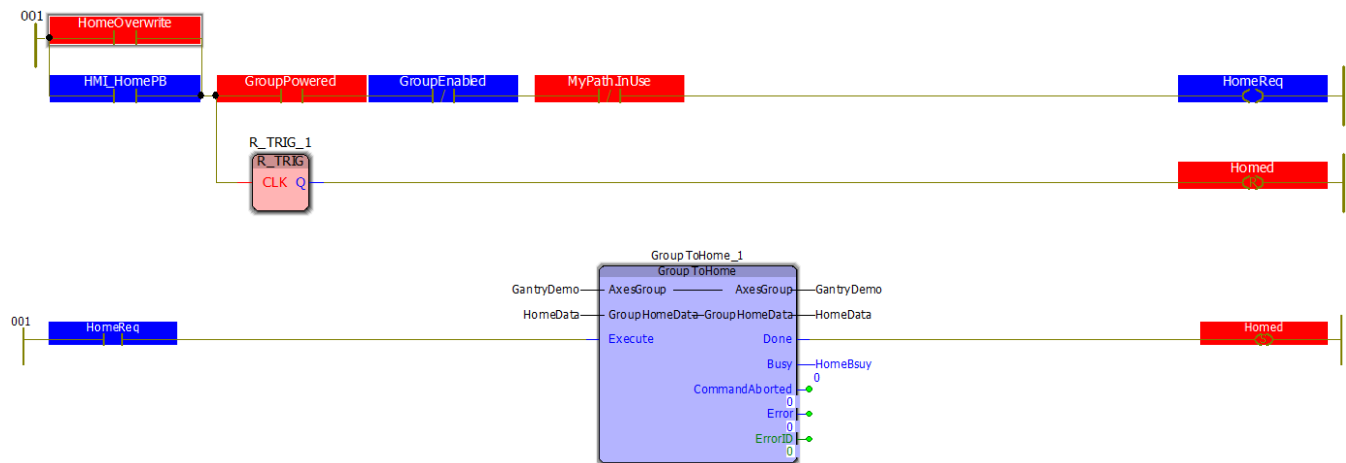
This example homes a three axis gantry by first raising the Z upward to 12mm (see line 167), then moving the X & Y axes to their home positions. (see line 161.)

```

159      (* Initialization for a 3 axis gantry (XYZ) also has YPrime. The handling of a prime axis is auto detected by the GroupToHome FB *)
160      FOR d:=INT#1 TO INT#3 DO
161          HomeData.DOF[d].Position:=LREAL#0.0;
162          HomeData.DOF[d].AccDec:=LREAL#150.0;
163          HomeData.DOF[d].ApproachVelocity :=LREAL#150.0;
164          HomeData.DOF[d].Direction :=MC_Direction#Negative_Direction;
165      END_FOR;
166      12.0000000 HomeData.DOF[3].Direction :=MC_Direction#Positive_Direction;
167      HomeData.DOF[3].Position:=LREAL#12.0;
168
169
170      1 HomeData.Sequence[1].DOF[1] :='Z';          (* Z move first in positive (up) direction *)
171      HomeData.Sequence[1].LastDOF:=INT#1;
172
173      Y HomeData.Sequence[2].DOF[1] :='X';          (* After Z is complete, X&Y start moving in the negative direction *)
174      2 HomeData.Sequence[2].DOF[2] :='Y';
175      HomeData.Sequence[2].LastDOF:=INT#2;
176
177      HomeData.LastSequence:=INT#2;
178
179      HomeData.PrimeAllowance:=LREAL#2.0;          (* mm of deviation max difference in the initial commanded position of the main & prime axes to be aligned *)

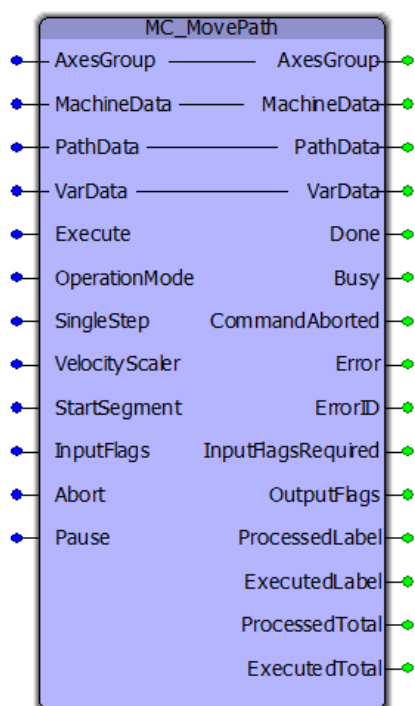
```

Example logic to start the home process.





MC_MovePath



This function block reads the information in the PathData struct and performs the required actions such as interpolated motion, waiting for inputs, setting outputs, etc. The PathData struct is typically populated by various sources, such as the following function blocks: [Read_GCode_File](#), [Read_GCode_Stream](#), and CP_Generator.

Library

Group Toolbox

Parameters

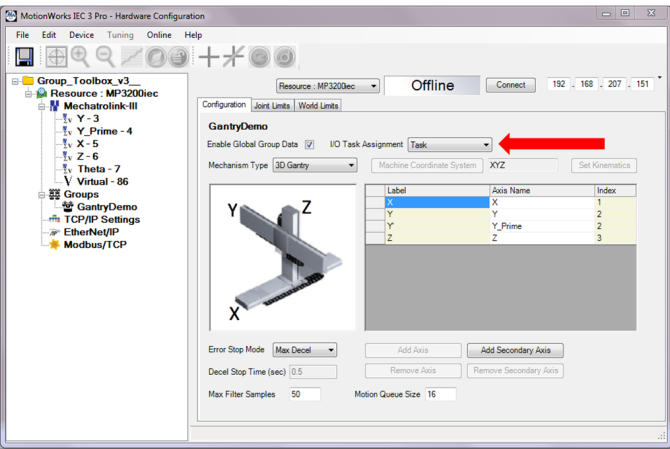
| * | Parameter | Data Type | Description |
|-------------------|-------------|--------------------------------|---|
| VAR_IN_OUT | | | |
| B | AxesGroup | AXES_GROUP_REF | A logical reference to a group of axes, which contains several additional substructures pertaining to the group. |
| V | MachineData | MachineStruct | Contains machine parameters including accel and velocity maximums, and support for additional axes such as extruder and tangent axes if required. |

| | | | |
|------------------|----------------|----------------------------------|--|
| V | PathData | MC_PATH_DATA_REF | Structure of data that contains the details for executing a path sequence. Typically PathData is populated by a source function such as Read_GCode_File , Read_GCode_Stream , or CP_Generator but simple sequences could also be populated as a static script in ST code. |
| V | VarData | VariableArray | An array of LREAL data which is only used with G Code applications where registers contain variable data. For such applications, connect GCodeData.Variables from the Read_GCode_File function block to this VAR_IN_OUT. If this data is not applicable to the application, connect a dummy variable to satisfy the compiler. |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| V | OperationMode | INT | Enumeration with the following meanings: GT_OperationMode#Forward GT_OperationMode#SingleStepFwd GT_OperationMode#Neutral GT_OperationMode#SingleStepRev (Future support) GT_OperationMode#Reverse (Future support) GT_OperationMode#InfiniteRepeat See Notes below for details. |
| V | SingleStep | BOOL | When OperationMode is set for SingleStepFwd, the function will execute one Segment from the PathData at each rising edge of SingleStep. |
| V | VelocityScaler | REAL | The 'FeedRate' element of each Segment is multiplied by the VelocityScaler Input. Changes only affect new motion segments executed after a change to VelocityScaler, previous segments already in the motion buffer will be executed at the Feedrate and VelocityScaler specified at the time they were processed. To change the velocity of the path segments already in the motion buffer at the firmware layer, use the MC_GroupSetOverride function block. |
| V | StartSegment | INT | The first Segment of the PathData to use upon the rising edge of the Execute input. For fault recovery, set this to a non zero value to resume a path that was interrupted. Refer to PathData.Buffer.ExecutedSegment. Capture this value in the event of an Error or other interruption of the path and set it as the StartSegment to recover a path in progress. |
| V | InputFlags | DWORD | Specify up to 32 digital inputs which can be used to control path operations in conjunction with the following SegmentTypes: GT_SegmentType#WaitForInputs GT_SegmentType#LoopDecision GT_SegmentType#BranchDecision GT_SegmentType#NonBlockingInputCheck See Examples below. |

| | | | | |
|-------------------|--------------------|--------------|--|-------|
| V | Abort | BOOL | Stops executing Segments and uses MC_GroupStop to stop any ongoing motion. The CommandAborted Output will be set and motion cannot be started again until the Execute Input is toggled. | FALSE |
| V | Pause | BOOL | This input puts MC_MovePath into an idle state where it will non longer process new segments, but segments already executed and in the motion buffer will be unaffected and continue until the buffer is empty. This may cause a delay from the time Pause is set high until the group physically stops. To Pause or "Interrupt" the group immediately, use the MC_GroupInterrupt function block externally with MC_MovePath. | FALSE |
| VAR_OUTPUT | | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |
| E | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |
| V | InputFlagsRequired | DWORD | For use as a debugging tool. This Output reports the InputConditions of the current Segment. For example, if the machine appears to be stuck, it is possible that the active Segment is waiting for a specific set of InputFlags to match before proceeding. | |
| V | OutputFlags | DWORD | PathData.Segment[].OutputFlags are copied to the OutputFlags Output based on the following conditions: 1) If motion is active, the OutputFlags associated with the Segment responsible for ongoing motion is applied. This technique relies on Group Parameters 2201 and 2202. 2) When there is no ongoing motion, the OutputFlags of the Segment being processed are applied. | |
| V | ProcessedLabel | YTB_STRING16 | If PathData.Segment[].Label was populated by the source, this Output reports a descriptive name of the Segment being processed. If this is a motion segment, the motion instruction is executed, but it does not mean that it is physically causing motion. It may be buffered behind many other motion instructions based on the path data. | |
| V | ExecutedLabel | YTB_STRING16 | If PathData.Segment[].Label was populated by the source, this Output reports a descriptive name of the Segment actually causing motion. In the case of other non motion Segment Types, ProcessedLabel and ExecutedLabel are likely equal to each other. | |
| V | ProcessedTotal | UDINT | Running count of the number of PathData.Segments[] processed since the rising edge of the Execute input. This value will likely be ahead of ExecutedTotal based on the path characteristics, and the size of the Group motion queue as configured in the Hardware Configuration. | |
| V | ExecutedTotal | UDINT | Running count of the number of PathData.Segments[] executed since the rising edge of Execute. The difference between the ProcessedTotal and ExecutedTotal is the number of motion blocks still in the motion buffer. | |

Notes

This function block references information in AxesGroup.Status, which is updated by the firmware at the task interval configured in the Hardware Configuration. The IO task assignment must be set to the same or faster task interval as where the MC_MovePath function is executing, or errors such as 4369 may occur.



Additional information about OperationMode:

- It is possible to change ControlMode on the fly.
- When using GT_OperationMode#SingleStepFwd, if the SingleStep input is pulsed before a motion Segment has completed, the request is not buffered and will be ignored.
- GT_OperationMode#InfiniteRepeat will permit MC_MovePath to remain Busy indefinitely (Done will not occur.) When the function reaches the last Segment as identified by comparing (PathData.Buffer.UsePointer = PathData.FinalSegment) it will immediately continue at the beginning of the PathData again. The advantage of this feature is to provide continuous motion for cyclic operations and improve overall cycle time (OEE). This mode is only available when the PathData has not been loaded via Ethernet stream. The total Path must be contained within the PataData structure without being overwritten, otherwise an Error will be generated.

G Code Support:

- Work Coordinate Offsets G54 through G59.3 are stored in the MachineStruct.CoordinateSystem.Offset. The offsets can be updated by the application program via an HMI or PC, or from the G Code data itself via the G10 command.
- Tool Compensation: T0 ~ T20, G40, G41, G42. Tool data must be loaded in the ToolStruct before executing Read_GCode_File or Read_GCode_Stream. Select a tool using the T command.
- For small paths which fit within the MC_PATH_DATA_REF:
 - Because tool compensation is pre processed, changes will not occur unless the Read_GCode* block re reads the G Code data.
- For large data being continuously buffered:
 - Changes will take effect for the segments processed after updated MachineData values become Active.

Error Description

The number of possible Errors is large due to the number of sub function blocks within MC_MovePath. Check the master list of Function Block ErrorID's if the ErrorID is omitted from the following list.

| ErrorID | Meaning |
|---------|-----------|
| 0 | No error. |

| ErrorID | Meaning |
|----------------------|--|
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4390 | Position cannot be defined while the axis is in a master / slave relationship. To redefine the position, use the MC_Stop function block for slave axis, then execute MC_SetPosition. If attempting the redefine a master position, execute MC_Stop for all slaves first. |
| 4412 | Parameter not supported for the specified axis or group. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4654 | Invalid Speed Unit setting in Y_MoveOptions.ProfileUnit. Select 0 for Absolute units, or 1 for % of maximum. |
| 4658 | Velocity parameter is less than or equal to zero. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4642 | Direction does not correspond to a valid enumeration value. |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 4680 | Invalid acceleration filter type entered. |
| 4982 | Default drive parameter info is not available for this parameter. Use the DataType Override input to specify the parameter size. |
| 4983 | The specified external axis may not be used. A physical axis is required. |
| 8960 | Invalid axes group. Confirm that the AxesGroup variable has the correct %M address as automatically assigned by the Hardware Configuration. Be sure the AxesGroup variable is global, and that if the group has been recently defined, the controller was rebooted. |
| 8963 | Specified Coordinate System is not supported. Possible causes: If a custom group is specified, only the ACS Coordinate System is applicable. |
| 8964 | Move prohibited because group has an alarm. |
| 8967 | The group reports one or more of its axes has an error. |
| 8969 | Invalid circular path method. |
| 8970 | Invalid PathChoice. MC_MoveCircularAbsolute.PathChoice cannot be set to Clockwise or Counter Clockwise if the Group can move in three dimensions. |
| 8971 | Invalid circle geometry. Check the PathChoice input, only Longest and Shortest are allowed if the group has more than two dimensions. Be sure that the starting point (which is the position of the group before executing MC_MoveCircularAbsolute,) the AuxPoints, and the EndPoint define the intended arc. If using MC_CircleMode#Center, the calculated radius of the start position to the center and the end position to the center must be within 0.1%. It may be necessary to increase the resolution of the values provided. |
| 8973 | Invalid transition mode. |

| ErrorID | Meaning |
|-----------------------|--|
| 8974 | Invalid transition parameter. |
| 8975 | Invalid transition geometry. The values for the acceleration, deceleration, and/or velocity of the transition yield an invalid geometry. Given the limits of accel/decel, velocity, and length of the segment, can't create the corner geometry to meet the specification. |
| 8978 | Infinite velocity constraint. The resolved velocity limit for the move was infinite. If there is no Cartesian motion, and a rotational change only, use the MoveOptions input to specify the VelocityUnits as "UseRotationalScalers." Or - There is a non zero value in the position VECTOR for a degree of freedom that the AxesGroup does not support. |
| 8979 | Infinite acceleration constraint. The resolved acceleration limit for the move was infinite. |
| 8980 | Infinite deceleration constraint. The resolved acceleration limit for the move was infinite. |
| 9000 | The specified blending transition is not possible based on the two moves in the buffer to be blended. For example, Move 1 is a line and Move 2 is an arc, and they are not in the same plane. |
| 9001 | The specified blending transition required exact corner distance or deviation, but insufficient distance remained in the segment to satisfy the transition geometry. |
| 9002 | The position was unreachable due to inverse kinematics limitations . Try a direct move instead of a linear move. |
| 9003 | Specified blending transition for the function block could not be realized due to blending parameter restrictions. Typically due to accel limit too low or segment length too short, relative to transition velocity. |
| 9216 | Invalid Host_ID. Supported Host_IDs are (0 = MECHATROLINK group, 1 = MLX hosted group) |
| 9217 | Invalid Interface_ID. Supported Interface_IDs are (0..7) |
| 9218 | Invalid Device_ID. Device_ID must be 0. |
| 9219 | The groups motion engine generated an error. Use the MC_GroupReadError function block to obtain the GroupErrorID. |
| 9220 | Group is not enabled. Enable the group using MC_GroupEnable. |
| 9221 | EtherNet/IP communication between the MPiec and the MLX robot interface was lost. |
| 9222 | State Transition Error. Refer to MC_GroupReadError for further details. |
| 9223 | Trajectory Shape Error. The value passed to MoveOptions.TrajectoryShape is invalid Valid trajectory types are 0 = Trapezoid and 1 = S-Curve. |
| 9224 | Profile Unit Error. The value passed to MoveOptions.ProfileUnit is invalid. Valid values are 0 (% of maximum) or 1 (Absolute units). |
| 9225 | Invalid Control Mode. The group is set for Jogging or Manual mode, and an MC_MoveLinear or similar function block was executed, or Y_GroupJog or similar function block was called while the group was set for Automatic mode. |
| 9240 | Calculation leads to a singularity. Calculated output coordinates is in a singular or gimbal lock configuration. |
| 9249 | The Group's E-Stop input is preventing motion. |
| 9250 | The Group's guard circuit input is preventing motion. |
| 9251 | One of the Group's interference zones is violated. |
| 9252 | The Group's liveman switch is preventing manual mode operation. |
| 9253 | The Group's Safety circuit is preventing motion. |
| 10022 | Internal error in the StoreMotionSegment function block. It tried to overwrite the circular buffer data. Call Yaskawa to report the issue. |
| 10054 | One of the segments in the path has an invalid Segment Type. Valid Segments Types are defined in Group Toolbox GroupTypes file as enumeration GTB_SegmentType. |
| 10136 | Loop Error. The ability to repeat sections of the path requires that the entire path is contained in the PataData structure at once. A LoopDecision or NonBlockingLoopDecision segment type detected that PathData.Buffer.Overwritten = TRUE. |
| 10137 | Path Dirty Error - The path has been overwritten (circular buffer) so it cannot be re executed from the beginning. Re read teh file or re start the stream. |
| 10139 | VelocityScaler cannot be less than or equal to zero. |
| 10607 | Segment Error. A function inside MC_MovePath could not find a SegmentID for the current motion that matches one assigned when the motion function block was executed. |

| ErrorID | Meaning |
|-----------------------|--|
| 10616 | OperationMode Error. The VAR_INPUT is requesting "Infinite Repeat" but the path is too large to fit within the PathData.Segment struct at once, and the beginning of the path was overwritten. Infinite repeat mode is only possible if the entire path can be contained in the PathData struture. |
| 10620 | Spindle Speed Calculation Error. PathData.HC_UserUnits is invalid or not supported. |
| 10621 | Final Segment Error. The PathData.FillMethod is set as n/a and the PathData.FinalSegment is zero. Please set PathData.FinalSegment properly. |
| 10622 | Tangent configuration error. Maybe the Tangent axis is configured as a theta axis of the group, and not as an external axis. (Must not be a group's theta axis.) |
| 10623 | Max Segments Error. AxesGroup.Status.FreeMotionSegments <= (MachineData.Prm-s.MaxSegmentsPerScan * 2). Either increase the Motion Queue Size in the Hardware Configuration for this group, or reduce MyMachine.MaxSegmentsPerScan. |
| 10633 | Queue Size Error occurs if the Motion Queue Size set in the Hardware Configuration is larger than the DataType MC_PATH_DATA_REF.Segment[] in the Group Toolbox. |
| 10634 | The Motion Queue Size set in the Hardware Configuration is larger than the DataType MC_PATH_DATA_REF.Segment[] in the Group Toolbox. Adjust the Motion Queue Size so it is smaller than the size declared for MC_PATH_DATA_REF.Segment[]. |
| 10640 | Tool Length Error - G Code Register. _H is not 0,1, or 2. |
| 10641 | Evaluation Error. There was something wrong with a logical command such as a missing # sign, unsupported or improperly formatted logical comaprison, or divide by zero. |
| 11051 | Segment Error, could not find the previous motion segment to determine change in XYZ coordinates. Maximum search is 20 segments. Contact Yaskawa Electric America for support. |
| 11052 | There are no degrees of freedom defined for the Group. The could be a group configuration error. At least one of the first 6 AxesGroup.Machine.Label[] must be populated with a string name, or the AxesGroup.HostID must indicate a remote hosted robot. |
| 57617 | Instance object is NULL. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |
| 60909 | This function block is not supported for the AxesGroup specified. |
| 61713 | This function block caused an internal error. Possible causes: MC_Power – Check if multiple instances of this block are executed for the same axis. Y_CamIn - Check in the cam table if the master values are the same for two datapoints or decreasing. Y_CamStructSelect – Y_MS_CAM_TABLE.Header.DataSize must not be zero. Tangent axis configured as Load Type = linear in Hardware Configuration? |

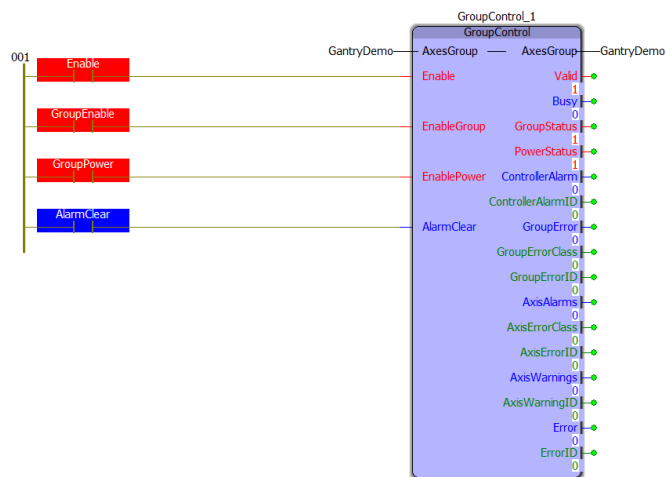
Example1 - Minimum setup required to get started

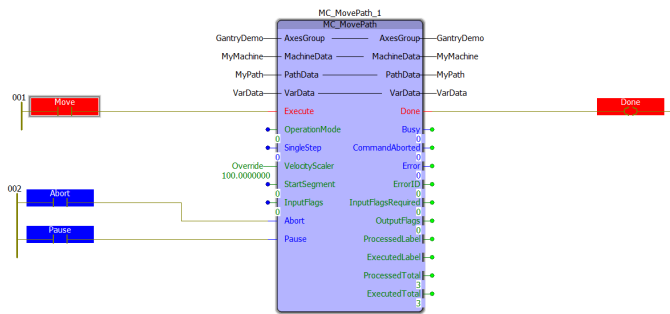
To learn how to configure the data to operate this block, this example includes hard coded initialization of the related data structures.

```

1  (* Set machine parameters *)
2  MyMachine.Prms.Acceleration:=LREAL#100.0;
3  MyMachine.Prms.Deceleration:=LREAL#100.0;
4  MyMachine.Prms.MaxVelocity:=LREAL#250.0;
5  MyMachine.Prms.MaxAcceleration:=LREAL#300.0;
6  MyMachine.Prms.MaxDeceleration:=LREAL#300.0;
7  MyMachine.Prms.MaxSegmentsPerScan:=INT#1; (* Group Toolbox v340 will default to INT#1 if not set *)
8  MyMachine.MachineType:=GTB_MachineType#Printer;
9
10
11
12  MyPath.Colinearity:=LREAL#30.0; (* Degrees *)
13
14  (* Sample minimum Path information for straight line *)
15  x:=INT#0;
16
17  MyPath.Segment[x].SegmentType:=GTB_SegmentType#StraightLine;
18  MyPath.Segment[x].AbsoluteMode:=TRUE;
19  MyPath.Segment[x].CoordSystem:=MC_CoordinateSystem#MCS;
20  MyPath.Segment[x].FeedRate:=REAL#34.5; (* If FeedRate is not specified, then MachineData.MaxVelocity will be used *)
21  MyPath.Segment[x].X:=LREAL#3.5;
22  MyPath.Segment[x].Y:=LREAL#1.5;
23  x:=x + INT#1;
24
25
26  MyPath.Segment[x].SegmentType:=GTB_SegmentType#StraightLine;
27  MyPath.Segment[x].AbsoluteMode:=TRUE;
28  MyPath.Segment[x].CoordSystem:=MC_CoordinateSystem#MCS;
29  MyPath.Segment[x].X:=LREAL#8.25;
30  MyPath.Segment[x].Y:=LREAL#3.75;
31  x:=x + INT#1;
32
33
34  MyPath.Segment[x].SegmentType:=GTB_SegmentType#StraightLine;
35  MyPath.Segment[x].AbsoluteMode:=TRUE;
36  MyPath.Segment[x].CoordSystem:=MC_CoordinateSystem#MCS;
37  MyPath.Segment[x].X:=LREAL#0.5;
38  MyPath.Segment[x].Y:=LREAL#21.5;
39  x:=x + INT#1;
40
41
42  MyPath.Segment[x].SegmentType:=GTB_SegmentType#StraightLine;
43  MyPath.Segment[x].AbsoluteMode:=TRUE;
44  MyPath.Segment[x].CoordSystem:=MC_CoordinateSystem#MCS;
45  MyPath.Segment[x].X:=LREAL#7.5;
46  MyPath.Segment[x].Y:=LREAL#5.5;
47
48  MyPath.FinalSegment:=x;
49  MyPath.FillMethod:=GTB_DataSource#File; (* Group Toolbox v340 can operate with default of GTB_DataSource#na *)
50  MyPath.Buffer.StorePointInter:=x; (* If using Group Toolbox v340 and FillMethod GTB_DataSource, this setting is unnecessary *)

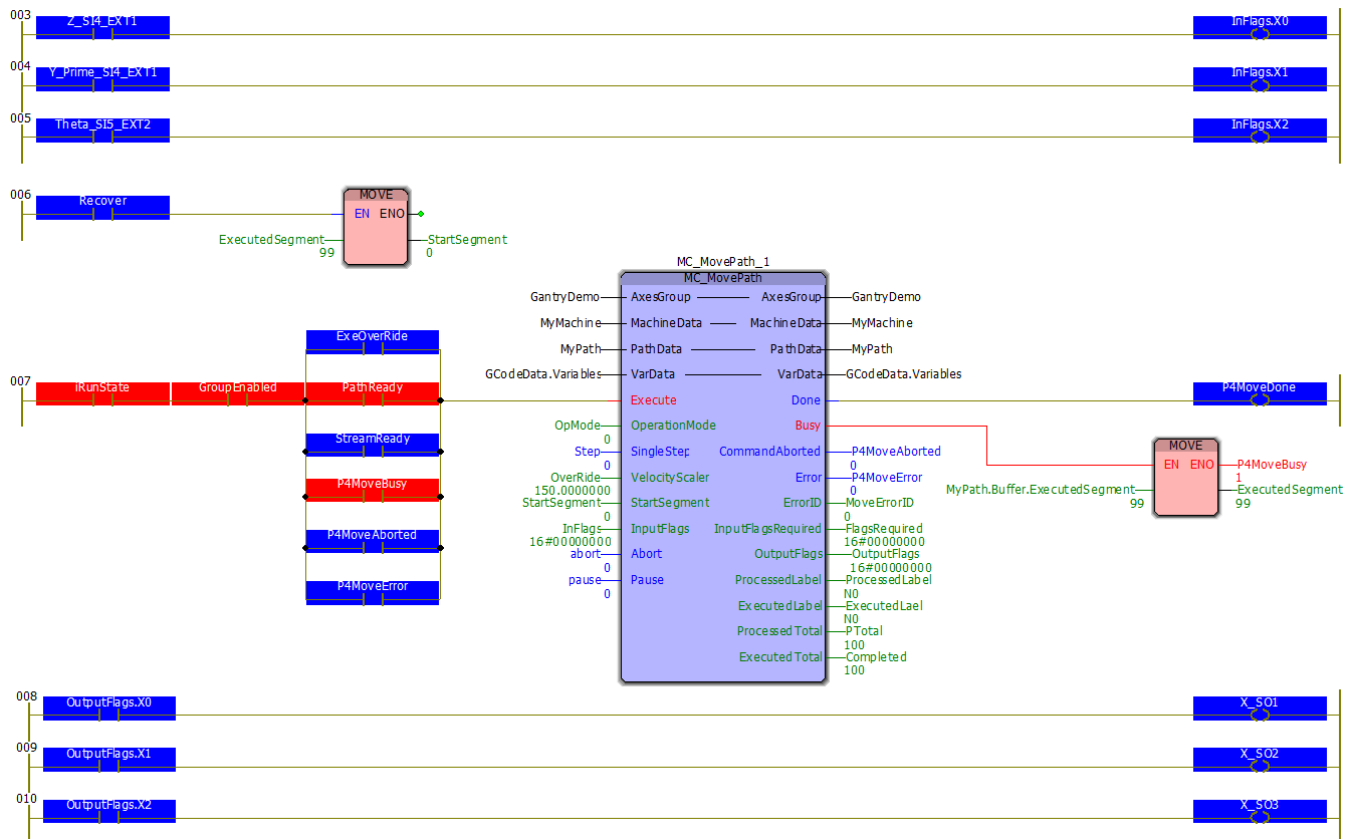
```





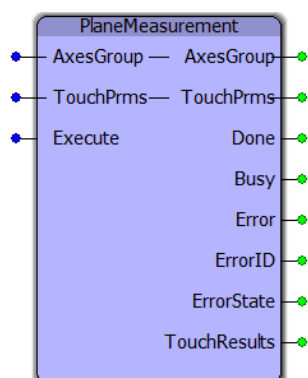
Example 2

This example shows a typical method to map physical inputs and outputs to the data used with the function block. See InFlags and OutFlags usage.





PlaneMeasurement



This function block moves a group to find a plane by touching three user specified locations. Once a torque limit is achieved, the position is recorded and output for use with other functions, such as Y_GroupSetFrameOffset.

Library

Group Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|--------------------------------|--|
| VAR_IN_OUT | | | |
| B | AxesGroup | AXES_GROUP_REF | A logical reference to a group of axes, which contains several additional substructures pertaining to the group. |
| V | TouchPrms | HomeStruct | Structure of data that provides information for learning the specified plane. |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| C | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |

| | | | |
|---|----------------|------|---|
| C | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

- This block will detect if joint has a prime axis, and will monitor the torque of all axes involved when moving the joint to the touch positions.

Error Description

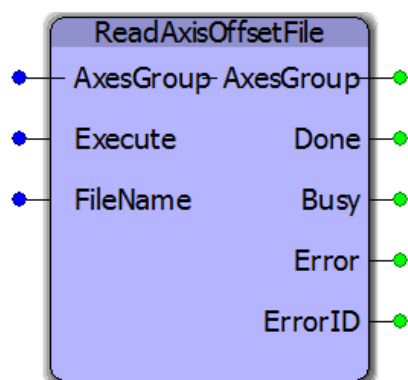
| ErrorID | Meaning |
|----------------------|--|
| 0 | No error. |
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4654 | Invalid Speed Unit setting in Y_MoveOptions.ProfileUnit. Select 0 for Absolute units, or 1 for % of maximum. |
| 4658 | Velocity parameter is less than or equal to zero. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 8960 | Invalid axes group. Confirm that the AxesGroup variable has the correct %M address as automatically assigned by the Hardware Configuration. Be sure the AxesGroup variable is global, and that if the group has been recently defined, the controller was rebooted. |
| 8961 | An axis is already owned by another group. |
| 8962 | Group activation is blocked. Ownership can not be changed while Mechatrolink reset is in progress. |
| 8963 | Specified Coordinate System is not supported. Possible causes: If a custom group is specified, only the ACS Coordinate System is applicable. |
| 8964 | Move prohibited because group has an alarm. |
| 8965 | Group activation prohibited, invalid axis/joint config. |
| 8966 | Group activation prohibited, mismatched axis command position for split axis. Example: X and X Prime sharing the same load. |
| 8967 | The group reports one or more of its axes has an error. |
| 8973 | Invalid transition mode. |
| 8974 | Invalid transition parameter. |

| ErrorID | Meaning |
|-----------------------|--|
| 8975 | Invalid transition geometry. The values for the acceleration, deceleration, and/or velocity of the transition yield an invalid geometry. Given the limits of accel/decel, velocity, and length of the segment, can't create the corner geometry to meet the specification. |
| 8978 | Infinite velocity constraint. The resolved velocity limit for the move was infinite. If there is no Cartesian motion, and a rotational change only, use the MoveOptions input to specify the VelocityUnits as "UseRotationalScalers." Or - There is a non zero value in the position VECTOR for a degree of freedom that the AxesGroup does not support. |
| 8979 | Infinite acceleration constraint. The resolved acceleration limit for the move was infinite. |
| 8980 | Infinite deceleration constraint. The resolved acceleration limit for the move was infinite. |
| 9000 | The specified blending transition is not possible based on the two moves in the buffer to be blended. For example, Move 1 is a line and Move 2 is an arc, and they are not in the same plane. |
| 9001 | The specified blending transition required exact corner distance or deviation, but insufficient distance remained in the segment to satisfy the transition geometry. |
| 9002 | The position was unreachable due to inverse kinematics limitations . Try a direct move instead of a linear move. |
| 9003 | Specified blending transition for the function block could not be realized due to blending parameter restrictions. Typically due to accel limit too low or segment length too short, relative to transition velocity. |
| 9216 | Invalid Host_ID. Supported Host_IDs are (0 = MECHATROLINK group, 1 = MLX hosted group) |
| 9217 | Invalid Interface_ID. Supported Interface_IDs are (0..7) |
| 9218 | Invalid Device_ID. Device_ID must be 0. |
| 9219 | The groups motion engine generated an error. Use the MC_GroupReadError function block to obtain the GroupErrorID. |
| 9220 | Group is not enabled. Enable the group using MC_GroupEnable. |
| 9221 | EtherNet/IP communication between the MPiec and the MLX robot interface was lost. |
| 9222 | State Transition Error. Refer to MC_GroupReadError for further details. |
| 9223 | Trajectory Shape Error. The value passed to MoveOptions.TrajectoryShape is invalid Valid trajectory types are 0 = Trapezoid and 1 = S-Curve. |
| 9224 | Profile Unit Error. The value passed to MoveOptions.ProfileUnit is invalid. Valid values are 0 (% of maximum) or 1 (Absolute units). |
| 9225 | Invalid Control Mode. The group is set for Jogging or Manual mode, and an MC_MoveLinear or similar function block was executed, or Y_GroupJog or similar function block was called while the group was set for Automatic mode. |
| 9240 | Calculation leads to a singularity. Calculated output coordinates is in a singular or gimbal lock configuration. |
| 9249 | The Group's E-Stop input is preventing motion. |
| 9250 | The Group's guard circuit input is preventing motion. |
| 9251 | One of the Group's interference zones is violated. |
| 9252 | The Group's liveman switch is preventing manual mode operation. |
| 9253 | The Group's Safety circuit is preventing motion. |
| 10115 | XML Tag not found. Possibly the file is corrupt or the schema is not compatible with this function block. |
| 10120 | File could not be opened. Check for accurate directory path and use of "/" |
| 10122 | Row Error. The data is out of sync with the expected row / column arrangement expected. |
| 10125 | Conversion Error. Check the ErrorRow and ErrorCol / ErrorMessage outputs for details. |
| 10127 | TooManyRecords - DataType is not large enough. |
| 10138 | The positions of the main and prime axes are outside the specified Allowance to permit motion on the prime axis. |
| 10165 | CommandString length is too long or command delimiter not found. |
| 10632 | Joint Not Configured. Could not find a Degree of Freedom in the HomeData. For Example, in HomeData.Sequence[1].DOF[1] := 'Z', 'Z' was not found in the AxesGroup configuration. |

Example



ReadAxisOffsetFile



This function block reads absolute encoder offset information from a file written by [WriteAxisOffsetFile](#). It restores the absolute encoder offsets retained in the MPiec controllers battery backed memory for all axes in an AxesGroup. Restoring encoder offsets is necessary in the event of an MPiec controller replacement or SRAM battery failure.

Library

Group Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|--------------------------------|--|
| VAR_IN_OUT | | | |
| B | AxesGroup | AXES_GROUP_REF | A logical reference to a group of axes, which contains several additional substructures pertaining to the group. |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | FileName | STRING | The file name as listed in the /Flash/Local directory on the controller. The extension is not required and will be automatically appended. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |

| | | | |
|---|---------|------|---|
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

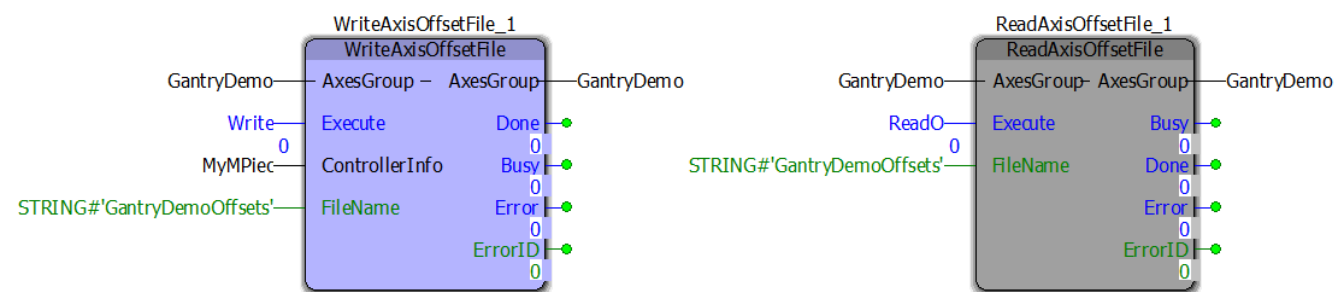
Notes:

- Firmware version 3.3.0 is required to use this function. It relies on MC_ReadParameter 1838, which was added for version 3.3.0.
- The Flash/Local directory was also added for firmware 3.3.0. It is not deleted when a project archive is deleted or the controller is restored to factory defaults.
- Once the file is created using [WriteAxisOffsetFile](#), it is highly recommended to save a backup copy of the file to another location other than the MPiec controller. This file can be replaced manually via the web UI in the event that a new MPiec controller is connected to the existing mechanical equipment.
- The offsets contained in this file are only valid in the following situations:
 - MPiec controller replacement
 - MPiec SRAM battery failure.
- The offsets contained in this file become invalid in the following situations:
 - Absolute encoder battery failure or disconnection. (ServoPack has A.810 alarm)
 - Motor replacement
 - Any mechanical alteration to the drive train, including belts, gearboxes, couplings, etc.

Error Description

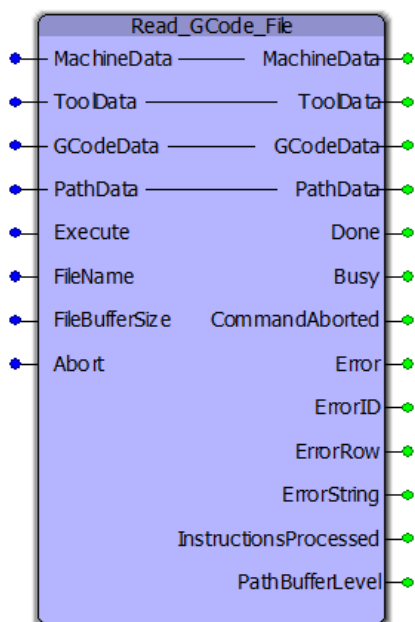
| ErrorID | Meaning |
|-----------------------|---|
| 2 | Maximum number of files are already open. |
| 4 | File is already opened. |
| 5 | File is write protected or access is denied. |
| 6 | File name not defined. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4392 | The function block can not be used with an inverter axis. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4648 | The parameter number does not exist for the specified axis - OR The parameter number requires the other function block (e.g. MC_WriteParameter vs MC_WriteBoolParameter) |
| 10117 | The controller already has a String Conversion Error at the rising edge of this function. Clear the alarm using Y_ClearAlarms and try again. |
| 10120 | File could not be opened. Check for accurate directory path and use of "/" |
| 10121 | The CSV file was written in a format unsupported by this function block. |
| 10122 | Row Error. The data is out of sync with the expected row / column arrangement expected. |
| 10124 | Unsupported Case condition. |
| 10125 | Conversion Error. Check the ErrorRow and ErrorCol / ErrorString outputs for details. |
| 10126 | NoDataError - The End Of File was reached, but the record count is zero. Verify the file is not corrupted. |
| 10127 | TooManyRecords - DataType is not large enough. |
| 10128 | MaxNotDefined - The user must set the maximum number of records that can be added to the structure. |
| 10129 | No Carriage return found in CSV buffer. The function searched the file for twice the length of the specified buffer and was unable to find a carriage return indicating the end of a row. Either the buffer size is too small, or the data is invalid. |
| 10166 | File Not Found |
| 10168 | Buffer Size Error. |
| 10619 | Invalid file name. File names must only contain alphanumeric characters. The first character must not be numeric. |

Example





Read_GCode_File



This function block reads a file containing G Codes from the MPiec controller's flash or ramdisk file system and stores the data in a structure for use with the [MC_MovePath](#) function block. Refer to the [list of supported G & M Codes](#).

Library

Group Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-------------|-------------------------------|---|
| VAR_IN_OUT | | | |
| V | MachineData | MachineStruct | Holds data such as motion parameters, origin, and external tangent configuration. |
| V | ToolData | ToolStruct | Structure holding ToolData structures. If this data is not applicable to the application, connect a dummy variable to satisfy the compiler. |

| | | | |
|-------------------|-----------------------|----------------------------------|---|
| V | GCodeData | GCodeStruct | Working data set used by the GCode Processor. It is made available as VAR_IN_OUT for debugging purposes. No data within the structure must be populated by the application program. For applications that use variables, the GCodeData.Variables sub structure must also be connected to the VarData input of MC_MovePath. |
| V | PathData | MC_PATH_DATA_REF | Data structure containing the details parsed from the G Code source and used by the MC_MovePath function block. |
| VAR_INPUT | | | |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| V | FileName | STRING | Name of file to be read or written. Example STRING#'/-flash/user/data/myFile.csv' FileName can include any extension. Max characters for the total FileName is 24. The directory path is not included in this maximum. |
| V | FileBufferSize | UDINT | The number of bytes to read from the file 'per cycle' or in one CYCLIC task in which the function block is executing. The maximum is 16384. See notes below for more details. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |
| V | ErrorRow | UINT | The row in the file which caused the error. If the file contains Nxxx line number codes, then the line number from the N code is reported. If no N codes are included, then the RowCount is from the very first line of the file starting at 1. If N codes are given on some lines but not all lines, ErrorRow may be inaccurate - it will report the last line which included an N code which may not be the one that caused an error. |
| V | ErrorString | STRING | The G Code instruction which caused the error. |
| V | InstructionsProcessed | UDINT | The number of individual G Code instructions processed since this function block was executed. Nxxx line number codes excluded from the count. For example, the command G1 X10 Y30 Z4 counts as four instructions, but only one Segment in PathData.Segment[.] |

| | | | |
|---|-----------------|------|---|
| V | PathBufferLevel | REAL | Percentage of the PathData.Segment[] which contains data waiting to be processed by MC_MovePath . The default PathData.Segment[] is declared with size = 250. If 200 instructions have been processed by this function block, but MC_MovePath and the physical machine have only processed 25, the PathBufferLevel would be (200-25)/250 * 100 = 70%. This function will automatically wait until MC_MovePath has processed segments and continue filling the PathData structure with new data until the entire file has been read. |
|---|-----------------|------|---|

Notes

Processing is divided into two parts; Read_GCode_File and [MC_MovePath](#). These blocks may be put into separate tasks. Typically MC_MovePath is placed in a faster task, especially if InputFlags and OutputFlags are used. Read_GCode_File should be executed in a slower task. It will parse the number of bytes as specified by FileBufferSize per cycle. A cycle is six scans. For example, if FileBufferSize is set to 10000, and Read_GCode_File is executed in a Cyclic task running every 50 mSec, a cycle is 300 mSec (50 * 6 = 300). Given these settings, the controller will process a maximum of 33,000 bytes/second, but may be less, based space available in the motion buffer. [MC_PATH_DATA_REF](#) has a default size allocation of 250 Segments. Once the buffer becomes full, Read_GCode_File will wait until MC_MovePath has executed 50% of the segments, then read from the file buffer again. The datatype definitions of [MC_PATH_DATA_REF.Segments](#) and the number of characters in the ByteBuffer-Struct specified by FileBufferSize is configurable if necessary. Consult Yaskawa for details.

Error Description

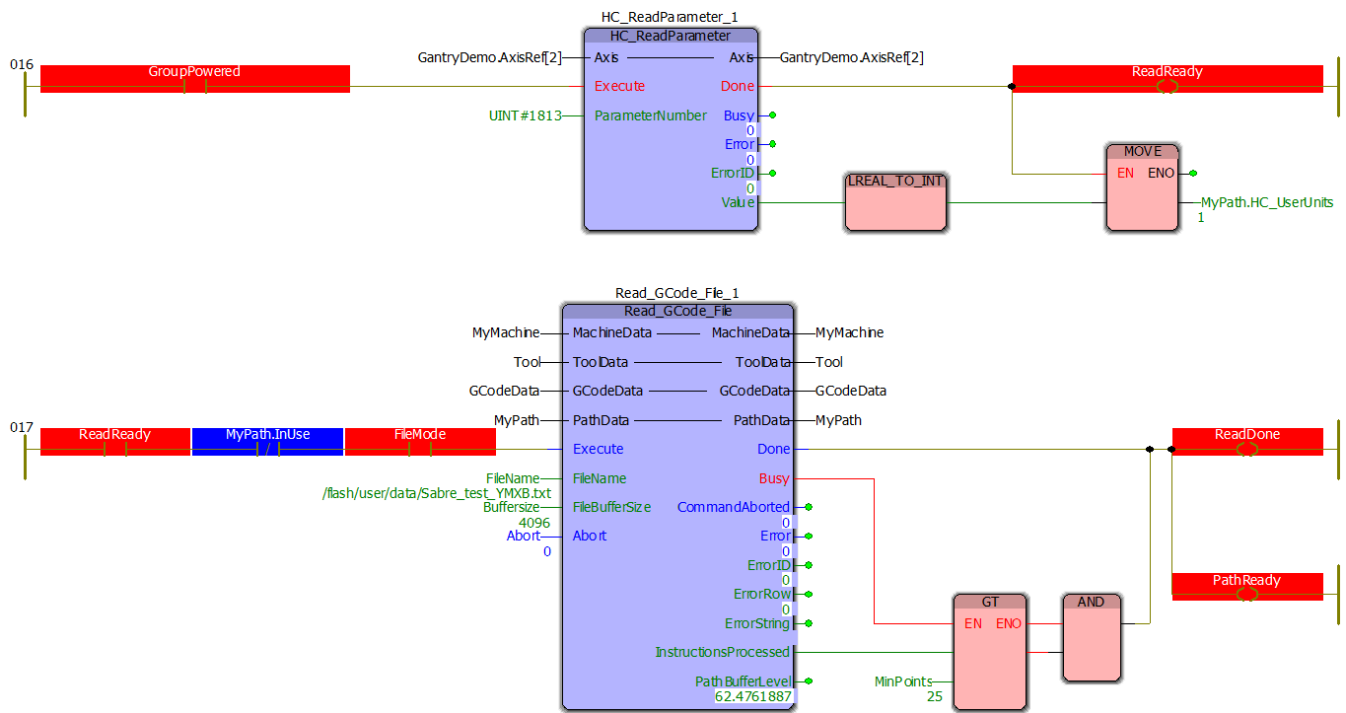
| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 10054 | One of the segments in the path has an invalid Segment Type. Valid Segments Types are defined in Group Toolbox GroupTypes file as enumeration GTB_SegmentType. |
| 10117 | The controller already has a String Conversion Error at the rising edge of this function. Clear the alarm using Y_ClearAlarms and try again. |
| 10120 | File could not be opened. Check for accurate directory path and use of "/" |
| 10122 | Row Error. The data is out of sync with the expected row / column arrangement expected. |
| 10123 | Column Start Error. The data is corrupted. |
| 10125 | Conversion Error. Check the ErrorRow and ErrorCol / ErrorString outputs for details. |
| 10126 | NoDataError - The End Of File was reached, but the record count is zero. Verify the file is not corrupted. |
| 10127 | TooManyRecords - DataType is not large enough. |
| 10128 | MaxNotDefined - The user must set the maximum number of records that can be added to the structure. |
| 10129 | No Carriage return found in CSV buffer. The function searched the file for twice the length of the specified buffer and was unable to find a carriage return indicating the end of a row. Either the buffer size is too small, or the data is invalid. |
| 10164 | Invalid character position input. |
| 10168 | Buffer Size Error. |
| 10600 | Unsupported Letter Code. A G Code started with a character that was not recognized. |
| 10601 | Unsupported G Code |
| 10602 | Unsupported M Code |
| 10603 | PathData is currently in use by MC_MovePath, it is not possible to START reading data into the structure until MC_MovePath is Done. |
| 10604 | Circle Error. When specifying an arc (G02 or G03), both the I and J registers cannot be zero. |
| 10605 | Offset Error. G10 'P' parameter must be 1 through 9. |

| ErrorID | Meaning |
|-----------------------|--|
| 10606 | User Unit Error. An invalid combination of user units between the Hardware Configuration and the G code data was found. Example: HC is configured for revolutions, and the G Code file specifies mm. The G Code Processor can only convert between linear units. |
| 10610 | Tool Compensation Error. No Solution Found (Logic Error) |
| 10611 | Division by zero. |
| 10612 | Tool Compensation Error. A segment transition from line to line, line to arc, arc to line, or arc to arc was not detected. |
| 10613 | Tool Compensation Error. No solution found for an arc to arc transition. |
| 10614 | Tool index as specified in the 'P' register must be between 1 and MaxTools, which is the size of the ToolDataStruct in the Group Toolbox GCode ypes file. |
| 10615 | G10 Error. The 'L' register must be 1 or 2. |
| 10617 | Group Name Error. Check AxesGroup.Name for validity. |
| 10618 | ControllerInfo Error. Connect a Global variable of datatype CONTROLLER_INFO and locate it at address %MD3.66560 |
| 10623 | Max Segments Error. AxesGroup.Status.FreeMotionSegments <= (MachineData.Prms.MaxSegmentsPerScan * 2). Either increase the Motion Queue Size in the Hardware Configuration for this group, or reduce MyMachine.MaxSegmentsPerScan. |
| 10624 | Emulation Error. MachineData.Emulation is not set to a valid value. |
| 10625 | Program List Error. There are more sub program calls in the data than are supported by the G Code functions. (O register) |
| 10626 | Stack Overflow. There are more Jump Segment Types in MC_PATH_DATA_REF than the defined size for PathData.Logic.Events |
| 10627 | Variable Error. A line that starts a variable assignment is missing an equal sign, or the variable index is out of range [1 to 1000] |
| 10628 | The canned cycle G Code is not supported. |
| 10629 | Cycle Array Error. The G code data contains more information for a canned cycle than an internal structure which holds all the XZ information contained within the P & Q line numbers. |
| 10630 | Canned Cycle Finishing Error. Possible causes are: #1) (End - Start) block must be at least one block. 2) The range of commands to be repeated must come after G71. |
| 10631 | A command was encountered that is not supported for the configured MachineType. For example, M270 is found (for 3D printing,) but MachineData.MachineType <> GTB_MachineType#Printer |
| 10635 | Program List Error. The G Code data refers to more program labels (typically from an IF or M98 command) than the declared size of ProgramList.Name[], which is typically 16. |
| 10636 | Logic Type Error. The command is not formatted correctly. Examples: N25 IF [#500 LT 25] N35 or N10 #3=0 |
| 10637 | Conversion Error. A logical expression could not be converted from a byte array to a string. Contact technical support for assistance. |
| 10638 | JumpError. The IF instruction must include a line number reference as Nxx where the first character is "N" and the remaining characters are numeric. Example: N25 IF [#500 LT 25] N35 |
| 10639 | Operand Error. The following operands are supported in an IF instruction: EQ, GE, GT, LE, LT, NE, =, >=, <, <=, <, <> |
| 10640 | Tool Length Error - G Code Register._H is not 0,1, or 2. |

Example

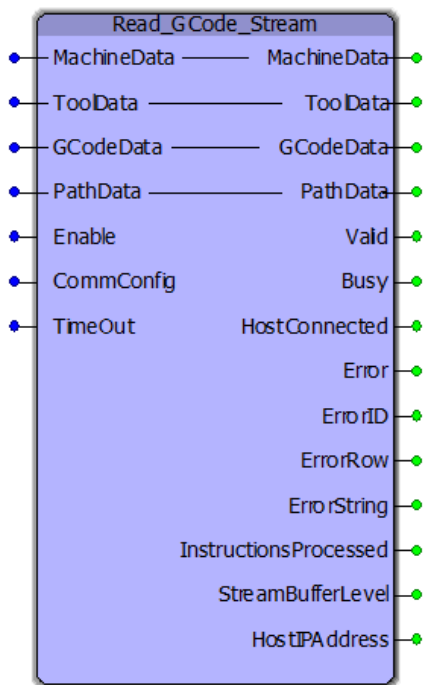
This example shows the HC_ReadParameter function block from the File_RW_Toolbox. It reads parameter 1813 to obtain the code for the user units selected for one of the Cartesian axes of the mechanism, which is copied into MyPath.HC_UserUnits. This allows the Read_GCode_File function block to compare the machine configuration to the G20 / G21 setting within data files and convert the position data as necessary.

This example also demonstrates that the InstructionsProcessed Output can be used to start motion. When the block is Busy and at least 6 datapoints have been processed, a BOOL variable is set which can be used to initiate motion using MC_MovePath.





Read_GCode_Stream



This function block reads and parses a G Code stream from the configured communication device and writes to the PathData, which can be used by [MC_MovePath](#).

Library

Group Toolbox

Parameters

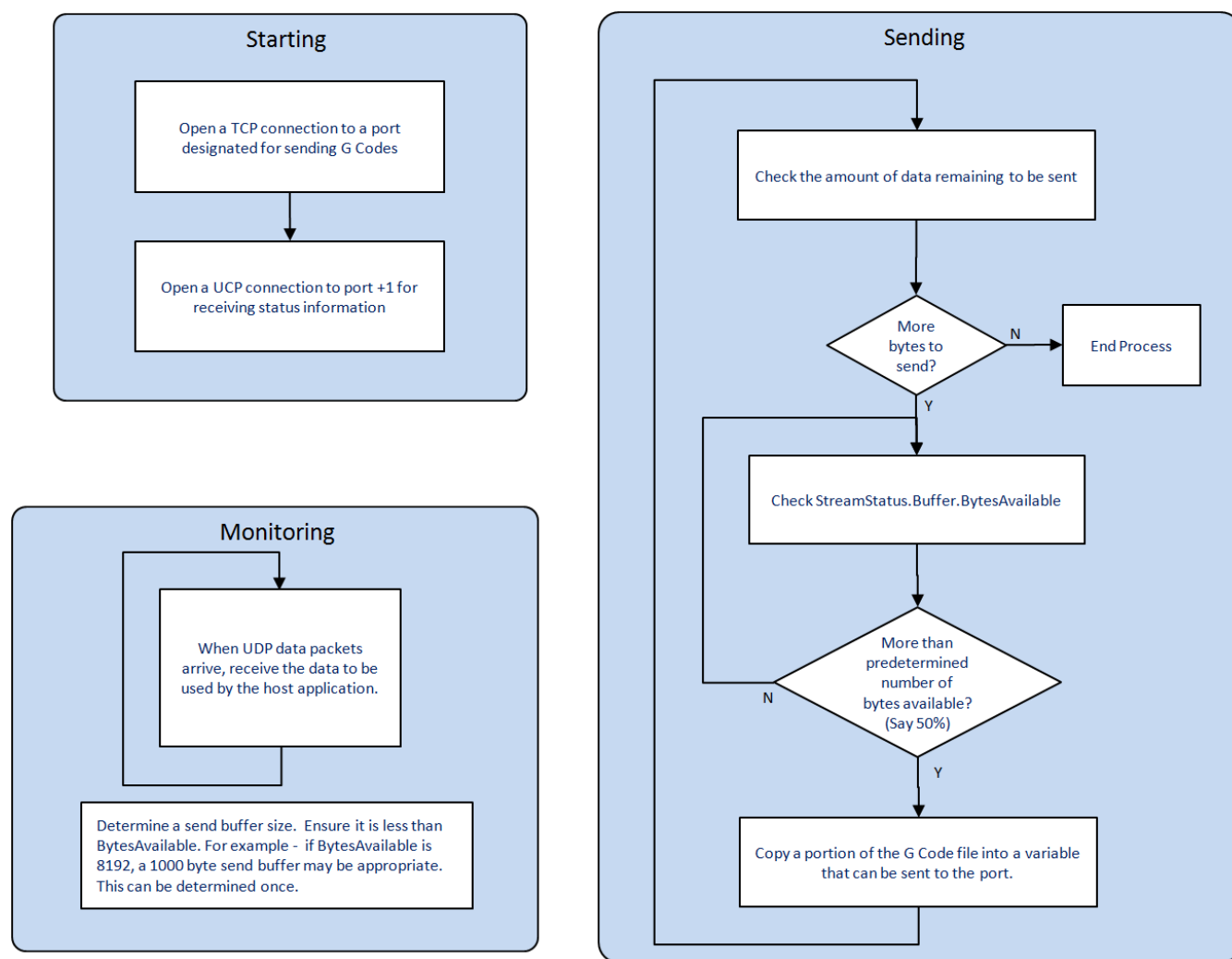
| * | Parameter | Data Type | Description |
|------------|-------------|-------------------------------|--|
| VAR_IN_OUT | | | |
| V | MachineData | MachineStruct | Contains data such as motion parameters, origin, and external tangent configuration. |
| V | ToolData | ToolStruct | Contains radius and length data for tools that may be selected. |

| | | | |
|-------------------|-----------------------|----------------------------------|--|
| V | GCodeData | GCodeStruct | Working data set used by the GCode Processor. It is made available as VAR_IN_OUT for debugging purposes. Not data within the structure must be populated by the application program. Only for applications that are using variables for register values must this GCodeData.Variables sub structure be connected to the VarData input of MC_MovePath. |
| V | PathData | MC_PATH_DATA_REF | Data structure containing the details parsed from the G Code source and used by the MC_MovePath function block. |
| VAR_INPUT | | | |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | CommConfig | CommStruct | For use with CommunicationChannel function block. Contains information about the communication interface used. See the example below. |
| V | TimeOut | TIME | Set this value if the controller should close the connection and stop waiting for commands. |
| VAR_OUTPUT | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| V | HostConnected | BOOL | Confirms that a host has successfully initiated a connection. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |
| V | ErrorString | STRING | For some errors, this string is the command which caused the error. |
| V | InstructionsProcessed | UDINT | The number of individual G Code instructions processed since this function block was enabled. Nxxx line number codes are excluded from the count. For example, the command G1 X10 Y30 Z4 counts as four instructions, but only one Segment in PathData.Segment[]. |
| V | StreamBufferLevel | REAL | Percentage of the PathData.Segment[] which contains data waiting to be processed by MC_MovePath. The default PathData.Segment[] is declared with size = 250. If 200 instructions have been processed by this function block, but MC_MovePath and the physical machine have only processed 25, the StreamBufferLevel would be $(200-25)/250 * 100 = 70\%$. This function will automatically wait until MC_MovePath has processed segments and continue filling the PathData structure with new data until the entire file has been read. |
| V | HostIPAddress | STRING | The IP address of the device which initiated a connection request to the MPiec controller for G Code streaming. |

Notes

- Search for AN.MPIEC.24 on www.yaskawa.com for information about the GCodeComm DLL for communicating from a host application to this function block.
- The host application must read the StreamStatus to determine the number of bytes available in the bytearray. The host application and the Read_GCode_Stream function block will work together to transmit / receive the byte stream of G Code information.

Basic Flowchart of Host PC application



Error Description

| ErrorID | Meaning |
|----------------------|--|
| 0 | No error. |
| 8705 | The maximum number of concurrently open user sockets/IO device handles has been reached or exceeded. |
| 8706 | The socket/IO device handle was invalid. Invalid IP address. |

| ErrorID | Meaning |
|-----------------------|--|
| 8707 | The IP address string was not in a valid format. |
| 8708 | The socket/IO device handle could not be created. |
| 8709 | The specified address or port is already in use on the local network. |
| 8710 | The specified address or port is not available for use. (Maybe the IP address specified is not assigned to one of the networks available on this MPiec?) |
| 8711 | Unable to accept new socket/IO device handle connection. |
| 8712 | Unable to bind to the specified address. |
| 8713 | The socket/IO device handle type argument was invalid. |
| 8714 | The local address or port was not valid. |
| 8715 | Connecting to the socket/IO device handle failed. |
| 8716 | The remote IP address is unreachable. Check the default gateway. |
| 8717 | The socket/IO device handle is already connected to another endpoint. |
| 8718 | The socket/IO device handle connection attempt was actively refused by the remote device. |
| 8719 | The socket/IO device handle was not connected to a remote endpoint. Call Y_ConnectSocket prior to Y_ReadDevice or Y_WriteDevice. |
| 8720 | An error occurred trying to get or set the device option. |
| 8721 | The communication device could not be read. |
| 8722 | The communication device could not be written. |
| 8723 | A valid buffer argument to WriteDevice and ReadDevice is required. |
| 8724 | Invalid Device Option ID. |
| 8725 | The device option value was not the right size or the data was out of range. |
| 8726 | The serial port ID was not a valid serial port. |
| 8727 | The serial port specified could not be opened. |
| 10023 | Buffer size too small / cannot be zero. |
| 10054 | One of the segments in the path has an invalid Segment Type. Valid Segments Types are defined in Group Tool-box GroupTypes file as enumeration GTB_SegmentType. |
| 10117 | The controller already has a String Conversion Error at the rising edge of this function. Clear the alarm using Y_ClearAlarms and try again. |
| 10120 | File could not be opened. Check for accurate directory path and use of "/" |
| 10122 | Row Error. The data is out of sync with the expected row / column arrangement expected. |
| 10123 | Column Start Error. The data is corrupted. |
| 10125 | Conversion Error. Check the ErrorRow and ErrorCol / ErrorString outputs for details. |
| 10126 | NoDataError - The End Of File was reached, but the record count is zero. Verify the file is not corrupted. |
| 10127 | TooManyRecords - DataType is not large enough. |
| 10128 | MaxNotDefined - The user must set the maximum number of records that can be added to the structure. |
| 10129 | No Carriage return found in CSV buffer. The function searched the file for twice the length of the specified buffer and was unable to find a carriage return indicating the end of a row. Either the buffer size is too small, or the data is invalid. |
| 10164 | Invalid character position input. |
| 10168 | Buffer Size Error. |
| 10600 | Unsupported Letter Code. A G Code started with a character that was not recognized. |
| 10601 | Unsupported G Code |
| 10602 | Unsupported M Code |
| 10603 | PathData is currently in use by MC_MovePath, it is not possible to START reading data into the structure until MC_MovePath is Done. |
| 10604 | Circle Error. When specifying an arc (G02 or G03), both the I and J registers cannot be zero. |
| 10605 | Offset Error. G10 'P' parameter must be 1 through 9. |
| 10606 | User Unit Error. An invalid combination of user units between the Hardware Configuration and the G code data was found. Example: HC is configured for revolutions, and the G Code file specifies mm. The G Code Processor can only convert between linear units. |
| 10610 | Tool Compensation Error. No Solution Found (Logic Error) |

| ErrorID | Meaning |
|-----------------------|---|
| 10611 | Division by zero. |
| 10612 | Tool Compensation Error. A segment transition from line to line, line to arc, arc to line, or arc to arc was not detected. |
| 10613 | Tool Compensation Error. No solution found for an arc to arc transition. |
| 10614 | Tool index as specified in the 'P' register must be between 1 and MaxTools, which is the size of the ToolDataStruct in the Group Toolbox GCode ypes file. |
| 10615 | G10 Error. The 'L' register must be 1 or 2. |
| 10617 | Group Name Error. Check AxesGroup.Name for validity. |
| 10618 | ControllerInfo Error. Connect a Global variable of datatype CONTROLLER_INFO and locate it at address %MD3.66560 |
| 10623 | Max Segments Error. AxesGroup.Status.FreeMotionSegments <= (MachineData.Prms.MaxSegmentsPerScan * 2). Either increase the Motion Queue Size in the Hardware Configuration for this group, or reduce MyMachine.MaxSegmentsPerScan. |
| 10624 | Emulation Error. MachineData.Emulation is not set to a valid value. |
| 10625 | Program List Error. There are more sub program calls in the data than are supported by the G Code functions. (O register) |
| 10626 | Stack Overflow. There are more Jump Segment Types in MC_PATH_DATA_REF than the defined size for PathData.Logic.Events |
| 10627 | Variable Error. A line that starts a variable assignment is missing an equal sign, or the variable index is out of range [1 to 1000] |
| 10628 | The canned cycle G Code is not supported. |
| 10629 | Cycle Array Error. The G code data contains more information for a canned cycle than an internal stucture which holds all the XZ information contained within the P & Q line numbers. |
| 10630 | Canned Cycle Finishing Error. Possible causes are: #1) (End - Start) block must be at least one block. 2) The range of commands to be repeated must come after G71. |
| 10631 | A command was encountered that is not supported for the configured MachineType. For example, M270 is found (for 3D printing,) but MachineData.MachineType <> GTB_MachineType#Printer |
| 10635 | Program List Error. The G Code data refers to more program labels (typically from an IF or M98 command) than the declared size of ProgramList.Name[], which is typcially 16. |
| 10636 | Logic Type Error. The command is not formatted correctly. Examples: N25 IF [#500 LT 25] N35 or N10 #3=0 |
| 10637 | Conversion Error. A logical expression could not be converted from a byte array to a string. Contact technical support for assitance. |
| 10638 | JumpError. The IF instruction must include a line number reference as Nxx where the first character is "N" and the remaining characters are numeric. Example: N25 IF [#500 LT 25] N35 |
| 10639 | Operand Error. The following operands are supported in an IF instruction: EQ, GE, GT, LE, LT, NE, =, >=, <, <=, <, <> |
| 10640 | Tool Length Error - G Code Register._H is not 0,1, or 2. |

Example

The following structured text shows the initialization of CommCfg.

- The LocalIPAddress is that of the MPiec controller. This is necessary because the controller may have more than one IP address and more than one network. It allows the function to listen for G Code data on the correct network. This information can be automatically obtained by referencing the ControllerInfo structure and converting the IP address as a byte array into a string using BYTE_TO_STRING. See the DataTypes section in the PLCopenPlus help manual for more information.
- Local Port can be nearly any convenient port number that you choose. The host application must open a connection to the port specified here.
- Timeout is not supported and must be set to T#0s.
- CommType is typically Ethernet, but if the MPiec controller has a 218IF-Y1 option card, serial data is possible.
- CommandType must be set to Command_Type#Variable. This is because G Code commands have a varying number of

characters separated by delimiters as opposed to fixed sized packets.

- BufferSize is not used in Variable command length mode.

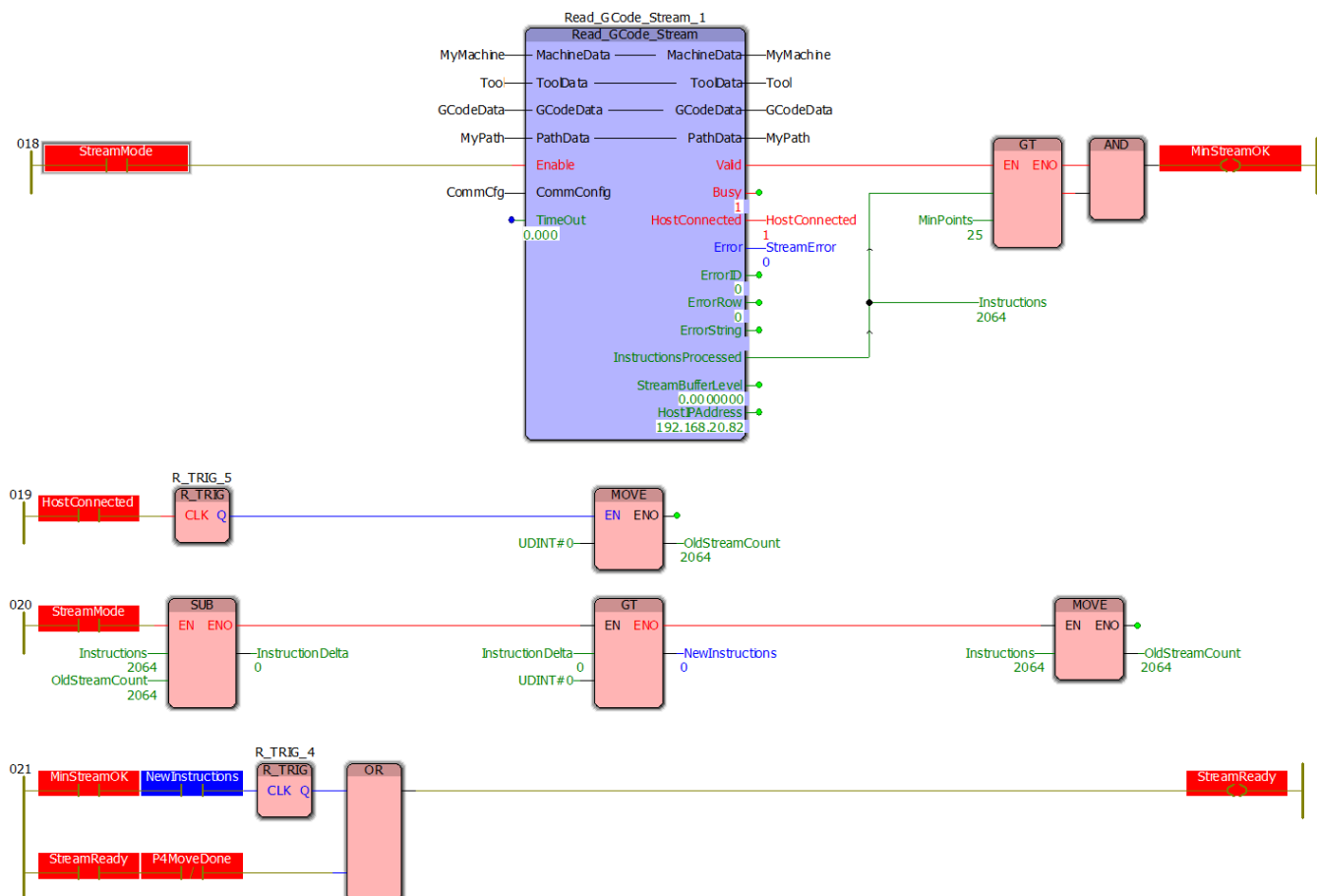
```

64      192.168.207.151|CommCfg.Ethernet.LocalIPAddress:=STRING#'192.168.207.151';
65      1206|CommCfg.Ethernet.LocalPort:=UINT#1206;
66      0.000|CommCfg.InactivityTimeout:=T#0S;
67      2|CommCfg.CommType:=Comm_Type#Ethernet;
68      0|CommCfg.CommandType:=Command_Type#Variable;
69      0|CommCfg.BufferSize:=UDINT#0; (* Y_ReadDevice reporting 8719 if non zero *)

```

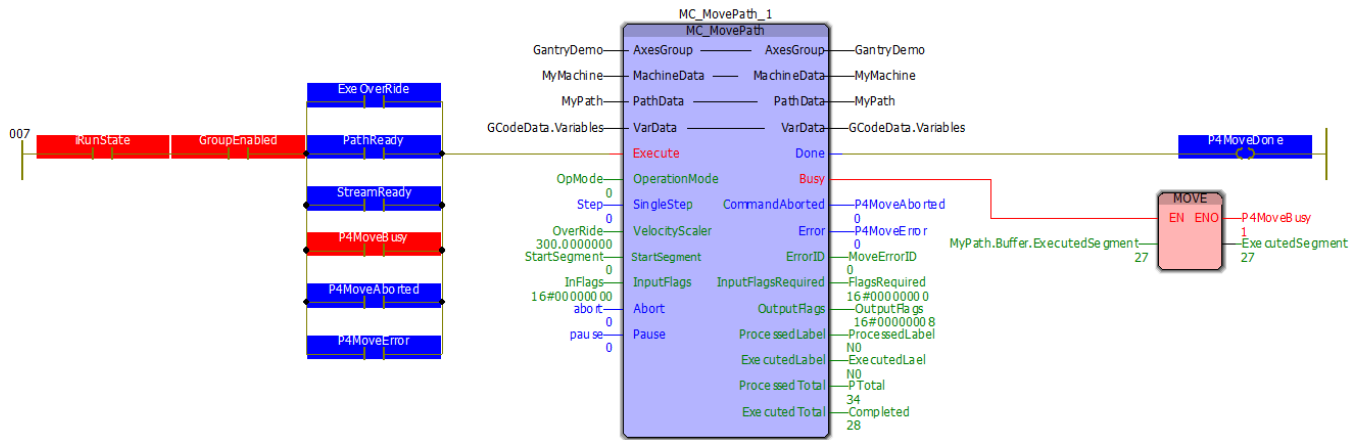
User Units

You can optionally use the [HC_ReadParameter](#) from the File Read Write Toolbox, which will read the Hardware Configuration setting for the axis selected. (Choose one of the axes that makes Cartesian movement.) Alternatively, if you know the user units of the group's MCS, load MyPath.HCUserUnits directly. 0=Inches, 1=millimeters, 2=microns. This setting allows the G Code processing functions to convert values to the correct units for the machine if the G Code data specifies different user units (Refer to [G20 / G21](#)).



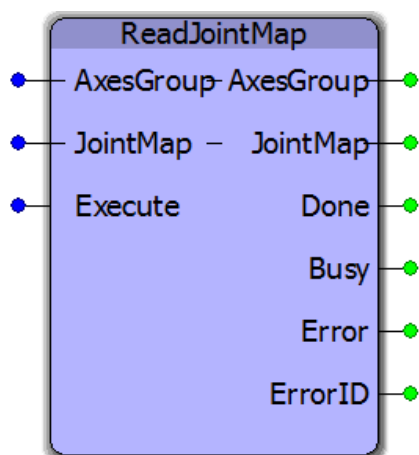
In the example above, a minimum number of points must be loaded into MC_PATH_DATA_REF.Segment[] before the StreamReady flag is set. This flag is referenced in another task which executes the [MC_MovePath](#) function block. This allows paths with many small segments to be buffered and sent to the motion engine more quickly to avoid data starvation when motions starts.

The example below shows the MC_MovePath function including StreamReady logic.





ReadJointMap



This function block will populate the JointMap with data linking Axis_Ref, Joint, and Joint Label. It can be useful when creating applications which must programmatically act upon specifically named joints or axes.

Library

Group Toolbox

Parameters

| * | Parameter | Data Type | Description | |
|-------------------|-----------|--------------------------------|--|----------------|
| VAR_IN_OUT | | | | |
| B | AxesGroup | AXES_GROUP_REF | A logical reference to a group of axes, which contains several additional substructures pertaining to the group. | |
| V | JointMap | JointMap | Structure containing group information populated by this function block. | |
| VAR_INPUT | | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. | FALSE |
| VAR_OUTPUT | | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. | |

| | | | |
|---|---------|------|--|
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

Error Description

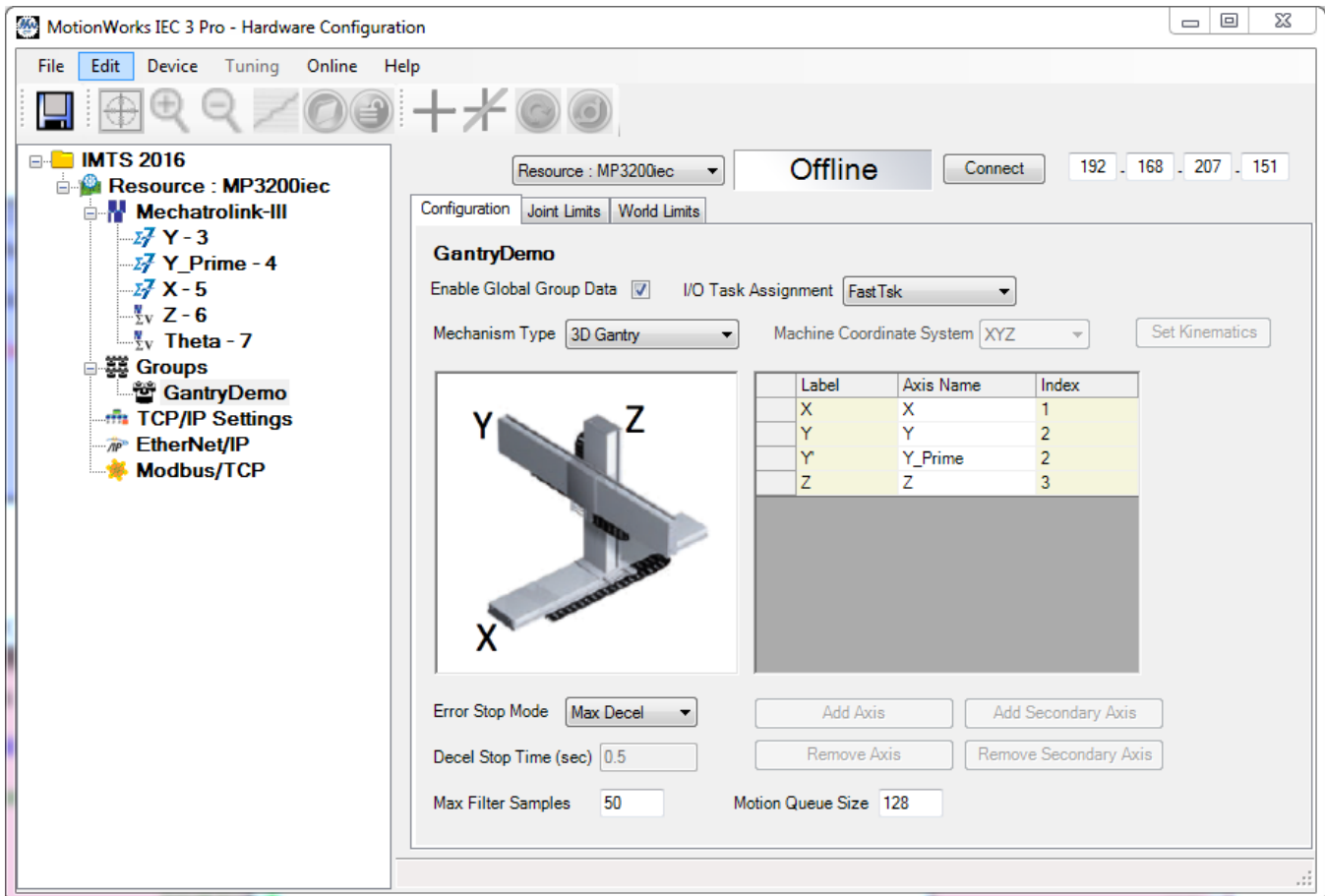
Some errors listed below are internal errors that should never occur, such as 10115 and 10128. Please report these errors to Yaskawa America Motion Applications if they occur.

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 2 | Maximum number of files are already open. |
| 4 | File is already opened. |
| 5 | File is write protected or access is denied. |
| 6 | File name not defined. |
| 10115 | XML Tag not found. Possibly the file is corrupt or the schema is not compatible with this function block. |
| 10120 | File could not be opened. Check for accurate directory path and use of "/" |
| 10122 | Row Error. The data is out of sync with the expected row / column arrangement expected. |
| 10125 | Conversion Error. Check the ErrorRow and ErrorCol / ErrorString outputs for details. |
| 10126 | NoDataError - The End Of File was reached, but the record count is zero. Verify the file is not corrupted. |
| 10127 | TooManyRecords - DataType is not large enough. |
| 10128 | MaxNotDefined - The user must set the maximum number of records that can be added to the structure. |
| 10125 | Conversion Error. Check the ErrorRow and ErrorCol / ErrorString outputs for details. |
| 10129 | No Carriage return found in CSV buffer. The function searched the file for twice the length of the specified buffer and was unable to find a carriage return indicating the end of a row. Either the buffer size is too small, or the data is invalid. |
| 10165 | CommandString length is too long or command delimiter not found. |
| 10168 | Buffer Size Error. |

Example

With a group configured as shown, the ReadJointMap function block will populate the JointMap as viewed in the Watch Window.

The configuration shown is a 3D gantry with a theta axis operated externally to the group using Y_SyncTangentAxisToGroup. The application uses a special configuration which inserts the theta axis into the AxesGroup structure, therefore axis 5 in the Jointmap shows an ExternalTanget as Axis_Ref 7.

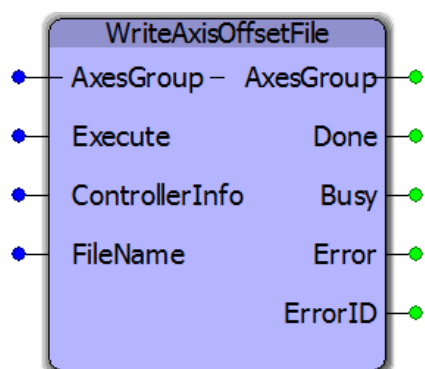


Watch Window

| Variable | Value | Type |
|-----------|-----------------|----------------|
| Joint Map | | JointMap |
| [1] | | JointMapDetail |
| Label | X | STRING |
| Joint | 1 | INT |
| AxisRef | 5 | UINT |
| [2] | | JointMapDetail |
| Label | Y | STRING |
| Joint | 2 | INT |
| AxisRef | 3 | UINT |
| [3] | | JointMapDetail |
| Label | Y_Prime | STRING |
| Joint | 2 | INT |
| AxisRef | 4 | UINT |
| [4] | | JointMapDetail |
| Label | Z | STRING |
| Joint | 3 | INT |
| AxisRef | 6 | UINT |
| [5] | | JointMapDetail |
| Label | ExternalTangent | STRING |
| Joint | 0 | INT |
| AxisRef | 7 | UINT |
| [6] | | JointMapDetail |
| Label | | STRING |
| Joint | 0 | INT |
| AxisRef | 0 | UINT |



WriteAxisOffsetFile



This function block writes absolute encoder offset information to a file which can later be read by [ReadAxisOffsetFile](#). It records the absolute encoder offsets retained in the MPiec controllers battery backed memory for all axes in an AxesGroup. These offsets can be restored in the event of an MPiec controller replacement or SRAM battery failure.

Library

Group Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|----------------|--------------------------------|--|
| VAR_IN_OUT | | | |
| B | AxesGroup | AXES_GROUP_REF | A logical reference to a group of axes, which contains several additional substructures pertaining to the group. |
| VAR_INPUT | | | |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | ControllerInfo | CONTROLLER_INFO | Place this variable of type CONTROLLER_INFO at address %MD3.66560. This is required to include other data in the file such as the controller firmware version. |
| V | FileName | STRING | The file name without an extension, which will be automatically appended. Do not include the directory folders, they are also automatically added. See the example below. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |

| | | | |
|---|---------|------|--|
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes:

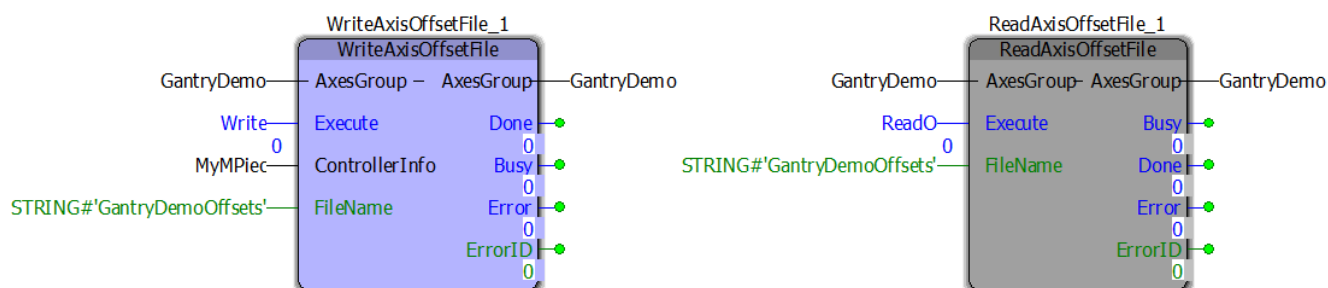
- Firmware version 3.3.0 is required to use this function. It relies on MC_ReadParameter 1838, which was added for version 3.3.0.
- The Flash/Local directory was also added for firmware 3.3.0. It is not deleted when a project archive is deleted or the controller is restored to factory defaults.
- It is highly recommended to save a backup copy of the file to another location other than the MPiec controller. This file can be downloaded / uploaded from the MPiec web UI in the event that a new MPiec controller is connected to the existing mechanical equipment.
- The offsets contained in this file are only valid in the following situations:
 - MPiec controller replacement
 - MPiec SRAM battery failure.
- The offsets contained in this file become invalid in the following situations:
 - Absolute encoder battery failure or disconnection. (ServoPack has A.810 alarm)
 - Motor replacement
 - Any mechanical alteration to the drive train, including belts, gearboxes, couplings, etc.

Error Description

| ErrorID | Meaning |
|-----------------------|---|
| 2 | Maximum number of files are already open. |
| 4 | File is already opened. |
| 5 | File is write protected or access is denied. |
| 6 | File name not defined. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4392 | The function block can not be used with an inverter axis. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4648 | The parameter number does not exist for the specified axis - OR The parameter number requires the other function block (e.g. MC_WriteParameter vs MC_WriteBoolParameter) |
| 8960 | Invalid axes group. Confirm that the AxesGroup variable has the correct %M address as automatically assigned by the Hardware Configuration. Be sure the AxesGroup variable is global, and that if the group has been recently defined, the controller was rebooted. |
| 10116 | Problem converting string data to the output buffer. |
| 10117 | The controller already has a String Conversion Error at the rising edge of this function. Clear the alarm using Y_ClearAlarms and try again. |
| 10120 | File could not be opened. Check for accurate directory path and use of "/" |
| 10121 | The CSV file was written in a format unsupported by this function block. |
| 10122 | Row Error. The data is out of sync with the expected row / column arrangement expected. |
| 10124 | Unsupported Case condition. |
| 10125 | Conversion Error. Check the ErrorRow and ErrorCol / ErrorString outputs for details. |

| | |
|-----------------------|--|
| 10126 | NoDataError - The End Of File was reached, but the record count is zero. Verify the file is not corrupted. |
| 10127 | TooManyRecords - DataType is not large enough. |
| 10128 | MaxNotDefined - The user must set the maximum number of records that can be added to the structure. |
| 10129 | No Carriage return found in CSV buffer. The function searched the file for twice the length of the specified buffer and was unable to find a carriage return indicating the end of a row. Either the buffer size is too small, or the data is invalid. |
| 10166 | File Not Found |
| 10168 | Buffer Size Error. |
| 10617 | Group Name Error. Check AxesGroup.Name for validity. |
| 10618 | ControllerInfo Error. Connect a Global variable of datatype CONTROLLER_INFO and locate it at address %MD3.66560 |
| 10619 | Invalid file name. File names must only contain alphanumeric characters. The first character must not be numeric. |

Example



Math Toolbox

Toolbox Help Documentation
Help version created 1/31/2018

YASKAWA



Math Revision History

Current Version:

(***** 2017-8-14 v340 released with MotionWorks IEC 3.4.0 *****)

CalcFrameOffset - New FB added.
CrossProduct - New FB added.
FrameTypeTransformation - New FB added.

Previous Versions:

(***** 2017-01-15 v331 released with Toolbox Installer - Jan 2017 Collection *****)

RECT_TO_POLAR - New FB added. Support for Tool Compensation in Group Toolbox.

(***** 2016-10-31 v330 released with MotionWorks IEC 3.3.0 *****)

CrossProduct - New FB added.
Multiply4x4 - New FB Added. Support tools for MC_MoveCircular* in PLCopen Part 4.
InvertFrameMatrix - New FB Added. Support tools for MC_MoveCircular* in PLCopen Part 4.
DecompFrameMatrix - New FB Added. Support tools for MC_MoveCircular* in PLCopen Part 4.
ConstructFrameMatrix - New FB Added. Support tools for MC_MoveCircular* in PLCopen Part 4.
Removed all Boolean logic and simple math functions. Use IEC-61131 functions instead .
CalcRadius - New FB Added. Support tools for MC_MoveCircular* in PLCopen Part 4.
CalcCenter - New FB Added. Support tools for MC_MoveCircular* in PLCopen Part 4.
CalcEndAngle - New FB Added. Support tools for MC_MoveCircular* in PLCopen Part 4.
CalcStartAngle - New FB Added. Support tools for MC_MoveCircular* in PLCopen Part 4.
CalcEndAngle - New FB added. Support tools for MC_MoveCircular* in PLCopen Part 4.
POLAR_TO_RECT - New FB added. Support tools for MC_MoveCircular* in PLCopen Part 4.

(***** 2015-01-31 v300 created *****)

(***** Identical to v202, but recompiled specifically for MotionWorks IEC v3.x. *****)

(*** 2012-10-22 v202 released *****)**

- 1) Added functionality to the ATAN2 function block. New ENUM type as VAR_INPUT was added to configure it to operate in 0 to 2 pi radians or 0 to 360 degree in addition to -pi to pi radians. The default behavior (-pi to pi) is the same as previous versions.
- 2) New MathDataTypes file added. This contains enum types for ATAN2 input options.

(*** 2012-01-23 v201 released *****)**

Made change in REM function to prevent a negative result. Added TRUNC_DINT to the code in REM
Refer SCR 1241 on LREAL_TO_DINT fixed in FW 2.0.0.255

(*** 2011-07-29 v200 released *****)**

Upgraded to version 2.0 Project for MotionWorks IEC. Built from Math Toolbox v004beta .

Enumerated Types

Toolbox Help Documentation

Help version created 1/31/2018

YASKAWA



Enumerated Types for Math Toolbox

Some blocks accept an enumerated type (ENUM), which is a keyword (or constant) representing a value which will configure the operation of the function block. Enumerated types are equivalent to zero-based integers (INT). Therefore, the first value equates to zero, the second to 1, etc. The format for enumerated types is as follows: ENUM:(0, 1, 2...) as displayed in the example below (MC_BufferMode#Aborting).

| Enumerated Type | #INT Value | Enum Value | Description |
|---------------------|------------|------------|---|
| TB_ATAN2_OutputType | | | |
| | 0 | NegPi_Pi | Output angle is defined from -Pi to Pi. |
| | 1 | Zero_TwoPi | Output angle is defined from 0 to 2Pi. |
| | 2 | ThreeSixty | Output angle is defined from 0 to 360. |

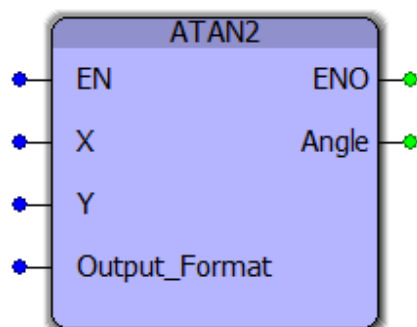
Function Blocks

Toolbox Help Documentation
Help version created 1/31/2018

YASKAWA



ATAN2



The ATAN2 function is useful in many applications involving vectors, such as finding the direction from one point to another. This two argument function is a variation of the ATAN function. For any LREAL arguments x and y , $\text{atan2}(y, x)$ is the angle between the positive x -axis of a plane and the point given by the coordinates (x, y) on it.

Library

Math Toolbox

Parameters

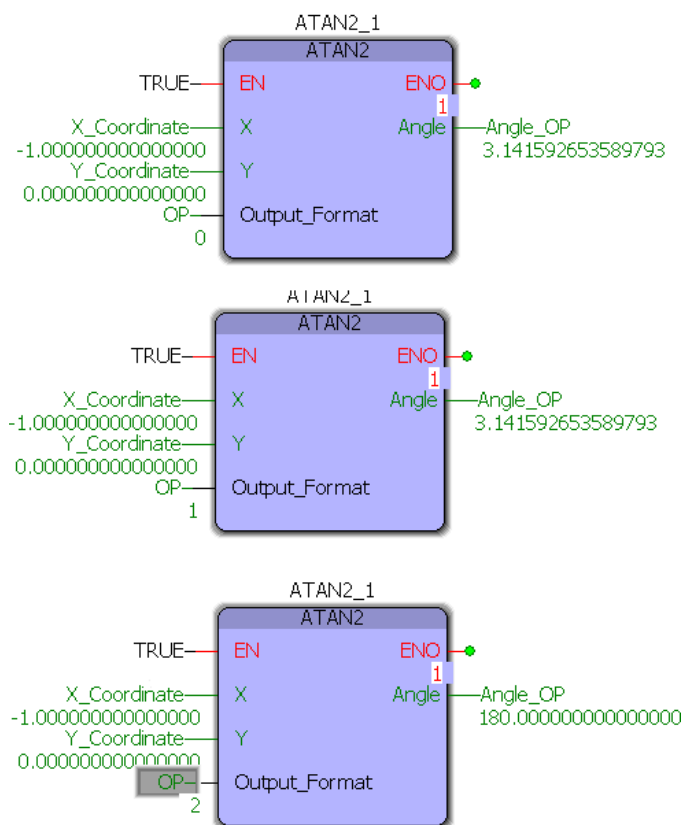
| * | Parameter | Data Type | Description | |
|-------------------|---------------|-----------|--|----------------|
| VAR_INPUT | | | | Default |
| B | EN | BOOL | This function will continue to calculate the ATAN2 result while EN is held high. | FALSE |
| V | X | LREAL | X coordinate | LREAL#0.0 |
| V | Y | LREAL | Y coordinate | LREAL#0.0 |
| V | Output_Format | INT | Format of the output value. 0: radians $(-\pi, \pi]$ 1: radians $[0, 2\pi)$ 2: degrees $[0^\circ, 360^\circ)$ | INT#0 |
| VAR_OUTPUT | | | | |
| B | ENO | BOOL | High if the function is executing normally. | |
| V | Angle | LREAL | The result of the ATAN2 calculation. | |

Notes

This is a function, not a function block and only provides one output. If ENO is not high when EN is high, this function cannot calculate the Angle.

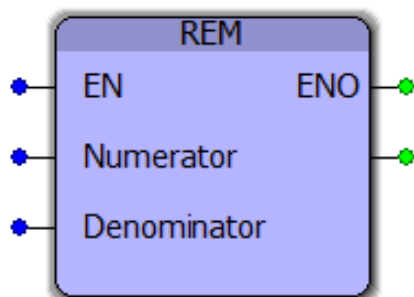
Example

ATAN2 used with various output formats:





REM



This function block returns the modulo division result of two LREAL inputs. It is useful for determining the position within a MachineCycle.

Library

Math Toolbox

Parameters

| * | Parameter | Data Type | Description | |
|-------------------|-------------|-----------|---|----------------|
| VAR_INPUT | | | | Default |
| B | EN | BOOL | This function will continue to calculate the remainder while EN his held high. | FALSE |
| V | Numerator | LREAL | The numerator for division, such as the free running motor position, which may be outside a desired range of values, such as 0 to 360.0 | LREAL#0.0 |
| V | Denominator | LREAL | The denominator for division, which is the desired max value for the Numerator input, such as 360.0 | LREAL#0.0 |
| VAR_OUTPUT | | | | |
| B | ENO | BOOL | High if the function is executing normally. | |
| V | REM | BOOL | This output contains the calculated remainder | |

Error Description

This is a function, not a function block and only provides one output. If ENO is not high when EN is high, this function cannot calculate the remainder. Verify that the Denominator is not zero.

Example 1 - Structured Text

IF InternalMode=INT #1 THEN

(* These calculations are designed for a rotary knife, rotary placer, one way cam, etc. *)

Correction:=REM((-RegistrationData.BufferNonCyclic[TempUsePointer] - RegistrationData.SensorOffset), CamMasterCycle)
+ ((ControlData.EndSyncPosition - ControlData.StartSyncPosition) / LREAL#2.0);

Duration:=RegistrationData.SensorDistance - ((ControlData.EndSyncPosition - ControlData.StartSyncPosition) /
LREAL#2.0) - (ActualPositionNonCyclic - RegistrationData.BufferNonCyclic[TempUsePointer]);

ELSE

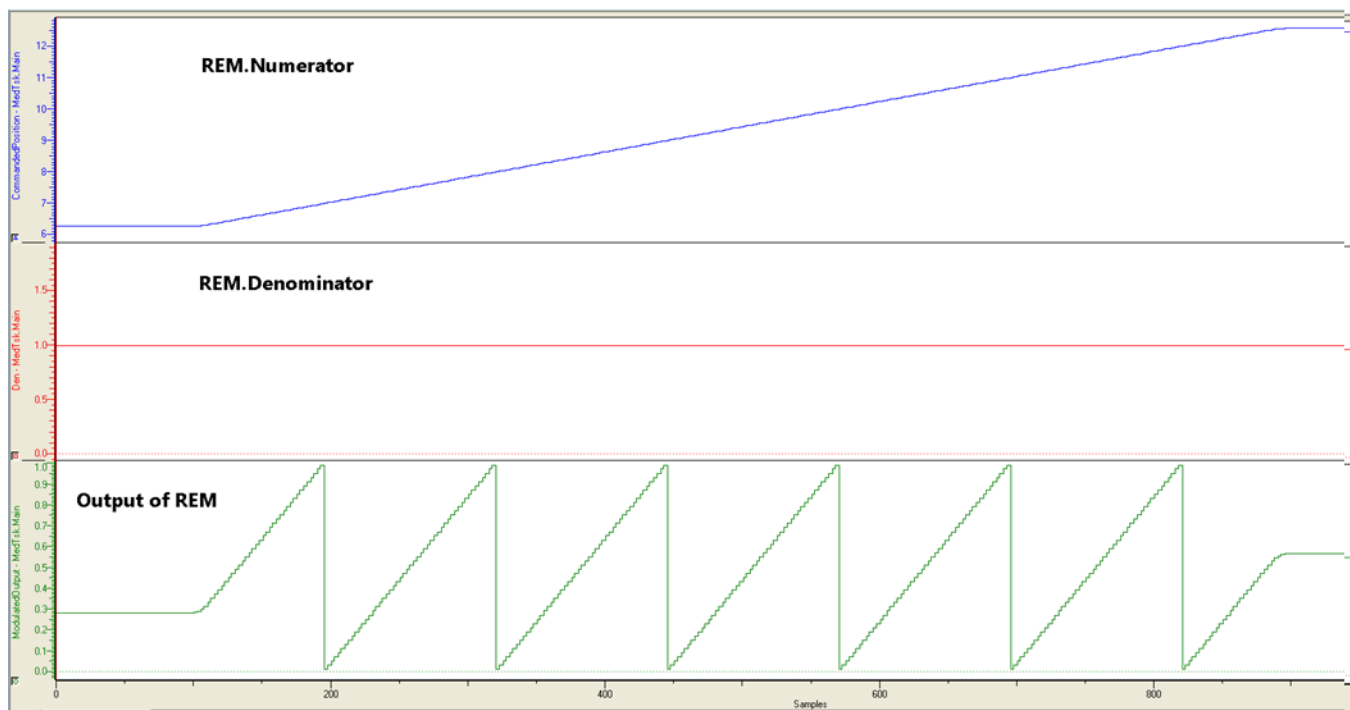
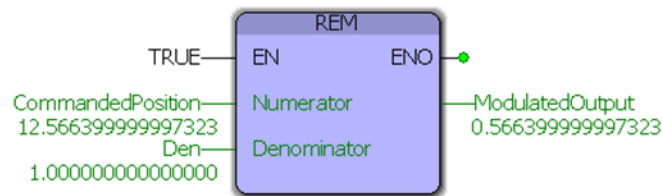
(* These calculations are designed for reciprocating cam profiles (Slave net change = zero each cycle, Out and Back *)

Correction:= - REM((REM(RegistrationData.BufferCyclic[TempUsePointer], CamMasterCycle) + (RegistrationData.SensorDistance - ControlData.StartSyncPosition - ((ControlData.EndSyncPosition - ControlData.StartSyncPosition) / LREAL#2.0))), CamMasterCycle);

Duration:=RegistrationData.SensorDistance - ControlData.StartSyncPosition - ((ControlData.EndSyncPosition - ControlData.StartSyncPosition) / LREAL#2.0);

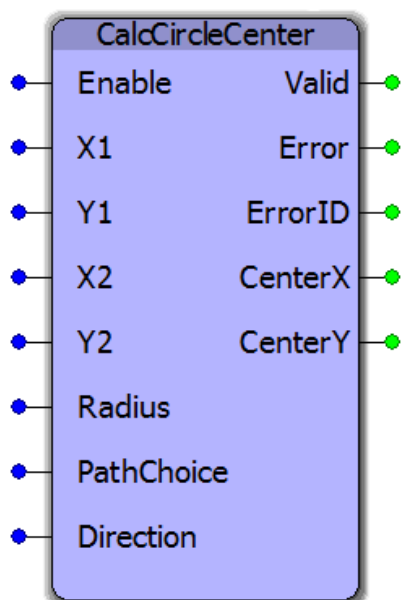
END_IF;

Example 2 - Function Block





CalcCircCenter



CalcCircCenter can be used whenever two points on the circle, the radius of the circle, the direction of the path (counterclockwise or clockwise), and the length of the path (shortest or longest) is given.

Library

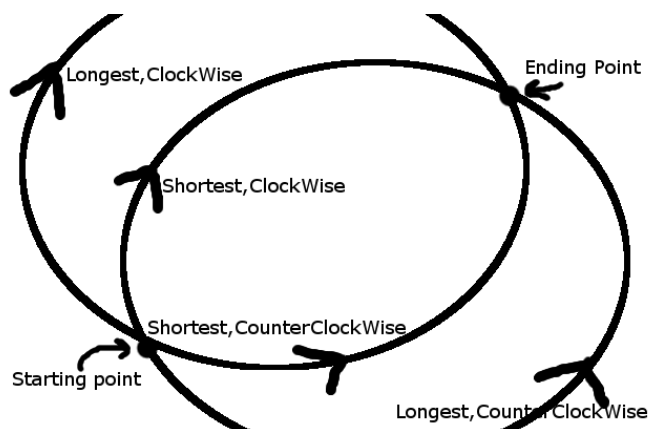
Math Toolbox

Parameters

| * | Parameter | Data Type | Description | |
|-----------|-----------|-----------|---|-----------|
| VAR_INPUT | | | | Default |
| U | ENABLE | BOOL | This function will continue to calculate the center of the circle while this is enabled | FALSE |
| U | X1 | LREAL | X coordinate of starting point | LREAL#0.0 |
| U | Y1 | LREAL | Y coordinate of starting point | LREAL#0.0 |
| U | X1 | LREAL | X coordinate of ending point | LREAL#0.0 |
| U | Y1 | LREAL | Y coordinate of ending point | LREAL#0.0 |
| U | Radius | LREAL | Radius of the circle | LREAL#0.0 |

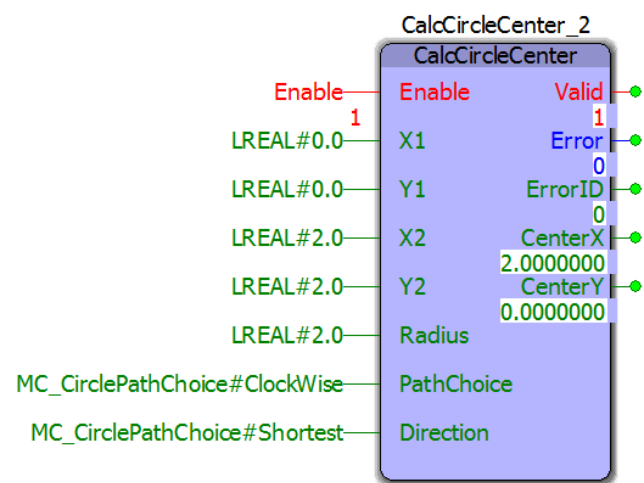
| | | | | |
|-------------------|------------|---------------------|--|-------------------------------|
| U | PathChoice | MC_CirclePathChoice | If the path length is larger than 180 degrees, use MC_CirclePathChoice#Longest. If the path length is 180 degrees or less, use MC_CirclePathChoice#Shortest | MC_CirclePathChoice#ClockWise |
| U | Direction | MC_CirclePathChoice | If the circle path travels clockwise use MC_CirclePathChoice#Clockwise. Otherwise if the circle path travels counterclockwise use MC_CirclePathChoice#CounterClockWise | MC_CirclePathChoice#ClockWise |
| VAR_OUTPUT | | | | |
| C | Valid | BOOL | Displays if inputs are valid | |
| C | Error | LREAL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| C | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |
| C | CenterX | LREAL | X coordinate of the center of the circle | |
| C | CenterY | LREAL | Y coordinate of the center of the circle | |

Notes



Whenever given two points and a radius, it is possible to create two circles that pass through both points with the same radius, and different center coordinates. In order to know which center coordinates we need we can either use a unique third point or the Direction (Clockwise vs CounterClockWise) and the PathChoice (Shortest or Longest). Currently support is only available for choosing the Direction and PathChoice method.

Example



PackML Toolbox

Toolbox Help Documentation

Help version created 1/31/2018

YASKAWA



Getting Started with PackML Toolbox

Requirements for v340

To use the PackML Toolbox, your project must also contain the following:

Firmware libraries:

- PROCONOS

User libraries:

The following User Libraries must be listed above the PackML Toolbox and in the following order:

-
- DataTypes Toolbox (v300 or higher)
- Math_Toolbox (v300 or higher)
- Yaskawa_Toolbox (v300 or higher)

Using the PackML Toolbox

See Yaskawa's [Understanding PackML Webinar](#) for an in depth look at this toolbox.



PackML Revision History

Current Version:

***** 2018-01-23: v340 Released

- 1) Altered the CM_Event and UN_Event FBs to pass the cfg_Event as an IN-OUT variable of EventCfgArray datatype.

Previous Versions:

***** 2016-10-19: v302 Released

- 1) Altered the CM_Event and UN_Event FBs to pass the cfg_Event as an IN-OUT variable of EventCfgArray datatype.
- 2) Added EventNumber[int] as an input to the CM_Event and UN_Event FBs.
- 3) Removed the Prefix input from the CM_Event block.
- 4) Removed the entire EM event level. This level is deemed unnecessary.
- 5) Removed StS_Latched output of CM_Event block.
- 6) Many changes to the event handling. The goal of this revision was to move away from the fixed event handling method of built-in Servopack, Motion and Controller events in favor of User-defined events that could include messages looked up from the other built-in lists.
- 7) Added "UnitMachine.EM[EM_Index].ModuleActive AND" to CM_ControlInputs function in combination with the CM Mask to determine if the CM ModuleActive bit should be ON. This is so Events can be suppressed if the module is deactivated. Also made the same change in EM_ModuleSummation except commented out the rewrite of the CM_ModuleActive bit.
- 8) Added EventBoxNumber to EventStructs.
- 9) Removed the ResetFirstOut Input from the UN_EventSummation block. It was redundant since we could not think of a case where we would reset all active events but leave the FirstOut event still showing.

***** 2016-07-06: v301 Released

- 1) Reconciled to the latest specification for PackML according to ISA-TR88 00 02 Edition 2. Rev 3D, 11/2014.
 - Automatic Mode renamed to Production Mode.
 - Added Unit Machine Layer to the PackTags. This is PackMLv30 datatype and contains PMLs, PMLc and PMLa.
 - Edited PackML datatypes to conform as closely as possible to v3.0 spec for Minimum Supported Set of PackTags.
 - Renamed Datatypes file and POUs to add the Prefix "PML_". This helps avoid superfluous warnings in the user's project.
- 2) Inputs for remote control have been removed from the PackML_State_Diagram function block.

- 3) Event categories was changed from a DWORD datatype to a DINT datatype. Most users set a category number for severity with lower numbers being higher severity (i.e. cat 1 = safety-type fault.)
- 4) Moved the Revision History from a POU into the comment section of the PML_FB_Palette POU to avoid nuisance Empty Worksheet Warnings.
- 5) renamed to v301beta.
- 6) Added AlarmHistory to the UN.admin datatypes.
- 7) Added UN_Event function block, similar to CM_Event, to capture events that are part of the general machine and not part of any particular Control Module.
- 8) Removed the Internal R_TRIGs of the State Diagram.

(***** 2015-01-31 v300 released *****)

- 1) Identical to v202, but recompiled specifically for MotionWorks IEC v3.x.

(***** 2012-03-28: v202 Released *****)

- 1) Modified CM_Control_Inputs Function Block to turn off all CM commands if the EM is not active. Previously commands would still be sent unless the particular CM was deactivated.

(***** 2012-02-26: v201 released *****)

- 1) First official release
- 2) Updated Math Toolbox link
- 3) Improved interlocking in the PackML_State_Diagram for Stop and Abort. There were instances on the beta applications where the control could get stuck in a particular state.



Data Type: ControlModule_Array

Supporting array used to pass commands and machine status to individual Control Modules. The toolbox supports up to 16 Control Modules numbered 0 to 15.

Data Type Declaration

ControlModule_ARRAY : ARRAY[0..15] of PackML_Module_Commands_STRUCT;



Data Type: EquipmentModule_Array

Supporting Array used to pass commands and machine status to individual Equipment Modules. Up to 16 Equipment Modules are supported, numbered 0 to 15.

Data Type Declaration

EquipmentModule_ARRAY : ARRAY[0..15] of EquipmentModule_STRUCT;



Data Type: EquipmentModule_STRUCT

Supporting data type used by [EquipmentModule_ARRAY](#).

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|---------------------------------|---|--|--|
| | MyEquipmentModule_STRUCT | EquipmentModule_STRUCT | | |
| U | EnabledCMs | WORD | Number of enabled Control Modules contained in the Equipment Module | MyEquipmentModule_STRUCT.EnabledCMs |
| U | CMs_Active | WORD | Every bit in this word indicates if a control module is active | MyEquipmentModule_STRUCT.CMs_Active |
| U | CMs_NotDone | WORD | Every bit in this word indicates if a control module is done | MyEquipmentModule_STRUCT.CMs_NotDone |
| U | CM_InactiveMask | WORD | Every bit in this word indicates if a control module is Inactive | MyEquipmentModule_STRUCT.CM_InactiveMask |
| U | CM | ControlModule_ARRAY [0..15] OF PackML_Module_Commands_STRUCT | Array containing the Commands, Status and Active bits for the 16 Control Modules contained in the Equipment module | MyEquipmentModule_STRUCT.CM[0]... |
| U | Cmd_Reset | BOOL | Command to Reset the machine | MyEquipmentModule_STRUCT.Cmd_Reset |
| U | Sts_Resetting_SC | BOOL | When set, the machine is in the resetting state | MyEquipmentModule_STRUCT.Sts_Resetting_SC |
| U | Cmd_Start | BOOL | Command to Start the machine | MyEquipmentModule_STRUCT.Cmd_Start |
| U | Sts_Starting_SC | BOOL | When set, the machine is in the Starting state | MyEquipmentModule_STRUCT.Sts_Starting_SC |
| U | Cmd_Stop | BOOL | Command to Stop the machine | MyEquipmentModule_STRUCT.Cmd_Stop |
| U | Sts_Stopping_SC | BOOL | When set, the machine is in the Stopping state | MyEquipmentModule_STRUCT.Sts_Stopping_SC |
| U | Cmd_Hold | BOOL | Command to Hold the machine | MyEquipmentModule_STRUCT.Cmd_Hold |
| U | Sts_Holding_SC | BOOL | When set, the machine is in the Holding state | MyEquipmentModule_STRUCT.Sts_Holding_SC |
| U | Cmd_UnHold | BOOL | Command to Unhold the machine | MyEquipmentModule_STRUCT.Cmd_UnHold |
| U | Sts_UnHolding_SC | BOOL | When set, the machine is in the UnHolding state | MyEquipmentModule_STRUCT.Sts_UnHolding_SC |
| U | Cmd_Suspend | BOOL | Command to Suspend the machine | MyEquipmentModule_STRUCT.Cmd_Suspend |
| U | Sts_Suspending_SC | BOOL | When set, the machine is in the Suspending state | MyEquipmentModule_STRUCT.Sts_Suspending_SC |
| U | Cmd_UnSuspend | BOOL | Command to UnSuspend the machine | MyEquipmentModule_STRUCT.Cmd_UnSus- |

| | | | | |
|---|---------------------|------|---|--|
| | | | | pend |
| U | Sts_UnSuspending_SC | BOOL | When set, the machine is in the UnSuspending state | MyEquipmentModule_STRUCT.Sts_UnSuspending_SC |
| U | Cmd_Abort | BOOL | Command to Abort the machine | MyEquipmentModule_STRUCT.Cmd_Abort |
| U | Sts_Aborting_SC | BOOL | When set, the machine is in the Aborting state | MyEquipmentModule_STRUCT.Sts_Aborting_SC |
| U | Cmd_Clear | BOOL | Command to Clear the machine | MyEquipmentModule_STRUCT.Cmd_Clear |
| U | Sts_Clearing_SC | BOOL | When set, the machine is in the Clearing state | MyEquipmentModule_STRUCT.Sts_Clearing_SC |
| U | Sts_Executing_SC | BOOL | When set, the machine is in the Executing state | MyEquipmentModule_STRUCT.Sts_Executing_SC |
| U | Cmd_StateComplete | BOOL | Command to enter the Completing State | MyEquipmentModule_STRUCT.Cmd_StateComplete |
| U | Sts_Completing_SC | BOOL | When set, the machine is in the Completing state | MyEquipmentModule_STRUCT.Sts_Completing_SC |
| U | ModuleActive | BOOL | Indicates if the module is active to receive commands | MyEquipmentModule_STRUCT.ModuleActive |



Data Type: Ingredient_ARRAY

An array that contains all the parameters for an ingredient

Data Type Declaration

Ingredient_ARRAY : ARRAY[0..31] OF Ingredient_STRUCT;



Data Type: Ingredient_STRUCT

A structure of parameters containing information for a specific ingredient. Support structure for [Ingredient_ARRAY](#).

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|---------------------|--|--|-------------------------------------|
| | MyIngredient_STRUCT | Ingredient_STRUCT | | |
| U | ID | INT | ID value assigned to the ingredient | MyIngredient_STRUCT.ID |
| U | Parameter | Parameter_ARRAY [0..9] OF Parameter_STRUCT | An array of parameters used for the specified Ingredient | MyIngredient_STRUCT.Parameter[0]... |



Data Type: Limit_ARRAY

An array containing user defined machine limits.

Data Type Declaration

Limit_ARRAY : ARRAY[0..9] OF Limit_STRUCT;



Data Type: Limit_STRUCT

Supporting structure for [Limit_ARRAY](#).

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-----------------------|---------------------|--|----------------------|
| | MyLimit_STRUCT | Limit_STRUCT | | |
| U | ID | INT | User defined ID for the limit, 0000 reserved for no limit assigned | MyLimit_STRUCT.ID |
| U | Name | STRING | Literal name for the limit | MyLimit_STRUCT.Name |
| U | Unit | STRING | Unit of the limit value | MyLimit_STRUCT.Unit |
| U | Value | REAL | Value assigned to the limit | MyLimit_STRUCT.Value |



Data Type: Node_ARRAY

Array that contains information used to coordinating machine nodes in a cell of multiple units. The array can be expanded as needed.

Data Type Declaration

Node_ARRAY : ARRAY[0..7] OF Node_STRUCT;



Data Type: Node_STRUCT

Supporting structure for [Node_ARRAY](#).

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|----------------------|---|--|--------------------------------|
| | MyNode_STRUCT | Node_STRUCT | | |
| U | Number | INT | A chosen unique number of the Upstream/Downstream PackML machine | MyNode_STRUCT.Number |
| U | ControlCmdNumber | INT | User defined command to be sent from one node on the network to another | MyNode_STRUCT.ControlCmdNumber |
| U | CmdValue | INT | A value to be associated with the ControlCmdNumber such as speed, or the mode requested to change to | MyNode_STRUCT.CmdValue |
| U | Parameter | Parameter_ARRAY [0..9] OF Parameter_STRUCT | An array of parameter names, values, and units of the parameter | MyNode_STRUCT.Parameter [0]... |



Data Type: PackML_Commands_STRUCT

Supporting structure for [PackTags_Commands_STRUCT](#)

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|--------------------------|------------------------|--|--|
| | MyPackML_Commands_STRUCT | PackML_Commands_STRUCT | | |
| U | Mode | DINT | Mode command, Mode's can be customized according to the PackML standard or for the user's needs. See template documentation for more on mode customization | MyPackML_Commands_STRUCT.Mode |
| U | Reset | BOOL | Command to Reset the Machine | MyPackML_Commands_STRUCT.Reset |
| U | Start | BOOL | Command to Start the Machine | MyPackML_Commands_STRUCT.Start |
| U | Stop | BOOL | Command to Stop the Machine | MyPackML_Commands_STRUCT.Stop |
| U | Hold | BOOL | Command to Hold the Machine | MyPackML_Commands_STRUCT.Hold |
| U | UnHold | BOOL | Command to UnHold the Machine | MyPackML_Commands_STRUCT.UnHold |
| U | Suspend | BOOL | Command to Suspend the Machine | MyPackML_Commands_STRUCT.Suspend |
| U | UnSuspend | BOOL | Command to UnSuspend the Machine | MyPackML_Commands_STRUCT.UnSuspend |
| U | Abort | BOOL | Command to Abort the Machine | MyPackML_Commands_STRUCT.Abort |
| U | Clear | BOOL | Command to Clear the Machine | MyPackML_Commands_STRUCT.Clear |
| U | StateComplete | BOOL | Command to enter the Completing State | MyPackML_Commands_STRUCT.StateComplete |



Data Type: PackML_Module_Commands_STRUCT

Supporting data type used by [ControlModule_ARRAY](#).

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|--|--------------------------------------|--|---|
| | MyPackML_Module_Commands_STRUCT | PackML_Module_Commands_STRUCT | | |
| U | Cmd_Reset | BOOL | Command to Reset the machine by moving from the Stopped state to the Resetting state. | MyPackML_Module_Commands_STRUCT.Cmd_Reset |
| U | Sts_Resetting_SC | BOOL | When set, the machine is in the resetting state. | MyPackML_Module_Commands_STRUCT.Sts_Resetting_SC |
| U | Cmd_Start | BOOL | Command to Start the machine by moving from the Idle state to the Execute state. | MyPackML_Module_Commands_STRUCT.Cmd_Start |
| U | Sts_Starting_SC | BOOL | When set, the machine is in the Starting state. | MyPackML_Module_Commands_STRUCT.Sts_Starting_SC |
| U | Cmd_Stop | BOOL | Command to Stop the machine by moving from any state other than Aborting, Aborted or Clearing to the Stopping state. | MyPackML_Module_Commands_STRUCT.Cmd_Stop |
| U | Sts_Stopping_SC | BOOL | When set, the machine is in the Stopping state. | MyPackML_Module_Commands_STRUCT.Sts_Stopping_SC |
| U | Cmd_Hold | BOOL | Command to Hold the machine by moving from the Execute state to the Holding state. | MyPackML_Module_Commands_STRUCT.Cmd_Hold |
| U | Sts_Holding_SC | BOOL | When set, the machine is in the Holding state. | MyPackML_Module_Commands_STRUCT.Sts_Holding_SC |
| U | Cmd_UnHold | BOOL | Command to Unhold the machine by moving from the Held state to the UnHolding state. | MyPackML_Module_Commands_STRUCT.Cmd_UnHold |
| U | Sts_UnHolding_SC | BOOL | When set, the machine is in the UnHolding state. | MyPackML_Module_Commands_STRUCT.Sts_UnHolding_SC |
| U | Cmd_Suspend | BOOL | Command to Suspend the machine by moving from the Execute state to the Suspending state. | MyPackML_Module_Commands_STRUCT.Cmd_Suspend |
| U | Sts_Suspending_SC | BOOL | When set, the machine is in the Suspending state. | MyPackML_Module_Commands_STRUCT.Sts_Suspending_SC |
| U | Cmd_UnSuspend | BOOL | Command to UnSuspend the machine by moving from the Suspended state to the UnSuspending state. | MyPackML_Module_Commands_STRUCT.Cmd_UnSuspend |
| U | Sts_UnSuspending_SC | BOOL | When set, the machine is in the UnSuspending state. | MyPackML_Module_Commands_STRUCT.Sts_UnSuspending_SC |
| U | Cmd_Abort | BOOL | Command to Abort the machine by moving from any state except Aborting or Aborted to the Aborting state. | MyPackML_Module_Commands_STRUCT.Cmd_Abort |

| | | | | |
|---|-------------------|------|---|---|
| U | Sts_Aborting_SC | BOOL | When set, the machine is in the Aborting state. | MyPackML_Module_Commands_STRUCT.Sts_Aborting_SC |
| U | Cmd_Clear | BOOL | Command to Clear the machine by moving from the Aborted state to the Clearing state. | MyPackML_Module_Commands_STRUCT.Cmd_Clear |
| U | Sts_Clearing_SC | BOOL | When set, the machine is in the Clearing state. | MyPackML_Module_Commands_STRUCT.Sts_Clearing_SC |
| U | Sts_Executing_SC | BOOL | When set, the machine is in the Executing state. | MyPackML_Module_Commands_STRUCT.Sts_Executing_SC |
| U | Cmd_StateComplete | BOOL | Command to enter the Completing State from the Execute state. | MyPackML_Module_Commands_STRUCT.Cmd_StateComplete |
| U | Sts_Completing_SC | BOOL | When set, the machine is in the Completing state. | MyPackML_Module_Commands_STRUCT.Sts_Completing_SC |
| U | ModuleActive | BOOL | Indicates if the Control Module is active and able to receive commands. Can also be used to enable the detection of Events for the Control Module | MyPackML_Module_Commands_STRUCT.ModuleActive |



Data Type: PackML_States_STRUCT

Supporting structure for [PackTags_Status_STRUCT](#).

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-------------------------------|-----------------------------|---|-------------------------------------|
| | MyPackML_States_STRUCT | PackML_States_STRUCT | | |
| U | Clearing | BOOL | Indicates the machine is in the Clearing State. | MyPackML_States_STRUCT.Clearing |
| U | Stopped | BOOL | Indicates the machine is in the Stopped State. | MyPackML_States_STRUCT.Stopped |
| U | Starting | BOOL | Indicates the machine is in the Starting State. | MyPackML_States_STRUCT.Starting |
| U | Idle | BOOL | Indicates the machine is in the Idle State. | MyPackML_States_STRUCT.Idle |
| U | Suspended | BOOL | Indicates the machine is in the Suspended State. | MyPackML_States_STRUCT.Suspended |
| U | Execute | BOOL | Indicates the machine is in the Execute State. | MyPackML_States_STRUCT.Execute |
| U | Stopping | BOOL | Indicates the machine is in the Stopping State. | MyPackML_States_STRUCT.Stopping |
| U | Aborting | BOOL | Indicates the machine is in the Aborting State. | MyPackML_States_STRUCT.Aborting |
| U | Aborted | BOOL | Indicates the machine is in the Aborted State. | MyPackML_States_STRUCT.Aborted |
| U | Holding | BOOL | Indicates the machine is in the Holding State. | MyPackML_States_STRUCT.Holding |
| U | Held | BOOL | Indicates the machine is in the Held State. | MyPackML_States_STRUCT.Held |
| U | UnHolding | BOOL | Indicates the machine is in the Unholding State. | MyPackML_States_STRUCT.UnHolding |
| U | Suspending | BOOL | Indicates the machine is in the Suspending State. | MyPackML_States_STRUCT.Suspending |
| U | UnSuspending | BOOL | Indicates the machine is in the Unsuspending State. | MyPackML_States_STRUCT.UnSuspending |
| U | Resetting | BOOL | Indicates the machine is in the Resetting State. | MyPackML_States_STRUCT.Resetting |
| U | Completing | BOOL | Indicates the machine is in the Completing State. | MyPackML_States_STRUCT.Completing |
| U | Complete | BOOL | Indicates the machine is in the Complete State. | MyPackML_States_STRUCT.Complete |



Data Type: PackTags_Admin_STRUCT

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|--------------------------------|------------------------------|---|---|
| | MyPackTags_Admin_STRUCT | PackTags_Admin_STRUCT | | |
| U | Alarm | EventHistoryArray | Array of Event information. | MyPackTags_Admin_STRUCT.Alarm[0]... |
| U | StateCurrentTime | DINT | Amount of time spent in the current state | MyPackTags_Admin_STRUCT.StateCurrentTime |
| U | StateCumulativeTime | StateCumulativeArray | Array containing all the times spent in the different states | MyPackTags_Admin_STRUCT.StateCumulativeTime[0]... |
| U | ModeCurrentTime | DINT | Amount of time spent in the current mode. | MyPackTags_Admin_STRUCT.ModeCurrentTime |
| U | ModeCumulativeTime | DINT_Array32 | Array containing all the times spent in the different modes. | MyPackTags_Admin_STRUCT.ModeCumulativeTime[0] |
| U | AccumTimeSinceReset | DINT | Time since the cumulative and current times have been reset. | MyPackTags_Admin_STRUCT.AccumTimeSinceReset |
| U | ResetAllTimes | BOOL | Command to reset all timers. | MyPackTags_Admin_STRUCT.ResetAllTimes |
| U | ResetCurrentModeTimes | BOOL | Command to reset all Current Times being tracked. | MyPackTags_Admin_STRUCT.ResetCurrentModeTimes |
| U | TimeRollover | BOOL | Warning when the timer is approaching a roll over. | MyPackTags_Admin_STRUCT.TimeRollover |
| U | ProdProcessed | DINT | Cumulative number of primary packages processed since the machine's counters and timers were reset. | MyPackTags_Admin_STRUCT.ProdProcessed |
| U | DefectiveProd | DINT | Cumulative number of defective packages processed since the machine's counters and timers were reset. | MyPackTags_Admin_STRUCT.DefectiveProd |
| U | ReWorkProd | DINT | Cumulative number of re-workable primary packages processed. | MyPackTags_Admin_STRUCT.ReWorkProd |
| U | UpstreamMessage | DINT | | MyPackTags_Admin_STRUCT.UpstreamMessage |
| U | DownstreamMessage | DINT | | MyPackTags_Admin_STRUCT.DownstreamMessage |
| U | CurrentUpstreamNodeID | DINT | | MyPackTags_Admin_STRUCT.CurrentUpstreamNodeID |
| U | CurrentDownstreamNodeID | DINT | | MyPackTags_Admin_STRUCT.CurrentDownstreamNodeID |



Data Type: PackTags_Commands_STRUCT

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-----------------------------------|---------------------------------|--|---|
| | MyPackTags_Commands_STRUCT | PackTags_Commands_STRUCT | | |
| U | UnitMode | DINT | Unit Mode Commanded | MyPackTags_Commands_STRUCT.UnitMode |
| U | UnitModeChangeRequest | BOOL | 1 = Change Machine Mode to Commanded Value | MyPackTags_Commands_STRUCT.UnitModeChangeRequest |
| U | ProcMode | DINT | Procedure Mode Commanded | MyPackTags_Commands_STRUCT.ProcMode |
| U | ProcModeChangeRequest | BOOL | 1 = Change Procedure Mode to Commanded Value | MyPackTags_Commands_STRUCT.ProcModeChangeRequest |
| U | CurMachSpeed | DINT | Machine Speed - In Primary Line Packages | MyPackTags_Commands_STRUCT.CurMachSpeed |
| U | MatReady | DWORD | Material Interlocks | MyPackTags_Commands_STRUCT.MatReady |
| U | MatLow | DWORD | Material Interlocks | MyPackTags_Commands_STRUCT.MatLow |
| U | ResetPackMLTimes | BOOL | 1 = Reset PackML Current Mode and State Current/Cumulative Times | MyPackTags_Commands_STRUCT.ResetPackMLTimes |
| U | CntrlCmd | DINT | Provides an alternate method of moving through the state diagram | MyPackTags_Commands_STRUCT.CntrlCmd |
| U | StateCmd | PackML_Commands_STRUCT | A structure for Coordinating machine nodes | MyPackTags_Commands_STRUCT.StateCmd |
| U | StateChangeRequest | BOOL | Indicates the state machine should proceed to the target state | MyPackTags_Commands_STRUCT.StateChangeRequest |
| U | CfgRemoteCmdEnable | BOOL | | MyPackTags_Commands_STRUCT.CfgRemoteCmdEnable |
| U | RemoteModeCmd | DINT | | MyPackTags_Commands_STRUCT.RemoteModeCmd |
| U | RemoteModeCmdChgReq | BOOL | | MyPackTags_Commands_STRUCT.RemoteModeCmdChgReq |
| U | RemoteStateCmd | DINT | | MyPackTags_Commands_STRUCT.RemoteStateCmd |
| U | RemoteStateCmdChgReq | BOOL | | MyPackTags_Commands_STRUCT.RemoteStateCmdChgReq |
| U | TargetDownstreamNodeID | DINT | | MyPackTags_Commands_STRUCT.TargetDownstreamNodeID |
| U | TargetUpstreamNodeID | DINT | | MyPackTags_Commands_STRUCT.TargetUpstreamNodeID |
| U | ChangeNodeServicedUpstream | DINT | | MyPackTags_Commands_STRUCT.ChangeNodeServicedUpstream |
| U | ChangeNodeServicedDownstream | DINT | | MyPackTags_Commands_STRUCT.ChangeNodeServicedDownstream |

| THE FOLLOWING FIELDS ARE INITIALLY COMMENTED OUT TO SAVE MEMORY WHEN NOT REQUIRED | | | | |
|---|------------------|-----------------------|---|---|
| U | Node | Node_ARRAY | Node (machine) interface & ID structure | MyPackTags_Commands_STRUCT.Node[0]... |
| U | ProcessVariables | ProcessVariable_ARRAY | Machine Engineering Parameters | MyPackTags_Commands_STRUCT.ProcessVariables[0]... |
| U | Product | Product_ARRAY | Machine Product/Recipe Parameters | MyPackTags_Commands_STRUCT.Product[0]... |
| U | Limits | Limit_ARRAY | Machine Parameter Prograble Limits | MyPackTags_Commands_STRUCT.Limits[0]... |



Data Type: PackTags_Status_STRUCT

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|---------------------------------|-------------------------------|---|---|
| | MyPackTags_Status_STRUCT | PackTags_Status_STRUCT | | |
| U | CommandRejected | BOOL | If an invalid request is given and rejected, this bit will be set | MyPackTags_Status_STRUCT.CommandRejected |
| U | UnitModeCurrent | DINT | Current Machine Mode | MyPackTags_Status_STRUCT.UnitModeCurrent |
| U | UnitModeCurBit | DWORD | Current Machine Mode Bit | MyPackTags_Status_STRUCT.UnitModeCurBit |
| U | UnitModeCurrentName | STRING | Current Machine Mode Name | MyPackTags_Status_STRUCT.UnitModeCurrentName |
| U | UnitModeRequested | BOOL | [1 = Acknowledges that a unit mode change has been requested] | MyPackTags_Status_STRUCT.UnitModeRequested |
| U | UnitModeChangeInProgress | BOOL | [1 = Requested unit mode change in process] | MyPackTags_Status_STRUCT.UnitModeChangeInProgress |
| U | ProcModeCurrent | DINT | Current Procedure Mode | MyPackTags_Status_STRUCT.ProcModeCurrent |
| U | ProcModeRequested | BOOL | [1 = Acknowledges that a procedure mode change has been requested] | MyPackTags_Status_STRUCT.ProcModeRequested |
| U | ProcModeChangeInProgress | BOOL | [1 = Requested procedure mode change in process] | MyPackTags_Status_STRUCT.ProcModeChangeInProgress |
| U | StateCurrent | DINT | Current Machine State | MyPackTags_Status_STRUCT.StateCurrent |
| U | StateCurBit | DWORD | | MyPackTags_Status_STRUCT.StateCurBit |
| U | StateCurrentName | STRING | Current Machine State Name | MyPackTags_Status_STRUCT.StateCurrentName |
| U | StateRequested | BOOL | [1 = Acknowledges that a state change has been requested] | MyPackTags_Status_STRUCT.StateRequested |
| U | StateChangeInProgress | BOOL | [1 = Requested state change in process] | MyPackTags_Status_STRUCT.StateChangeInProgress |
| U | StateChangeProgress | DINT | Percent Complete of current state | MyPackTags_Status_STRUCT.StateChangeProgress |
| U | StateLastCompleted | DINT | Machine state last completed | MyPackTags_Status_STRUCT.StateLastCompleted |
| U | SeqNumber | DINT | | MyPackTags_Status_STRUCT.SeqNumber |
| U | CurMachSpd | DINT | Current Machine Speed In Primary Line Packages Per Minute | MyPackTags_Status_STRUCT.CurMachSpd |
| U | MatReady | DWORD | Material Interlocks | MyPackTags_Status_STRUCT.MatReady |
| U | MatLow | DWORD | Material Interlocks | MyPackTags_Status_STRUCT.MatLow |
| U | MachDesignSpeed | REAL | Speed the machine is designed to operate at in it's installed environment | MyPackTags_Status_STRUCT.MachDesignSpeed |
| U | State | PackML_States_STRUCT | | MyPackTags_Status_STRUCT.State |

| | | | | |
|---|--------------------------------|-----------------------|--|---|
| U | ModeChangeNotAllowed | BOOL | This bit is set if an invalid mode change is requested and ignored | MyPackTags_Status_STRUCT.ModeChangeNotAllowed |
| U | MachCycle | DINT | Indicates the number of completed machine cycles with or without product | MyPackTags_Status_STRUCT.MachCycle |
| U | ProdRatio | DINT | Quantity of primary packages per current package being produced | MyPackTags_Status_STRUCT.ProdRatio |
| U | Dirty | BOOL | Set when the machine becomes dirty and machine must run through a cleaning cycle before production continues | MyPackTags_Status_STRUCT.Dirty |
| U | Clean | BOOL | Bit is set after a cleaning cycle and reset once production begins again | MyPackTags_Status_STRUCT.Clean |
| U | TimeToDirty | DINT | Time remaining until machine becomes dirty again | MyPackTags_Status_STRUCT.TimeToDirty |
| U | EquipmentAllocatedToUnitModeID | DINT | Allocating a machine to operating a different mode than another duplicate machine | MyPackTags_Status_STRUCT.EquipmentAllocatedToUnitModeID |
| U | MachineReusableForUnitModeID | DINT | Indicates machine does not require immediate cleaning and can resume production in a specific time window | MyPackTags_Status_STRUCT.MachineReusableForUnitModeID |
| U | MachineReusableTimeLeft | DINT | Amount of time left for a system to be reusable for a specific Unit mode | MyPackTags_Status_STRUCT.MachineReusableTimeLeft |
| U | MachineStoringProductID | DINT | For machines that have a storing capability | MyPackTags_Status_STRUCT.MachineStoringProductID |
| U | MachineTransferringProductID | DINT | For machines used in conveying, compacting and/or separating product and transferring it to other machinery | MyPackTags_Status_STRUCT.MachineTransferringProductID |
| THE FOLLOWING FIELDS COME INITIALLY COMMENTED OUT TO SAVE MEMORY WHEN NOT USED | | | | |
| U | Node | Node_ARRAY | Node (machine) interface & ID structure | MyPackTags_Status_STRUCT.Node[0]... |
| U | ProcessVariables | ProcessVariable_ARRAY | Machine Engineering Parameters | MyPackTags_Status_STRUCT.ProcessVariables[0]... |
| U | Product | Product_ARRAY | Machine Product/Recipe Parameters | MyPackTags_Status_STRUCT.Product[0]... |
| U | Limits | Limit_ARRAY | Machine Parameter Programmable Limits | MyPackTags_Status_STRUCT.Limits[0]... |



Data Type: Parameter_ARRAY

An array containing the names, units and values of a given parameter

Data Type Declaration

Parameter_ARRAY : ARRAY[0..9] OF Parameter_STRUCT;



Data Type: Parameter_STRUCT

Supporting Structure for [Parameter_ARRAY](#)

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|--------------------|------------------|---|--------------------------|
| | MyParameter_STRUCT | Parameter_STRUCT | | |
| U | ID | DINT | ID value assigned to the parameter | MyParameter_STRUCT.ID |
| U | Name | STRING | Literal description of the parameter | MyParameter_STRUCT.Name |
| U | Unit | STRING | Unit associated with the given parameter | MyParameter_STRUCT.Unit |
| U | Value | REAL | Numeric value associated with the given parameter | MyParameter_STRUCT.Value |



Data Type: ProcessVariable_ARRAY

An array containing the names, units and values of a given parameter that are used across multiple machines and can be displayed on an HMI screen.

Data Type Declaration

ProcessVariable_ARRAY : ARRAY[0..9] OF ProcessVariable_STRUCT;



Data Type: ProcessVariable_STRUCT

Supporting structure for [ProcessVariable_ARRAY](#).

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|---------------------------------|-------------------------------|---|--------------------------------|
| | MyProcessVariable_STRUCT | ProcessVariable_STRUCT | | |
| U | ID | DINT | ID value assigned to the parameter | MyProcessVariable_STRUCT.ID |
| U | Name | STRING | Literal description of the parameter. Can also be displayed on an HMI screen. | MyProcessVariable_STRUCT.Name |
| U | Unit | STRING_5 | Unit associated with the given parameter. Can also be displayed on an HMI screen. | MyProcessVariable_STRUCT.Unit |
| U | Value | REAL | Numeric value associated with the given parameter. Can also be displayed on an HMI screen. | MyProcessVariable_STRUCT.Value |



Data Type: Product_ARRAY

An array containing product information

Data Type Declaration

Product_ARRAY : ARRAY[0..9] OF Product_STRUCT;



Data Type: Product_STRUCT

A structure containing product information

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|------------------|-----------------------|---|-----------------------------------|
| | MyProduct_STRUCT | Product_STRUCT | | |
| U | ProductID | INT | Used to indicate to the machine what product it is producing, also displayed on all HMI screens | MyProduct_STRUCT.ProductID |
| U | ProcessVariables | ProcessVariable_ARRAY | Array of information containing parameters for multiple machines | MyProduct_STRUCT.ProcessVariables |
| U | Ingredients | Ingredient_ARRAY | An array containing all information regarding an ingredient | MyProduct_STRUCT.Ingredients |



Data Type: UNitMachine_STRUCT

Contains all the information about the machine's current state for each EM and CM.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-----------------------------|---------------------------|--|---|
| | MyUNitmachine_STRUCT | UNitmachine_STRUCT | | |
| U | PackML_StateControlReady | BOOL | Indicates when the PackML_State_Diagram function block is ready to control the machine | MyUNitmachine_STRUCT.PackML_StateControlReady |
| U | EnabledEMs | INT | Number of enabled equipment modules in the machine | MyUNitmachine_STRUCT.EnabledEMs |
| U | EMs_Active | WORD | Every bit in this word indicates which equipment modules are Active | MyUNitmachine_STRUCT.EMs_Active |
| U | EMs_NotDone | WORD | Every bit in this word indicates which equipment modules are Not Done | MyUNitmachine_STRUCT.EMs_NotDone |
| U | EM_InactiveMask | WORD | Every bit in this word indicates which equipment modules are Inactive | MyUNitmachine_STRUCT.EM_InactiveMask |
| U | EM | EquipmentModule_ARRAY | ARRAY[0..15] of EquipmentModule_STRUCT | MyUNitmachine_STRUCT.EM |
| U | Sts_Resetting_SC | BOOL | When set, the machine is in the resetting state | MyUNitmachine_STRUCT.Sts_Resetting_SC |
| U | Sts_Starting_SC | WORD | When set, the machine is in the Starting state | MyUNitmachine_STRUCT.Sts_Starting_SC |
| U | Sts_Stopping_SC | WORD | When set, the machine is in the Stopping state | MyUNitmachine_STRUCT.Sts_Stopping_SC |
| U | Sts_Holding_SC | WORD | When set, the machine is in the Holding state | MyUNitmachine_STRUCT.Sts_Holding_SC |
| U | Sts_UnHolding_SC | WORD | When set, the machine is in the UnHolding state | MyUNitmachine_STRUCT.Sts_UnHolding_SC |
| U | Sts_Suspending_SC | BOOL | When set, the machine is in the Suspending state | MyUNitmachine_STRUCT.Sts_Suspending_SC |
| U | Sts_UnSuspending_SC | BOOL | When set, the machine is in the UnSuspending state | MyUNitmachine_STRUCT.Sts_UnSuspending_SC |
| U | Sts_Aborting_SC | BOOL | When set, the machine is in the Aborting state | MyUNitmachine_STRUCT.Sts_Aborting_SC |
| U | Sts_Clearing_SC | BOOL | When set, the machine is in the Clearing state | MyUNitmachine_STRUCT.Sts_Clearing_SC |
| U | Sts_Executing_SC | BOOL | When set, the machine is in the Executing state | MyUNitmachine_STRUCT.Sts_Executing_SC |
| U | Sts_Completing_SC | BOOL | When set, the machine is in the Completing state | MyUNitmachine_STRUCT.Sts_Completing_SC |



Enumerated Types for PackML Toolbox

Some blocks accept an enumerated type (ENUM), which is a keyword (or constant) representing a value which will configure the operation of the function block. Enumerated types are equivalent to zero-based integers (INT). Therefore, the first value equates to zero, the second to 1, etc. The format for enumerated types is as follows: ENUM:(0, 1, 2...) as displayed in the example below (MC_BufferMode#Aborting).

Enumerated Types Declaration

| Enumerated Type | #INT Value | Enum Value | Description |
|-----------------|--|--------------|-------------|
| PackMLState | ENUM Type for indicating the PackML state. | | |
| | 0 | Undefined | |
| | 1 | Clearing | |
| | 2 | Stopped | |
| | 3 | Starting | |
| | 4 | Idle | |
| | 5 | Suspended | |
| | 6 | Execute | |
| | 7 | Stopping | |
| | 8 | Aborting | |
| | 9 | Aborted | |
| | 10 | Holding | |
| | 11 | Held | |
| | 12 | UnHolding | |
| | 13 | Suspending | |
| | 14 | UnSuspending | |
| | 15 | Resetting | |
| | 16 | Completing | |
| | 17 | Complete | |

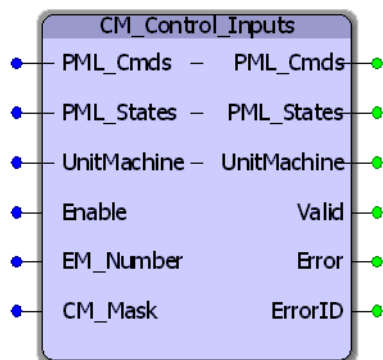
PackML FBs

Toolbox Help Documentation
Help version created 1/31/2018

YASKAWA



CM_Control_Inputs



The CM_Control_Inputs function block passes the high level commands from the PackML_StateControl into each of the enabled and active Control Modules.

Library

Pack ML Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-------------|--|--|
| VAR_IN_OUT | | | |
| V | PML_Cmds | PackML_Commands_STRUCT | Structure that contains the current Unit mode of operation and the commands sent by PackML_StateMachine. |
| V | PML_States | PackML_States_STRUCT | Structure containing information about the current state of the machine. |
| V | UnitMachine | UnitMachine_STRUCT | Structure containing all the information about the machines current state and mode of operation for all EMs and CMs. |
| VAR_INPUT | | | |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | EM_Number | INT | The EM number corresponding to the EM in which this FB is located. |
| | | | Default |
| | | | FALSE |
| | | | INT#0 |

| | | | | |
|-------------------|---------|------|---|--------------|
| V | CM_Mask | WORD | Mask to deactivate CMs. When a CM is deactivated, commands will not be sent down to the CM, for testing purposes. Each bit corresponds to the same number CM to deactivate. (Example: to deactivate CM_3, set CM_Mask.X3. | WORD#16#0000 |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

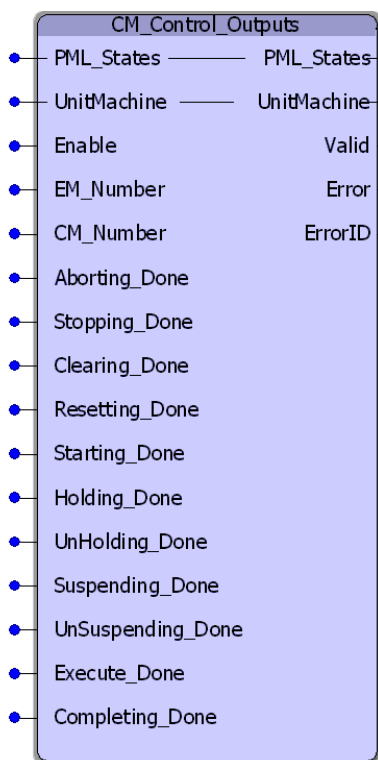
- See the PackML template documentation for further details on recommended usage.

Error Description

| ErrorID | Meaning |
|-----------------------|---|
| 0 | No Error |
| 12560 | Invalid Equipment Module number. |
| 12561 | Equipment Module not enable in the system. |
| 12562 | Invalid number of enabled Control Modules in selected Equipment Module. |



CM_Control_Outputs



The CM_Control_Outputs function block sets the State Complete bits for the control module to be passed up and assembled into the Equipment Module status in the EM00_ModuleControl worksheet.

Library

Pack ML Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-------------|--------------------------------------|--|
| VAR_IN_OUT | | | |
| V | PML_States | PackML_States_STRUCT | Structure containing information about the current state of the machine. |
| V | UnitMachine | UnitMachine_STRUCT | Structure containing all the information about the machines current state and mode of operation for all EMs and CMs. |

| VAR_INPUT | | | | Default |
|------------|-------------------|------|---|---------|
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. | FALSE |
| V | EM_Number | INT | The EM number corresponding to the EM in which this FB is located. | INT#0 |
| V | CM_Number | WORD | The CM number corresponding to the CM in which this FB is located. | WORD#0 |
| V | Aborting_Done | BOOL | Setting this bit indicates that the current CM is done 'Aborting' and is ready to move to the next state. | FALSE |
| V | Stopping_Done | BOOL | Setting this bit indicates that the current CM is done 'Stopping' and is ready to move to the next state. | FALSE |
| V | Clearing_Done | BOOL | Setting this bit indicates that the current CM is done 'Clearing' and is ready to move to the next state. | FALSE |
| V | Resetting_Done | BOOL | Setting this bit indicates that the current CM is done 'Resetting' and is ready to move to the next state. | FALSE |
| V | Starting_Done | BOOL | Setting this bit indicates that the current CM is done 'Starting' and is ready to move to the next state. | FALSE |
| V | Holding_Done | BOOL | Setting this bit indicates that the current CM is done 'Holding' and is ready to move to the next state. | FALSE |
| V | UnHolding_Done | BOOL | Setting this bit indicates that the current CM is done 'UnHolding' and is ready to move to the next state. | FALSE |
| V | Suspending_Done | BOOL | Setting this bit indicates that the current CM is done 'Suspending' and is ready to move to the next state. | FALSE |
| V | UnSuspending_Done | BOOL | Setting this bit indicates that the current CM is done 'UnSuspending' and is ready to move to the next state. | FALSE |
| V | Execute_Done | BOOL | Setting this bit indicates that the current CM is done 'Executing' and is ready to move to the next state. | FALSE |
| V | Completing_Done | BOOL | Setting this bit indicates that the current CM is done 'Completing' and is ready to move to the next state. | FALSE |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

- See template documentation for further details on recommended usage.

Error Description

| ErrorID | Meaning |
|-----------------------|---|
| 0 | No Error |
| 12560 | Invalid Equipment Module number. |
| 12561 | Equipment Module not enable in the system. |
| 12562 | Invalid number of enabled Control Modules in selected Equipment Module. |

PackML_State_Diagram



The PackML_State_Diagram function block handles the operation of the state machine, including mode and state transitions, as defined in the OMAC PackML specification. This function block, when enabled, initializes the machine to be in mode 3 (Manual Mode) and in the Stopped state.

Library

Pack ML Toolbox

Parameters

| * | Parameter | Data Type | Description |
|---|------------|-----------|-------------|
| | VAR_IN_OUT | | |

| | | | |
|-----------|---------------------|------------------------------------|--|
| V | Cfg_ModeNames | STRING_ Array32 | An array of strings containing the names of the different Unit modes of operation. |
| V | Cfg_ModeTransitions | DINT_ Array32 | An array of acceptable mode transition states. Mode changes into the NEW MODE can only be performed at the chosen states. Each element in the array represents a mode, and each bit in the array element represents a state. (Ex. To allow Mode Transitions for Mode 1 at Aborted (bit 9), Stopped (bit 2), and Idle (bit 4) states 0000 0000 0000 0000 0000 0010 0001 0100 = 16#0000_0214 = DINT#532 = Cfg_ModeTransitions[1]) |
| V | Cfg_StateNames | STRING_ Array18 | An array of strings containing the names of all the PackML states. |
| V | Cfg_DisableStates | DINT_ Array32 | An array representing each mode and their states. Each mode can disable certain states.(Ex In Manual Mode (Mode 3) disable Holding(10), Held(11), UnHolding(12), Suspended(5), Suspending(13), UnSuspending(14),Completing(16), Complete(17) = 0000 0000 0000 0011 0111 1100 0010 0000 = 16#0003_7C20 = DINT#228384 = Cfg_DisableStates[3]) |
| V | UnitMachine | UNitMachine_STRUCT | Structure containing all the information about the machines current state and mode of operation for all EMs and CMs. |
| VAR_INPUT | | | |
| B | EnableIn | BOOL | The function will continue to execute while the enable is held high |
| V | Cmd_Mode | DINT | The value of the new mode the machine will transition to if possible. If the input remains unchanged, the machine will stay in the same mode of operation |
| V | Cmd_Reset | BOOL | Setting this bit sends the 'Restart' command to all enabled and active EMs if it is a legal transition from |
| V | Cmd_Start | BOOL | Setting this bit sends the 'Start' command to all enabled and active EMs if it is a legal transition from the current machine state, otherwise the command will be ignored |
| V | Cmd_Stop | BOOL | Setting this bit sends the 'Stop' command to all enabled and active EMs if it is a legal transition from the current machine state, otherwise the command will be ignored |
| V | Cmd_Hold | BOOL | Setting this bit sends the 'Hold' command to all enabled and active EMs if it is a legal transition from the current machine state, otherwise the command will be ignored |
| V | Cmd_UnHold | BOOL | Setting this bit sends the 'UnHold' command to all enabled and active EMs if it is a legal transition from the current machine state, otherwise the command will be ignored |

| | | | | |
|-------------------|-----------------------------|------|--|-------|
| V | Cmd_Suspend | BOOL | Setting this bit sends the 'Suspend' command to all enabled and active EMs if it is a legal transition from the current machine state, otherwise the command will be ignored | FALSE |
| V | Cmd_UnSuspend | BOOL | Setting this bit sends the 'UnSuspend' command to all enabled and active EMs if it is a legal transition from the current machine state, otherwise the command will be ignored | FALSE |
| V | Cmd_Abort | BOOL | Setting this bit sends the 'Abort' command to all enabled and active EMs if it is a legal transition from the current machine state, otherwise the command will be ignored | FALSE |
| V | Cmd_Clear | BOOL | Setting this bit sends the 'Clear' command to all enabled and active EMs if it is a legal transition from the current machine state, otherwise the command will be ignored | FALSE |
| V | Cmd_Complete | BOOL | Setting this bit sends the 'Complete' command to all enabled and active EMs if it is a legal transition from the current machine state, otherwise the command will be ignored | FALSE |
| V | Cfg_RemoteModeCmd | DINT | The remotely requested mode to transition to | 0 |
| V | Inp_RemoteModeCmdChangeReq | BOOL | When this input is set, the machine will transition to the mode set by Cfg_RemoteModeCmd if it is a legal transition from the current state of the machine | FALSE |
| V | Inp_RemoteStateCmd | DINT | The remotely requested state to transition to | 0 |
| V | Inp_RemoteStateCmdChangeReq | BOOL | When this input is set, the machine will transition to the state set by Cfg_RemoteStateCmd if it is a legal transition from the current state of the machine | FALSE |
| VAR_OUTPUT | | | | |
| B | EnableOut | BOOL | Indicates that the outputs of the function are valid | |
| V | Clearing | BOOL | When this bit is set, the machine is in the 'Clearing' state | |
| V | Stopped | BOOL | When this bit is set, the machine is in the 'Stopped' state | |
| V | Starting | BOOL | When this bit is set, the machine is in the 'Starting' state | |
| V | Idle | BOOL | When this bit is set, the machine is in the 'Idle' state | |

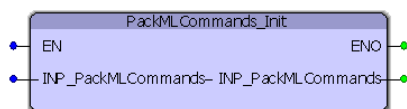
| | | | |
|---|----------------------|--------|---|
| V | Suspended | BOOL | When this bit is set, the machine is in the 'Suspended' state |
| V | Execute | BOOL | When this bit is set, the machine is in the 'Execute' state |
| V | Stopping | BOOL | When this bit is set, the machine is in the 'Stopping' state |
| V | Aborting | BOOL | When this bit is set, the machine is in the 'Aborting' state |
| V | Aborted | BOOL | When this bit is set, the machine is in the 'Aborted' state |
| V | Holding | BOOL | When this bit is set, the machine is in the 'Holding' state |
| V | Held | BOOL | When this bit is set, the machine is in the 'Held' state |
| V | UnHolding | BOOL | When this bit is set, the machine is in the 'UnHolding' state |
| V | Suspending | BOOL | When this bit is set, the machine is in the 'Suspending' state |
| V | UnSuspending | BOOL | When this bit is set, the machine is in the 'UnSuspending' state |
| V | Resetting | BOOL | When this bit is set, the machine is in the 'Resetting' state |
| V | Completing | BOOL | When this bit is set, the machine is in the 'Completing' state |
| V | Complete | BOOL | When this bit is set, the machine is in the 'Complete' state |
| V | ModeChangeNotAllowed | BOOL | When this bit is set, the requested Mode change isn't allowed and the machine will remain in the current mode and state. |
| V | Sts_StateCurrent | DINT | Number in decimal corresponding to the current state the machine is in |
| V | Sts_StateCurrentName | STRING | The name of the current state the machine is in |
| V | Sts_StateCurrentBits | DINT | DWORD indicating the current state the machine is in (Ex. If Sts_StateCurrentBits[x] = 1, then the machine is in State x) |
| V | Sts_ModeCurrent | DINT | Number in decimal corresponding to the current mode the machine is in |
| V | Sts_ModeCurrentName | STRING | The name of the current mode the machine is in |
| V | StsModeCurrentBits | DWORD | DWORD indicating the current mode the machine is in (Ex. If Sts_ModeCurrentBits[x] = 1, then the machine is in State x) |

Notes

- Should always be enabled when program is running to ensure proper operation of the state machine.
- See template documentation for further details on recommended usage.



PackMLCommands_Init



The PackMLCommands_Init function block clears all commands and sets the machine to be in the stopped state.

Library

Pack ML Toolbox

Parameters

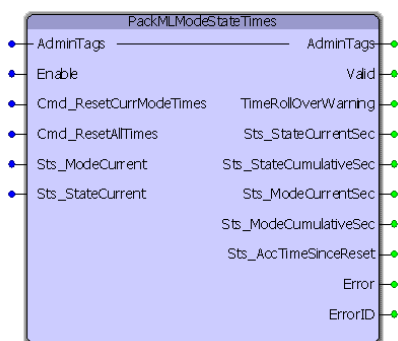
| * | Parameter | Data Type | Description |
|-------------------|---------------------|---|--|
| VAR_IN_OUT | | | |
| V | INP_Pack-MLCommands | PackML_Module_Commands_STRUCT | Structure containing the current state and commanded actions |
| VAR_INPUT | | | |
| B | EN | BOOL | Enables the function. |
| VAR_OUTPUT | | | |
| B | ENO | BOOL | High if the function is executing normally. |

Notes

- Intended to be executed when initially entering the stopped state to clear all previous commands.



PackMLModeStateTimes



The PackMLModeStateTimes function block keeps track of the times spent in each mode and state of operation for the machine.

Library

Pack ML Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|------------------------|---------------------------------------|--|
| VAR_IN_OUT | | | |
| V | AdminTags | PackTags_Admin_STRUCT | Structure containing alarm data from the machine. |
| V | UnitMachine | UNitMachine_STRUCT | Structure containing all the information about the machines current state and mode of operation for all EMs and CMs. |
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| B | Cmd_ResetCurrModeTimes | BOOL | When set, all time counting will be stalled and all of the times being counted for the Sts_ModeCurrent will be cleared. |
| B | Cmd_ResetAllTimes | BOOL | When set, all times being monitored will be reset to zero. Time counting will also be stalled while this input is held high. |
| V | Sts_ModeCurrent | DINT | The current mode in which the machine is operating. |
| V | Sts_StateCurrent | DINT | The current state in which the machine is operating. |
| VAR_OUTPUT | | | |

| | | | |
|---|------------------------|----------------------|---|
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| V | TimeRollOverWarning | BOOL | A warning is sent when any of the time accumulators is approaching rolling over. |
| V | Sts_StateCurrentSec | DINT | Time (in seconds) spent in the current state. |
| V | Sts_StateCumulativeSec | StateCumulativeArray | An array containing the times spent operating in different modes and states. |
| V | Sts_ModeCurrentSec | DINT | Time (in seconds) spent in the current mode. |
| V | Sts_ModeCumulativeSec | DINT_Array32 | An array of times spent in each mode. |
| V | Sts_AccTimeSinceReset | DINT | Accumulated time since Cmd_ResetAllTimes went high or the program was stopped for any reason. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

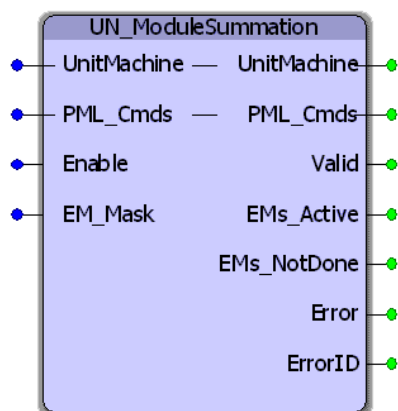
- See the PackML template documentation for further details on recommended usage.

Error Description

| ErrorID | Meaning |
|-----------------------|------------------------|
| 0 | No Error |
| 12563 | Time rollover warning. |



UN_ModuleSummation



The UN_ModuleSummation function block rolls up all the Equipment Module State Complete bits for active, enabled EMs. The result is an overall PMLs State Complete bit that is transferred to the PackML_StateControl function.

Library

Pack ML Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-------------|--|--|
| VAR_IN_OUT | | | |
| V | UnitMachine | UNitMachine_STRUCT | Structure containing all the information about the machines current state and mode of operation for all EMs and CMs |
| V | PML_Cmds | PackML_Commands_STRUCT | Structure that contains the current Unit mode of operation and the commands sent by PackML_StateMachine |
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. FALSE |
| V | EM_Mask | WORD | Mask to deactivate EMs. When an EM is deactivated, commands will not be sent down to the EM, for testing purposes. Each bit corresponds to the same number EM to deactivate. (Example: to deactivate EM_3, set EM_Mask.X3 =TRUE) WORD#16#0000 |
| VAR_OUTPUT | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |

| | | | |
|---|-------------|------|---|
| V | EMs_Active | WORD | The list of active EMs. Same bit scheme as EM_Mask. (Example: if EMs_Active.X4 = TRUE then EM_4 is active) |
| V | EMs_NotDone | WORD | A compilation of which Equipment Modules have not completed the transition task. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Error Description

| ErrorID | Meaning |
|-------------------|----------|
| 0 | No Error |

PLCopen Toolbox

Toolbox Help Documentation

Help version created 1/31/2018

YASKAWA



Getting Started with PLCopen Toolbox

Requirements for v340 / 341

To use the PLCopen Toolbox, your project must also contain the following:

Firmware libraries:

- YMotion
 - Only required if using the [ReadAxisParameters](#) function block.

User libraries:

The following User Libraries must be listed above the PLCopen Toolbox and in the following order:

- DataTypes_Toolbox (v340 or higher)
- Math_Toolbox (v340 or higher)
 - Only required if using the [Jog_To_Position](#) or [ProductBuffer](#) function block.
- Yaskawa Toolbox (v340 or higher)
 - Only required if using the [Full_Closed_Control](#) function block.

Data Types

For versions prior to v205, this toolbox already includes the PLCTaskInfoTypes and MotionBlockTypes DataTypes files typically included when starting a new project, so delete them from your project to avoid compile errors that indicate duplicate DataType definitions. Starting in v205, the data type files that are included in the new project templates were added to a new User Library called DataTypes toolbox. You must include the DataTypes Toolbox in your project as mentioned above, and delete standard data type files from the main project to avoid compile errors that indicate duplicate DataType definitions. Starting with MotionWorks IEC v3.x, the new project templates will include the PLCopen and DataTypes Toolboxes, and the data types files will be excluded to save many steps during new project creation.

See the [PLCopen_Toolbox eLearning Modules](#) on Yaskawa's YouTube channel for video tutorials and examples.



PLCopen Revision History

New for PLCopen v205 and higher – All firmware library DataType definitions were moved to a new toolbox called the DataTypes Toolbox. Formerly, the PLCopen Toolbox contained the MotionInfoTypes and the PLCTaskInfoTypes datatype files. These were removed and are now included in the DataTypes Toolbox. If upgrading from an older version of PLCopen Toolbox, you must do the following:

- 1) Include the DataTypes Toolbox in your project.
- 2) Remove any other Yaskawa supplied datatype files with firmware library definitions such as
 - a. ControllInfoTypes
 - b. YDeviceCommTypes

Current Version:

(***** 2017-11-22 v341 released (Filename is still 340, using new project version control)
*****)

This version is included in the MotionWorks IEC 3.4.0.233a

- 1) AxisControl - Reverted change to only show outputs when Enable is High in v340. The v340 behavior was not ideal. DCR 918.
- 2) SetAccDecPns - This was a new block added for v340 to enhance the capabilities of Home_LS_Pulse and Home_LS, but there was a compile error due to an incorrectly declared variable, now fixed. DCR 1318.

(***** 2017-08-14 v340 released
*****)

- 1) Home_LS_Pulse, Home_LS - Improved homing FBs by calculating required Pn305 / 306 / 80E for acc dec while in velocity mode. DCR 490.
- 2) Home_TouchProbe - HomeData.HomeDirection input was ignored. DCR 826.
- 3) AxisControl - Changed to only show outputs when Enable is High. DCR 918.
- 4) AbsolutePositionManager - Improved PositionValid output for the case when the user resets the Absolute Encoder even if there is not an alarm. DCR 949.
- 5) Y_DigitalCamSwitch - Upgraded functionality to support FT62 ServoPacks. DCR 1035.
- 6) Full_Closed_Loop - Fixed calculation for MaxCorrectionPerScan. DCR 1050.
- 7) UpdateUsePointer - updated to also update MultiUsePointer. DCR 1105.
- 8) Feed_To_Length - Improved operation so LatchPosition does not toggle to zero between moves. DCR 1167.
- 9) FeedRegistrationCheck - Added ErrorID to if negative latch distance is reported. DCR 1175.
- 10) Feed_To_Length - Improved operation in cases where latch comes very late in the move and the tuning is soft. DCR 1183.
- 11) ProductBuffer - Added ErrorID to catch firmware bug (SCR 10736) if previous latch is reported. DCR 1185.
- 12) HomeTouchProbe - Now executes MC_AbortTrigger if there is an Error. DCR 1187.

Previous Versions:

(***** 2016-10-31 v330 released
*****)

1) ReadMotorSpeed - New FB added. - Known issue: This function block only works for Sigma 5 motors.

(***** 2016-06-21 v302 released
*****)

1) Feed_To_Length - Added Active Output. DCR 695.

2) AbsoluteEncoderManager - Added Busy Output. DCR 830.

3) ProductBuffer - Added new check and ErrorID 10099 if the Axis type is not a servo or external encoder, and TestMode is not set TRUE. (This combination is not supported. Also suppressed an Error generated by internal function MC_AbortTrigger when an unsupported axis is selected while in TestMode. DCR 903.

4) Full_Closed_Control - New Function block added for applications that require full closed control but cannot use the Full Closed option card on the ServoPack, either because its an MP2600iec or because the safety option card is installed. DCR 930.

(***** 2015-08-19 v301 created
*****)

1) ProductBuffer - Updated to support M-III simultaneous latch (Two instances of ProductBuffer FB for the same axis. This function now uses new parameter 1034 to obtain the unmodularized latch for TRIGGER_REF.ID=1. Compatibility with older firmware on MPiec controllers using ID=1 for the first is maintained.

(***** 2015-01-31 v300 created
*****)

1) Identical to v207, but recompiled specifically for MotionWorks IEC v3.x.

(***** 2014-12-11 v207 released - developed using firmware 2.7.0 *****)

1) Toolbox_DataTypes - Added new data types under ProductBufferStruct to support multiple latch patterns.

2) ProductBuffer - Added code to support multiple latch patterns, such as rising edge and falling edge .

3) ProductBuffer - Added code to automatically detect External Encoder type, even on MP3000iec series .

4) AxisInterLock - Replaced prm 1005 (actual position cyclic) with 1006 (actual position non cyclic.)

5) ReadMotorSpeed - New function block to read peak and rated speeds of connected rotary servos .

6) FeedToLength - Improved output logic - NOT Done added to RETURN rung. Enable added to Done rung.

7) ReadMotorSpeed - New function added to read the Motor part number string to report the Rated and Maximum speeds.

(***** 2014-03-03 v206 released - developed using firmware 2.5.0 *****)

1) UpdateUsePointer - New function block. This code can be used to update the ProductBufferStruct's UsePointer which is used in the ProductBuffer function block.

2) ProductBuffer - Added a Busy output because it takes 3 scans after Enable goes FALSE before iActive goes FALSE. ProductBuffer.Busy can be used as an interlock if the ProductBuffer FB is used within other user function blocks to prevent the code from going dormant before the block is finished.

3) HomeTouchProbe - New function block. Homes an axis based on a sensor wired to the high speed latch input on the ServoPack.

4) VelocityLimits - Fixed cut & paste typos in code.

5) MA_2Stage_Calc - New supporting function block used by MoveAbsolute_2Stage.

- 6) MoveAbsolute_2Stage - New function block. Provides two acceleration and two deceleration values switchable at a specified speed.
- 7) Jog_To_Position - Fixed typo with Accel variable causing complete inoperability in v205.
- 8) MoveRelative_ByTime - Added Acceleration and Deceleration inputs.
- 9) GetActionPointers - New function block. For use with user functions that use the ProductBuffer for multi operation support.
- 10) ProductBufferStruct - Multiple pointers for several actions are now supported.
- 11) Jog - Improved logic to account for continuously changing inputs without getting stuck.
- 12) Home_LS - Added NC contact LimitError to workaround issue described in SCR 8025.
- 13) Home_LS - Added NC contact LimitError to workaround issue described in SCR 8025.
- 14) HighSpeedOutput - Added iActive contact to various rungs to clear outputs from previous execution.
- 15) HighSpeedOutput - Changed the DIV order in rung 4. Converted DINT_TO_LREAL so that the variable factor can take a non integer value. This correction allows HighSpeedOutput FB functionality with the MinTime input.

(***** 2013-09-01 v205 released - developed using firmware 2.5.0 *****)

- 1) Removed references to Math Toolbox functions where possible. Only the ProductBuffer function block still requires the Math Toolbox.
- 2) Because of the reintroduction of functions with EN/ENO, the MP2600 requires firmware 2.1.
- 3) Moved all datatype definitions for firmware libraries to a new DataTypes Toolbox. Upgrading to PLCopen v205 will require deleting any Yaskawa firmware datatypes files and adding the DataTypes Toolbox.
- 4) JogToPosition - Fixed method in which a change of speed is detected to refire MC_MoveVelocity.

(***** 2013-03-15 v204 released - developed using firmware 2.4.0 *****)

- 1) ProductBuffer - Swapped position of RegistrationData and ProductAxis to conform to VAR_IN_OUT convention.
- 2) AccDecLimits - Fixed several copy / paste errors and variable naming confusion.
- 3) AbsoluteEncoderManager - Verified operation using Signa-II 2 digit alarm formats.

(***** 2012-10-29 v203 released - developed using firmware 2.4.0 *****)

- 1) AbsoluteEncoderManager - Removed the 'Active' contact from rung 5 to clear alarms that have been reset.
- 2) ReadAxisParameters - Added 14 parameters. (Mainly limit parameters)
- 3) Jog_To_Position - Improved deceleration ramp.
- 4) Feed_To_Length - Added. This function will index a default amount, and update the final target based on a registration input.

(***** 2012-06-29 v202 released - developed using firmware 2.2.1 *****)

- 1) ReadAxisParameters - Added the following parameters FilterCmdVelocity 1021, CmdAcceleration 1022, and postFilterCmdTorque 1024.
- 2) PLCTaskInfoTypes - Added DataTypes to mirror the 2.0 additions for high resolution task timing.
- 3) AbsolutePositionManager - Added additional alarm detection to catch A830, A840, and ACC0 alarms. Also added code to clear EncoderAlarmID and ControllerAlarmID when the block goes inactive.
- 4) Jog_To_Position - Added. For rotary applications that must stop at a specific location.
- 5) HighSpeedOutput - Fixed issue with MinTime. Was not working correctly if Min Time not zero. (YEU)

(***** 2011-12-08 v201 released - developed using firmware 2.0.0 *****)

- 1) ProductBuffer - Added two optional inputs to allow FB to operate in a test or simulation mode.

- 2) ReadAxisParameters - Disabled reading parameter 1311 because it causes an error on MP2600iec. This parameter is scheduled to return a zero instead of an ErrorID in firmware 2.2.
- 3) ReadAxisParameters - Fixed two swapped values CamOffset and CamScale were swapped in v200.

(***** 2011-07-29 v200 released - developed using firmware 2.0.0 *****)

Built from v022beta

ReadAxisParameters - Upgraded to use the new Y_ReadMultipleParameters firmware function block.

(***** 2011-02-24 v022beta created - developed using firmware 2.0.0 *****)

- 1) Home_Init - Added for users who prefer to avoid structured text POU for initializing the HomeStruct
- 2) Math Toolbox - Upgraded to v004 with Enable / Valid as function block I/O for compatibility with FW 2.1*)
- 3) Changed AxisControl to allow clearing a drive warning while the servo is enabled.

(***** 2011-01-24 v021 released - developed using firmware 1.2.3 *****)

- 1) HighSpeedOutput - Added. For simplified operation with the external encoder high speed output.
- 2) Home_LS_Pulse - Added a MC_MoveRelative between searching for the limit switch and C channel to prevent ErrorID 4397 from occurring: "Over travel limit still ON after attempting to move away from it."
- 3) Axes_Interlock - Enhanced to work with axes configured for rotary mode.

(***** 2010-10-04 v020 released. developed using firmware 1.2.2.9 *****)

- 1) Jog - Rewrote function to follow the 'Enable' template standard created for ST functions.
- 2) ProductBuffer - Improved lockout operation when a manual offset was applied. See ProductBuffer FB comments for more details.
- 3) Jog - Improved Done output (It will only pulse; this block is a special case of Enable type
- 4) AxisParams Struct - Added CamTableCumulativeOutput
- 5) Home_LS - Fixed rung 6 (incorrect execute bit), duplicated StartOffset from rung 5.
- 6) DigitalCamSwitch - Added. See the initialize POU for example data setup.
- 7) ReadAxisParameters - Added LoadType and MachineCycle parameters.
- 8) AbsolutePositionManager - Added. For confirmation that the absolute position was set and valid
- 9) Moved Math functions to Math Toolbox

(***** 2010-02-03 v019 released *****)

- 1) CamGenerator - Added.
- 2) CamSlaveFeedToLength - Removed MC_AbortTrigger.
- 3) Fixed Missed Latch counter (not initialized properly)
- 4) Added CamMaster_Lookup, and SlaveIndex_Lookup
- 5) Added MissedLatch and LatchPosition outputs to CamSlave_FeedToLength
- 6) Improved ProductBuffer FB to account for external encoder master (prm 1016 / 1006 switch
- 7) Added CamBlend function block
- 8) Added WindowCheck function block
- 9) CamGenerator formula type 4 (Cycloidal) changed to 3 (Simple harmonic). It was incorrectly identified.*)

- 10) Added ParamTypes input to ReadAxisParameters to increase efficiency of the function (Provides selective parameter reads by group.)
- 11) MOVED ALL CAMMING SUPPORT FUNCTIONS TO CAM TOOLBOX - FOR PRO VERSION ONLY.
- 12) The "PLCTaskInfoTypes" DataType file was removed from this Toolbox. If you need to replace it in your project, open a second copy of MotionWorks IEC, and open a project that already has the PLCTaskInfoTypes DataType file, then copy & paste it into your project explorer.

(***** 2009-10-27 v018 released *****)

- 1) Added SensorWindow input to CamSlave FeedToLength
- 2) Added PositionLimits, VelocityLimits, and AccDecLimits function blocks
- 3) Removed Enable Servo FB, use AxisControl FB
- 4) Removed the variable Speed from HomeStruct, it was not used for anything.
- 5) Converted Home blocks removed all Set or RESET coils.
- 6) Added MOVE_UNIT & MOVE_LREAL function block to provide compatibility with MP2600iec.
- 7) AxesInterlock does not support rotary mode axes.
- 8) ReadAxisParameters changed to increase efficiency.
- 9) Added some outputs such as 'Valid' to some blocks for increased consistency with PLCopen.
- 10) First version formalized with help documentation.

(***** 2009-07-15 v017 released *****)

- 1) Created Home_Pulse, Homes to C Channel, performs moves offset and defines position.
- 2) Removed R_TRIGs from the ErrorID portion of Home_LS, Home_LS_Pulse, and Home_Pulse because it was preventing the blocks from showing errors.
- 3) Updated ProductBuffer function block for both modularized and non modularized latch data.
- 4) Updated ReadAxisParameters to include VAR_IN_OUT (for speed) and additional input parameter to specify axis type. Also reduced parameter set to eliminate those that typically do not change.
- 5) Added MC_Status data.
- 6) Improved interlock logic in Home_LS_Pulse, Home_LS, Home_Pulse functions, added CommandAborted as output, and fixed a typo in all three blocks where the variable attached to the Busy output of one of the internal blocks was referencing an error bit.

(***** 2009-05-28 v016 released *****)

- 1) Y_AdjustMode in the DataTypes file was incorrectly named Y_AdjustMethod.
- 2) Added NOT(Busy) to the Execute of MC_TouchProbe in CamSlave_FeedToLength. New Error code in firmware 1.1.2.5 caused new problem if the block was executed when already executing. This may occur if there is bounce on the input sensor.
- 3) Fixed MoveRelative_ByTime - calculations would cause error if negative distance. Also added checks for negative time (causes error) and zero distance (No Error)

(***** 2009-05-07 v015 released *****)

- 1) Added interlock to Jog's MC_MoveVelocity to prevent rising edge of exe if Stop is busy to prevent ErrorID 4370 from appearing.
- 2) Added Axes_Interlock function.

(***** 2009-04-16 v014 released *****)

- (* Fixed AxisControl and Enable Servo to allow a re attempt to enable servo if MC_Power has Error. *)
- (* Previously they had a normally closed contact from the MC_Power FB preventing the block from enabling *)
- (* again. Also changed these two blocks to reset Error & ErrorID outputs when Enable=FALSE *)
- (* Changed the Jog Block Error and ErrorID outputs to only come on if JogFwd or JogRev is On *)
- (* Added CommandAborted to the Busy interlock circuits of Home_LS_Pulse and Home_LS. *)

(***** 2009-03-30 v013 released *****)

Released version of v012.

- 1) Explicitly set some parameters in ReadAxisParameters to LREAL#0.0 and documented as being unavailable. because they were causing Access Violation Errors when viewed in the Watch Window.

(***** 2009-01-27 v012 created *****)

- 1) This version was released to a few people as a work in progress.
- 2) PLCopenPlus-v_2_2 firmware library used and included with this version.
- 3) Added LatchPositionNonCyclic to the AxisParameterStruct structure for ReadAxisParameters FB.
- 4) Corrected naming of Cam parameters 1500, 1501, 1502.
- 5) Corrected AxisStatus FB, Drive Warnings and Errors were backwards.
- 6) Changed AxisControl.ControlAlarmID And AxisStatus.ControlAlarmID to a 32 bit UDINT output.
- 7) Jog converted to PLCopen convention (outputs) and code converted to ST.
- 8) Added CamSlave_FeedToLength, which uses MC_TouchProbe, SlaveRegistrationCheck, and Y_SlaveOffset.

(***** 2009-01-27 v011 released *****)

- 1) PLCopenPlus-v_2_2 firmware library used and included with this version.
 - 2) Added AxisStruct STRUCT
- (* Fixes *)
- 3) Simplified MoveRelativeByTime function, removed additional interlocks, and just copied MC_MoveRelative outputs to MoveRelativeByTime outputs. *)
 - 4) Made corrections to the AxisParameterArray, added cam parameters. NOTE: will require controller firmware 1.1.0.4 or greater to read some of the cam parameters. Set the READ flag for those parameters to FALSE if you are using older firmware.

(***** 2009-01-12 v010 released *****)

- 1) PLCopenPlus-v_2_1 firmware library used and included with this version.
- 2) Changed interface of homing blocks to use HomeStruct. Makes FB smaller and quicker to enter home data.
- 3) Added example initialization code as a Program POU to enable cut & paste to speed development.
- 4) Open the Toolbox as a project in a second copy of MotionWorks IEC as a project to see the Initialization POU.
- 5) Added 'ControllerAlarm' function block to provide BOOL output when there is a controller alarm.
(Uses Y_ReadAlarm and compares the AlarmID for non zero.
- 6) Added Homed BOOL to HomeStruct.

(***** 2008-11-05 v009 released *****)

- 1) Completed and tested the MoveRelative_ByTime function.
- 2) Previous versions would not allow the block to run more than once.

(***** 2008-10-17 v008 released *****)

- 1) In Home_LS_Pulse and Home_LS, added Reset Coil for Homing Done at the last rung.

(***** 2008-10-10 v007 released *****)

- 1) Added BOOL outputs to AxisControl (DriveAlarm, DriveWarning)
- 2) Fixed DriveWarningID and DriveAlarmID, they were backwards.

(***** 2008-10-02 v005 released *****)

Added Functions:

- 1) AxisControl
- 2) AxisStatus

Fixes:

- 3) Changed errant F_TRIG functions used in Home_LS_Pulse for ErrorID to R_TRIG.

(***** 2008-09-22 v004 released *****)

Changes:

- 1) EnableServo, upgraded to include ErrorClass output from MC_ReadAxisError from PLCopen.
- 2) FIRMWARE library 1.0.4.5 and PLCopenPlus-v_2_1
- 3) Includes structures for axis parameters and homing functions

Not complete:

- 4) MoveRelative_ByTime

(***** 2008-08-29 v003 released *****)

Added Functions:

- 1) Home_LS_Pulse
- 2) Home_LS
- 3) ReadAxisParameters

Not complete:

- 4) MoveRelative_ByTime
- 5) NOTE: v0035 supplied with the MP2300Siec_Sales_Demo_v001

(***** 2008-05-20 v002 released *****)

Includes:

- 1) EnableServo
- 2) Jog

Not complete:

3) MoveRelative_ByTime

PLCopen DataTypes

Data Type: AXIS_REF

Toolbox Help Documentation

Help version created 1/31/2018

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Data Type: AxisParamData

Supporting structure for [AxisPrmArray](#). Used by the [ReadAxisParameters](#) function block.

Data Type Declaration

TYPE

AxisParamData:ARRAY[0..60] OF IndividualParamDetails;

END_TYPE



Data Type: AxisParameterStruct

For use with the [CamSlave_FeedToLength](#) and [CamSlave_WindowCheck](#) function blocks.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|------------------------------|----------------------------|-------------|--|
| | MyAxisParameterStruct | AxisParameterStruct | | |
| C | ActualPosition | LREAL | 1000 | MyAxisParameterStruct.ActualPosition |
| C | ActualPositionCyclic | LREAL | 1005 | MyAxisParameterStruct.ActualPositionCyclic |
| C | ActualPositionNonCyclic | LREAL | 1006 | MyAxisParameterStruct.ActualPositionNonCyclic |
| C | ActualTorque | LREAL | 1004 | MyAxisParameterStruct.ActualTorque |
| C | ActualVelocity | LREAL | 1001 | MyAxisParameterStruct.ActualVelocity |
| C | AtVelocity | BOOL | 1141 | MyAxisParameterStruct.AtVelocity |
| C | BufferedMotionBlocks | LREAL | 1600 | MyAxisParameterStruct.BufferedMotionBlocks |
| C | CamMasterCycle | LREAL | 1512 | MyAxisParameterStruct.CamMasterCycle |
| C | CamMasterPosition | LREAL | 1500 | MyAxisParameterStruct.CamMasterPosition |
| C | CamMasterShiftedCyclic | LREAL | 1502 | MyAxisParameterStruct.CamMasterShiftedCyclic |
| C | CamMasterShiftedPosition | LREAL | 1501 | MyAxisParameterStruct.CamMasterShiftedPosition |
| C | CamMasterScale | LREAL | 1510 | MyAxisParameterStruct.CamMasterScale |
| C | CamMasterShift | LREAL | 1511 | MyAxisParameterStruct.CamMasterShift |
| C | CamOffset | LREAL | 1531 | MyAxisParameterStruct.CamOffset |
| C | CamScale | LREAL | 1530 | MyAxisParameterStruct.CamScale |
| C | CamShiftRemaining | LREAL | 1513 | MyAxisParameterStruct.CamShiftRemaining |
| C | CamState | LREAL | 1540 | MyAxisParameterStruct.CamState |
| C | CamTableIDEngaged | LREAL | 1541 | MyAxisParameterStruct.CamTableIDEngaged |
| C | CamTableOutput | LREAL | 1520 | MyAxisParameterStruct.CamTableOutput |
| C | CommandedAcceleration | LREAL | 1012 | MyAxisParameterStruct.CommandedAcceleration |
| C | CommandedPosition | LREAL | 1010 | MyAxisParameterStruct.CommandedPosition |
| C | CommandedPositionCyclic | LREAL | 1015 | MyAxisParameterStruct.CommandedPositionCyclic |
| C | CommandedPositionNonCyclic | LREAL | 1016 | MyAxisParameterStruct.CommandedPositionNonCyclic |
| C | CommandedTorque | LREAL | 1014 | MyAxisParameterStruct.CommandedTorque |
| C | CommandedVelocity | LREAL | 1011 | MyAxisParameterStruct.CommandedVelocity |
| C | InPosition | BOOL | 1140 | MyAxisParameterStruct.InPosition |
| C | LatchPositionNonCyclic | LREAL | 1031 | MyAxisParameterStruct.LatchPositionNonCyclic |
| C | PositionError | LREAL | 1130 | MyAxisParameterStruct.PositionError |
| C | PositionWindow | LREAL | 1120 | MyAxisParameterStruct.PositionWindow |



Data Type: AxisPrmArray

Used by the [ReadAxisParameters](#) function block.

Data Type Declaration

TYPE

AxisPrmArray: STRUCT

Param: [AxisParamData](#);

END_STRUCT;

END_TYPE



Data Type: AxisStruct

For use as a container for all axis related data. (Customizable)

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|---------------------|---------------------|--|-----------------------------|
| | MyAxisStruct | AxisStruct | | |
| U | Ref | AXIS_REF | Used with the Axis VAR_IN_OUT of PLCopen function blocks. | MyAxisStruct.Ref |
| U | JogSpeed | LREAL | In user units/sec as defined in the Hardware Configuration. | MyAxisStruct.JogSpeed |
| U | RunSpeed | LREAL | In user units/sec as defined in the Hardware Configuration. | MyAxisStruct.RunSpeed |
| U | Position | LREAL | In user units as defined in the Hardware Configuration. | MyAxisStruct.Position |
| U | Acceleration | LREAL | In user units/sec2 as defined in the Hardware Configuration. | MyAxisStruct.Acceleration |
| U | Deceleration | LREAL | In user units/sec2 as defined in the Hardware Configuration. | MyAxisStruct.Deceleration |
| U | Jerk | LREAL | In user units/sec3 as defined in the Hardware Configuration. | MyAxisStruct.Jerk |
| U | Status | BOOL | To indicate if the axis is enabled. | MyAxisStruct.Status |
| U | Warning | BOOL | Indicates if the axis has a warning, typically an alarm code beginning with 9 such as A.910 on Sigma series ServoPacks. | MyAxisStruct.Warning |
| U | Alarm | BOOL | Indicates if the axis has an alarm, which may originate in either the controller or the drive. | MyAxisStruct.Alarm |
| U | DriveAlarmID | UINT | Indicates the drives alarm ID, typically equivalent to the alarm displayed on the front display of the drive if viewed in hex. | MyAxisStruct.DriveAlarmID |
| U | DriveWarningID | UINT | Indicates the drives warning ID, typically equivalent to the alarm displayed on the front display of the drive if viewed in hex. | MyAxisStruct.DriveWarningID |
| U | ControlAlarmID | UDINT | Indicates the controllers alarm ID, equivalent to the alarm displayed in the web server if viewed in hex. | MyAxisStruct.ControlAlarmID |
| U | Prm | AxisParameterStruct | | MyAxisStruct.Prm |
| U | Home | HomeStruct | | MyAxisStruct.Home |
| U | Latch | RegistrationStruct | | MyAxisStruct.Latch |
| U | Cam | CamStruct | | MyAxisStruct.Cam |



Data Type: BufferPatternArray

Supporting structure for [ProductBufferStruct](#). Used by the [ProductBuffer](#) function block.

Data Type Declaration

TYPE

BufferPatternArray: ARRAY[0..9] OF TRIGGER_REF;

END_TYPE



Data Type: CAMSWITCH_ARRAY

Supporting structure for [CAMSWITCH_REF](#). Used by the [Y_DigitalCamSwitch](#) function block.

Data Type Declaration

TYPE

CAMSWITCH_ARRAY: ARRAY[0..255] OF [CAMSWITCH_STRUCT](#);

END_TYPE



Data Type: CAMSWITCH_REF

Used by the [Y_DigitalCamSwitch](#) function block.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-----------------|---------------------------------|---|------------------------------|
| | MyCAMSWITCH_REF | CAMSWITCH_REF | | |
| U | MasterType | INT | 0 = Infinite/Rotary, 1 = Finite/Linear | MyCAMSWITCH_REF.MasterType |
| U | MachineCycle | LREAL | This number should match the setting in the Hardware Configuration. Valid for Type = 0. | MyCAMSWITCH_REF.MachineCycle |
| U | LastSwitch | INT | To limit the evaluation of the array | MyCAMSWITCH_REF.LastSwitch |
| U | Switch | CAMSWITCH_ARRAY | | MyCAMSWITCH_REF.Switch[0]... |



Data Type: CAMSWITCH_STRUCT

Supporting structure for [CAMSWITCH_ARRAY](#). Used by the [Y_DigitalCamSwitch](#) function block.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|--------------------|------------------|---|------------------------------------|
| | MyCAMSWITCH_STRUCT | CAMSWITCH_STRUCT | | |
| U | TrackNumber | INT | A reference to the track number to which this switch is to be applied. The PLS block will support up to 32 tracks. There is no limit to how many switches can be assigned to a single track except for the maximum of 256 switches. | MyCAMSWITCH_STRUCT.TrackNumber |
| U | FirstOnPosition | LREAL | Lower boundary where the switch is ON. | MyCAMSWITCH_STRUCT.FirstOnPosition |
| U | LastOnPosition | LREAL | Upper boundary where the switch is ON. If LastOnPosition < FirstOnPosition, then the switch should be OFF between the positions (inverse cam switch) | MyCAMSWITCH_STRUCT.LastOnPosition |
| U | AxisDirection | INT | The direction of the master for which this switch applies. 0 = Both Pos and Neg; 1 = Positive Only (future); 2 = Negative Only (future). ONLY 0 should be implemented at this time. | MyCAMSWITCH_STRUCT.AxisDirection |
| U | CamSwitchMode | INT | Position vs Time-Based output. 0 = Position. 1 = Time. | MyCAMSWITCH_STRUCT.CamSwitchMode |
| U | Duration | DINT | The duration of the switch. If CamSwitchMode = 0 (Position) AND Duration <> 0.0, this Duration will serve as a Maximum ON time for the switch. A setting of 0.0 means infinite time. If CamSwitchMode = 1 (Time), this duration will serve as the ON time of the switch once FirstOnPosition has been reached. A setting of 0.0 will result in a block error. | MyCAMSWITCH_STRUCT.Duration |



Data Type: HomeStruct

For use with all HOME_*** function blocks.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-----------------------|-------------------|--|------------------------------------|
| | MyHomeStruct | HomeStruct | | |
| U | Direction | INT | Specified the initial direction of homing. Refer to MC_Direction enumerated types. Note: For the Home_TouchProbe function block, this element is not used. Set a positive or negative ApproachDistanceLimit. | MyHomeStruct.Direction |
| U | SwitchMode | INT | Configuration for action of the home sensor. [See MC_SwitchMode] | MyHomeStruct.SwitchMode |
| U | TorqueLimit | LREAL | Default if zero or unconnected is 100.00% of rated torque. | MyHomeStruct.TorqueLimit |
| U | ApproachVelocity | LREAL | Velocity at which the axis will travel in search of the first switch, usually a limit switch. | MyHomeStruct.ApproachVelocity |
| U | ApproachTimeLimit | LREAL | In seconds. | MyHomeStruct.ApproachTimeLimit |
| U | ApproachDistanceLimit | LREAL | The maximum distance the axis will travel in search of the first switch (typically limit switch) before aborting the homing operation and issuing an error. | MyHomeStruct.ApproachDistanceLimit |
| U | AccDec | LREAL | The acceleration and deceleration which will be applied to all homing moves. | MyHomeStruct.AccDec |
| U | CreepVelocity | LREAL | Velocity at which the axis will travel in search of the C channel on the encoder. | MyHomeStruct.CreepVelocity |
| U | CreepTimeLimit | LREAL | In seconds. | MyHomeStruct.CreepTimeLimit |
| U | CreepDistanceLimit | LREAL | The maximum distance the axis will travel in search of the C channel before aborting the homing operation and issuing an error. | MyHomeStruct.CreepDistanceLimit |
| U | Offset | LREAL | Position offset to MOVE after finding the last input device (switch or C channel, based on the function block being used.) | MyHomeStruct.Offset |
| U | OffsetVelocity | LREAL | Velocity at which the axis will travel during the home offset move. | MyHomeStruct.OffsetVelocity |
| U | Position | LREAL | This is the position that will be defined when all homing actions are complete, including the offset move. | MyHomeStruct.Position |
| U | Homed | BOOL | Flag to indicate that the axis was successfully homed. Not used by the homing function blocks, reserved for use by the application. | MyHomeStruct.Homed |



Data Type: LatchBufferArray

Supporting structure for [ProductBufferStruct](#) Used by the [ReadAxisParameters](#) function block.

Data Type Declaration

TYPE

LatchBufferArray: ARRAY[0..100] OF LREAL;

END_TYPE



Data Type: MoveStruct

For use with MC_MoveAbsolute, MC_MoveRelative, and MC_MoveVelocity.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|---------------------|-------------------|--|---------------------------|
| | MyMoveStruct | MoveStruct | | |
| U | Position | LREAL | In user units as defined in the Hardware Configuration. | MyMoveStruct.Position |
| U | Velocity | LREAL | In user units/sec as defined in the Hardware Configuration. | MyMoveStruct.Velocity |
| U | Acceleration | LREAL | In user units/sec ² as defined in the Hardware Configuration. | MyMoveStruct.Acceleration |
| U | Deceleration | LREAL | In user units/sec ² as defined in the Hardware Configuration. | MyMoveStruct.Deceleration |
| U | Jerk | LREAL | In user units/sec ³ as defined in the Hardware Configuration. | MyMoveStruct.Jerk |



Data Type: MultiUseData

Supporting structure for [ProductBufferStruct](#). Used by the [ProductBuffer](#) function block.

Data Type Declaration

TYPE

MultiUseData:ARRAY[0..9] OF MultiUsePointers;

END_TYPE



Data Type: MultiUsePointers

Supporting structure for [ProductBufferStruct](#). Used by the [ProductBuffer](#) function block.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-----------------|------------|--|--|
| | MyAxisStruct | AxisStruct | | |
| U | UsePointer | INT | For applications that require several operations to be performed is sequence based on the same registration mark. This feature could be used when position data captured on the master axis must be shared by multiple axes or multiple actions on one axis. | MyProductBufferStruct.Multi[x].UsePointer |
| U | DependentAction | INT | Specify the previous action that, when complete, thenext action can be processed. | MyProductBufferStruct.Multi[x].DependentAction |



Data Type: PatternAwayDistanceArray

Supporting structure for [ProductBufferStruct](#). Used by the [ProductBuffer](#) function block.

Data Type Declaration

TYPE

PatternAwayDistanceArray: ARRAY[0..9] OF LREAL;

END_TYPE



Data Type: PatternPointerArray

Supporting structure for [ProductBufferStruct](#). Used by the [ProductBuffer](#) function block.

Data Type Declaration

TYPE

PatternPointerArray: ARRAY[0..100] OF UINT;

END_TYPE

Data Type: ProductBufferStruct



For use with the [ProductBuffer](#) function block.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|---------|-----------|-------------|-------|
|---|---------|-----------|-------------|-------|

| | | | | |
|--|-----------------------|---------------------|--|--|
| | MyProductBufferStruct | ProductBufferStruct | | |
|--|-----------------------|---------------------|--|--|

| | | | | |
|---|---------------------|----------------------------------|---|---|
| U | BufferSize | INT | Maximum number of registration marks to be tracked. (Circular buffer size). Allow enough extra capacity in the circular buffer. A larger size does not impact performance. | MyProductBufferStruct.BufferSize |
| C | BufferNonCyclic | LatchBufferArray | Array (circular buffer) of all recorded registration marks (unmodularized latch values). | MyProductBufferStruct.BufferNonCyclic[x] |
| C | BufferCyclic | LatchBufferArray | Array (circular buffer) of all recorded registration marks (modularized latch values). | MyProductBufferStruct.BufferCyclic[x] |
| U | Sensor | TRIGGER_REF | TRIGGER_REF for the axis which registration marks are to be detected. See TRIGGER_REF data type description in the PLCopen help. | MyProductBufferStruct.Sensor.Bit |
| U | SensorDistance | LREAL | Distance in units of the master axis from the registration sensor to the required synchronization point with a slave axis. | MyProductBufferStruct.SensorDistance |
| U | SensorOffset | LREAL | If the sensor is an exact multiple of machine cycles from cut position, this number would be zero. If for example the sensor was 3.5 machine cycles away from the synchronization point, then this value would be 1/2 of the machine cycle. | MyProductBufferStruct.SensorOffset |
| U | ManualOffset | LREAL | Amount to adjust the synchronization point, typically comes from an HMI. | MyProductBufferStruct.ManualOffset |
| U | LockoutDistance | LREAL | Distance after recording a latch that another latch must be ignored. | MyProductBufferStruct.LockoutDistance |
| U | ProductAwayDistance | LREAL | The distance the product travels from its initial detection until it is safely past the slave operation to slave processing the next product. | MyProductBufferStruct.ProductAwayDistance |
| C | StorePointer | INT | Array index of the latch data that was last stored by MC_TouchProbe. | MyProductBufferStruct.StorePointer |
| U | UsePointer | INT | Array index of the latch data to be used by the process. | MyProductBufferStruct.UsePointer |
| U | PrevUsePointer | INT | Array Index of the previously used latch | MyProductBufferStruct.PrevUsePointer |

| | | | | |
|---|---------------------|--|---|--|
| | | | data. | |
| U | Multi | MultiUseData | Array of pointers for applications which process multiple operations based on a single registration mark. Examples of such applications are pick and place, score and punch etc. | MyProductBufferStruct.Multi[x].UsePointer |
| U | LastAction | INT | Total number of actions to be performed based on a single registration mark. If the default value of zero is used, non "Multi" operation is performed using the basic StorePointer and UsePointer method. | MyProductBufferStruct.LastAction |
| U | BufferPatternSize | INT | Size of the repeating pattern of TRIGGER_REFs. This value is only required if a pattern of latches must be captured. For example, if ServoPack signals EXT1 and EXT2 capture a products leading and trailing edge in a repeating sequence, set BufferPatternSize: =2. Set to default BufferPatternSize: =0 if only one TRIGGER_REF is required for the application. | MyProductBufferStruct.BufferPatternSize |
| U | BufferPattern | BufferPatternArray | Array of TRIGGER_REFs to be specified by the user. This provides support for capturing a rising and falling edge of the same sensor, such as for product length measurement. | MyProductBufferStruct.BufferPattern[x].Bit |
| U | PatternAwayDistance | PatternAwayDistanceArray | Array of product away distances corresponding to each TRIGGER_REF. | MyProductBufferStruct.PatternAwayDistance[x] |
| C | BufferedPattern | PatternPointerArray | Array of TRIGGER_REFs corresponding to recorded registration latches. This reports the type of signal that was captured (as configured by BufferPattern) for each corresponding element in the LatchBufferArrays. | MyProductBufferStruct.BufferedPattern[x] |

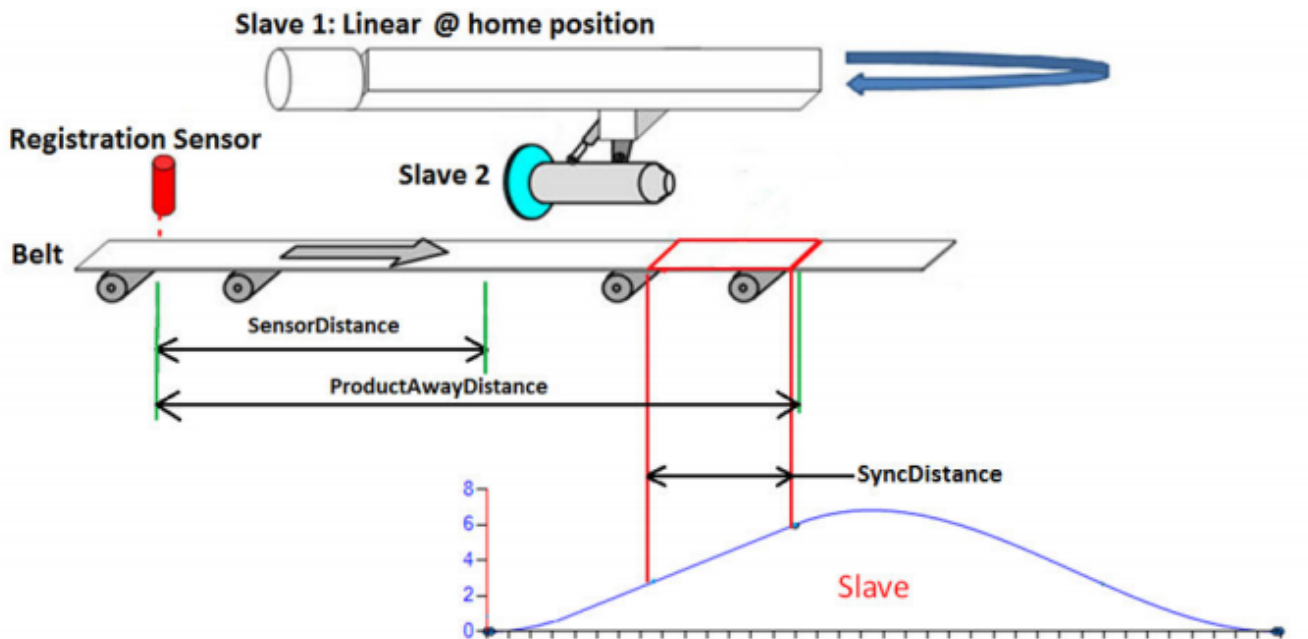
Notes:

The following structure values are not used by the ProductBuffer function block, but are included because typical applications that can benefit from this function require this data for successful operation:

- SensorDistance
- SensorOffset
- ProductAwayDistance

Example 1:

Example of ProductBufferStruct being initialized for a linear flying shear application



(*Data for Registration based Linear Flying Shear*)

(*ProductBufferStruct for Registration Data *)

(*=====*)

Products.BufferSize := INT#20; (* Maximum size of buffer*)

Products.LockoutDistance := LREAL#9.0; (* Looks for a new part only after conveyor has traveled LockOutDistance after previous part*)

Products.SensorDistance := LREAL#14.075; (* Distance from sensor to start of slave 1 home position (beginning of cam profile) *)

Products.ProductAwayDistance := LREAL#20.075; (* Distance from sensor to end of sync position in the cam table.

This is used to update the use pointer. Cam disengages only when use pointer = store pointer *)

Products.Sensor.Bit:=UINT#1; (* Equates to EXT1 on a Sigma-5 amplifier, see MC_TouchProbe help for details *)

Example 2:

Example of ProductBufferStruct being initialized for a linear flying shear application where rising and falling edges of a product are being captured.

(*ProductBufferStruct for Registration Data *)

(*=====*)

Products.BufferSize := INT#20; (* Maximum size of Buffer*)

Products.LockoutDistance := LREAL#90.0; (* Looks for a new part only after conveyor has traveled LockOutDistance after previous part*)

Products.SensorDistance := LREAL#1580.0; (* Distance from sensor to start of slave 1 home position (beginning of cam profile) *)

Products.BufferPattern[0].Bit := UINT#1; (* PART SENSOR Signal - RISING EDGE connected to Latch DI_01*)

Products.BufferPattern[1].Bit := UINT#0; (* PART SENSOR Signal - FALLING EDGE Connected to PCL5 External Encoder Sensor...*)

Products.BufferPatternSize := INT#2;

Products.PatternAwayDistance[0] := LREAL#1730.0; (*Distance from Sensor*)

Products.PatternAwayDistance[1] := LREAL#1930.0; (*Distance from Sensor + Minimum Part Length =200mm*)



Data Type: SWERROR_STRUCT

Used by the [Y_DigitalCamSwitch](#) function block.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|--------------------|----------------|--|-------------------------------------|
| | MySWERROR_STRUCT | SWERROR_STRUCT | | |
| U | TrackNumber | INT | The last switch number where an invalid setting for TrackNumber occurred. | MySWERROR_STRUCT.TrackNumber |
| U | FirstOnPosition | INT | The last switch number where an invalid setting for FirstOnPosition occurred. | MySWERROR_STRUCT.FirstOnPosition |
| U | LastOnPosition | INT | The last switch number where an invalid setting for LastOnPosition occurred. | MySWERROR_STRUCT.LastOnPosition |
| U | AxisDirection | INT | The last switch number where an invalid setting for AxisDirection occurred. | MySWERROR_STRUCT.AxisDirection |
| U | CamSwitchMode | INT | The last switch number where an invalid setting for CamSwitchMode occurred. | MySWERROR_STRUCT.CamSwitchMode |
| U | Duration | INT | The last switch number where an invalid setting for Duration occurred. | MySWERROR_STRUCT.Duration |
| U | ImproperOnPosition | INT | The last switch number where an improper relationship between FirstOnPosition and LastOnPosition occurred. | MySWERROR_STRUCT.ImproperOnPosition |
| U | OnOffPositionError | INT | The last switch number where the OnCompensationScaler and/or OffCompensationScaler resulted in an improper relationship between the modified FirstOn and LastOn positions. | MySWERROR_STRUCT.OnOffPositionError |



Data Type: TRACK_ARRAY

Supporting structure for [TRACK_REF](#). Used by the [Y_DigitalCamSwitch](#) function block.

Data Type Declaration

TYPE

TRACK_ARRAY: ARRAY[0..31] OF [TRACK_STRUCT](#);

END_TYPE



Data Type: TRACK_REF

Used by the [Y_DigitalCamSwitch](#) function block.

Data Type Declaration

TYPE

TRACK_REF:STRUCT

Track:[TRACK_ARRAY](#);

END_STRUCT;

END_TYPE



Data Type: TRACK_STRUCT

Supporting structure for [TRACK_ARRAY](#). Used by the [Y_DigitalCamSwitch](#) function block.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|-----------------------|---------------------|--|--------------------------------------|
| | MyTRACK_STRUCT | TRACK_STRUCT | | |
| U | OnCompensationScaler | LREAL | Compensation for the FirstOnPosition of each switch on the track. Positive values advance, negative values retard. | MyTRACK_STRUCT.OnCompensationScaler |
| U | OffCompensationScaler | LREAL | SpeedCompensation for the LastOnPosition of each switch on the track. | MyTRACK_STRUCT.OffCompensationScaler |
| U | Value | BOOL | The resulting status of the track after evaluating and combining all switches that affect the track. | MyTRACK_STRUCT.Value |



Enumerated Types for PLCopen Toolbox

Some blocks accept an enumerated type (ENUM), which is a keyword (or constant) representing a value which will configure the operation of the function block. Enumerated types are equivalent to zero-based integers (INT). Therefore, the first value equates to zero, the second to 1, etc. The format for enumerated types is as follows: ENUM:(0, 1, 2...) as displayed in the example below (MC_BufferMode#Aborting).

Enumerated Types Declaration

| Enumerated Type | #INT Value | Enum Value | Description |
|-----------------|--|--------------------|--|
| TB_AxisType | Indicates the axis type for the ReadAxisParameters function block. | | |
| | 0 | Servo | |
| | 1 | VFD | |
| | 2 | Stepper | |
| | 3 | Virtual | |
| | 4 | External | |
| MC_Direction | 0 | Positive_Direction | In a rotary application, forces the axis to move in a positive direction. |
| | 1 | Shortest_Way | For use in applications where the Load Type is configured as a rotary or modularized axis. |
| | 2 | Negative_Direction | In a rotary application, forces the axis to move in a negative direction. |
| | 3 | Current_Direction | For use in applications where the Load Type is configured as a rotary or modularized axis. Only applies if an existing move is in progress and another function block such as MC_MoveAbsolute or MC_MoveRelative is executed. Once the axis is at StandStill, using MC_Direction_CurrentDirection will default to the positive direction |
| | | | |

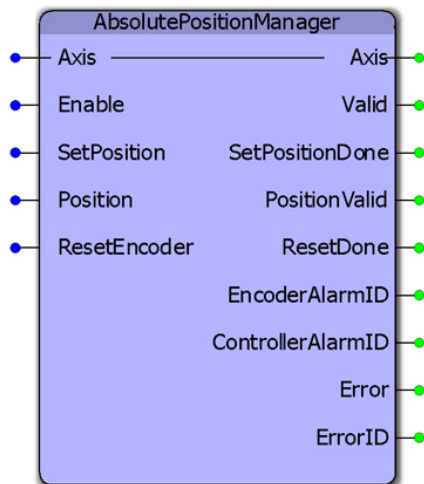
PLCopen FBs

Toolbox Help Documentation
Help version created 1/31/2018

YASKAWA



AbsolutePositionManager



This function monitors for any controller or servo alarm related to the absolute encoder or battery backed encoder offset data stored in the controller. It can serve as the single point of monitoring, clearing, and defining the position of an absolute encoder. This function includes a retained Boolean output variable that once set, requires that the alarm be cleared through this function, and that the position of the encoder is redefined. The intention is to prevent the machine from operating until the position of the absolute encoder has been calibrated to the machine coordinates.

This function includes the following PLCopen function blocks: MC_ReadAxisError, MC_ReadAlarm, MC_ResetAbsoluteEncoder, Y_ClearAlarm and MC_SetPosition.

Library

PLCopen Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|--------------------------|---|
| VAR_IN_OUT | | | |
| B | Axis | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. FALSE |

| | | | | |
|-------------------|-------------------|-------|--|-----------|
| V | SetPosition | BOOL | Value of the axis position to be set when homing is Done. | FALSE |
| V | Position | LREAL | A positive or negative value within the coordinate system in user units. | LREAL#0.0 |
| V | ResetEncoder | BOOL | Initiates the Y_ResetAbsoluteEncoder function to clear any absolute encoder related SERVOPACK alarm, including A.810 and A.CC0. | LREAL#0.0 |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| V | SetPositionDone | BOOL | Indicates that MC_SetPosition has successfully completed. | |
| V | PositionValid | BOOL | Indicates that the absolute encoder has no alarms, and the MC_SetPosition has been used at some point in the past to align the encoder with the mechanical system. | |
| V | ResetDone | BOOL | Indicates that the ResetEncoder request has completed successfully. | |
| V | EncoderAlarmID | UINT | ServoPack alarm related to the absolute encoder. | |
| V | ControllerAlarmID | UDINT | Controller alarm related to the SRAM or battery, which stores the absolute encoder offset. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

- This function block is not supported on the Sigma7-Siec because there is a Retain variable in the code which is not supported due to hardware limitations; there is no SRAM memory on the Sigma7-Siec.
- To clear the absolute encoder alarm from a ServoPack, the user must use the 'ResetEncoder' input, then reset the ServoPack by either cycling power the ServoPack or using the Y_ResetMechatrolink function block.
- Check the Hardware Configuration to ensure that the alarm format for Sigma III and higher drives is set for 3 digit alarm mode.
- See the [AbsolutePositionManager eLearning Module](#) on Yaskawa's YouTube channel.

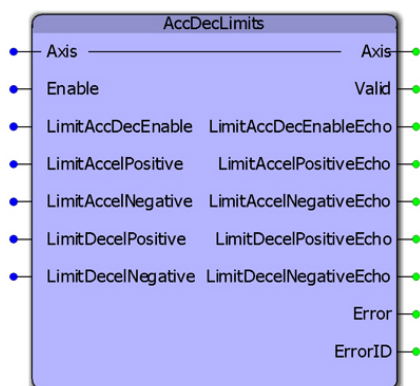
Error Description

| ErrorID | Meaning |
|----------------------|--|
| 4378 | The function block is not applicable for the external axis specified. |
| 4380 | MC_SetPosition cannot be executed while the axis is already moving. |
| 4382 | When an axis is configured for rotary mode, and the MC_SetPosition tries to set a position that is equal to or greater than the MachineCycle, this error is generated, and the position is not set. |
| 4390 | Position cannot be defined while the axis is in a master / slave relationship. To redefine the position, use the MC_Stop function block for slave axis, then execute MC_SetPosition. If attempting the redefine a master position, execute MC_Stop for all slaves first. |
| 4391 | The function block cannot be used with a virtual axis. |
| 4401 | The controller cannot communicate with the drive. It may be disconnected from the MECHATROLINK network. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |

| | |
|-----------------------|--|
| 4646 | Mode does not correspond to a valid enumeration value or the enumeration is not supported. |
| 45335 | Failed to initialize absolute encoder. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |



AccDecLimits



This function block manages the parameters associated with enabling/disabling the acceleration and deceleration limits. The limits can be enabled or disabled and the values of the limits can be input and verified at the output. The outputs are provided as an echo from the motion engine. This function allows for streaming of variable limits.

Library

PLCopen Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|--------------------|--------------------------|---|
| VAR_IN_OUT | | | |
| B | Axis | AXIS REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| VAR_INPUT | | | |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | LimitAccDecEnable | BOOL | Enables or Disables the Limit Accel Decel function. Parameter 1222 and 1232 are combined |
| V | LimitAccelPositive | LREAL | Parameter 1221 |
| V | LimitAccelNegative | LREAL | Parameter 1220 |
| V | LimitDecelPositive | LREAL | Parameter 1231 |
| V | LimitDecelNegative | LREAL | Parameter 1230 |
| VAR_OUTPUT | | | |
| | Valid | BOOL | Output indicating if the limits are valid. |
| | Error | BOOL | Output indicating if an error has occurred. |
| | ErrorID | UINT | Output indicating the error ID. |

| | | | |
|---|------------------------|-------|---|
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| V | LimitAccDecEnableEcho | BOOL | Echo of Parameter 1222 ANDed with 1232 |
| V | LimitAccelPositiveEcho | LREAL | Echo of parameter 1221 echoed from motion engine |
| V | LimitAccelNegativeEcho | LREAL | Echo of parameter 1220 echoed from motion engine |
| V | LimitDecelPositiveEcho | LREAL | Echo of parameter 1231 echoed from motion engine |
| V | LimitDecelNegativeEcho | LREAL | Echo of parameter 1230 echoed from motion engine |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

The function block uses MC_ReadBoolParameter, MC_WriteBoolParameter, MC_ReadParameter, and MC_WriteParameter.

Hardware Configuration



Always Loaded at power up

Application Program



Changing Accel / Decel limit values via MC_WriteParameter at run time will supersede the values stored in the Hardware Configuration, but the Hardware Configuration values will be reloaded at power up.

LimitAccelEnable [1222]
LimitAccelPositive [1221]
LimitAccelNegative [1220]

LimitDecelEnable [1232]
LimitDecelPositive [1231]
LimitDecelNegative [1230]



LimitAccelEnable [1222] Closed = TRUE

LimitDecelEnable [1232] Closed = TRUE

LimitAccelPositive [1221]

LimitDecelPositive [1231]

LimitDecelNegative [1230]

LimitAccelNegative [1220]

Commanded Speed

Accel / Decel Limits

- The software acceleration & deceleration limits are managed in the MPlc controller.
- When an acceleration or deceleration limit is exceeded, a controller alarm will be generated, obtainable via the MC_ReadAxisError function block, or the web server.

- The controller alarm will be 16#3202 0005 if the positive position limit is exceeded and 16#3202 0006 if the negative position limit is exceeded.

Acceleration Limits

- Acceleration is defined as increasing velocity away from zero.
- The parameters are called LimitAccelPositive and LimitAccelNegative, with values of UINT#1221 and UINT#1220 respectively. Use the MC_WriteParameter function block for these and all controller side parameters. Acceleration limit parameters are in user units / sec².
- To disable the acceleration limit, set LimitAccelEnable, parameter 1222 to zero.

Deceleration Limits

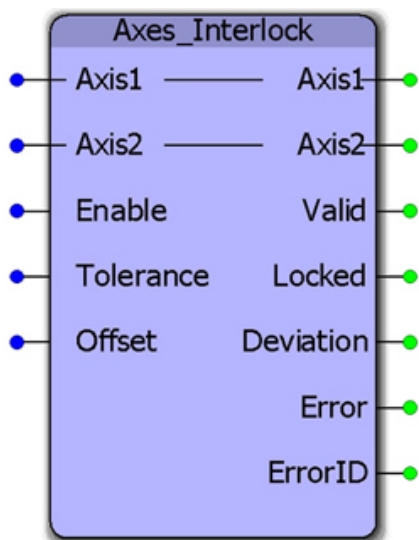
- Deceleration is defined by decreasing velocity towards zero.
- The parameters are called LimitDecelPositive and LimitDecelNegative, with values of UINT#1231 and UINT#1230 respectively. Use the MC_WriteParameter function block for these and all controller side parameters. Deceleration limit parameters are in user units / sec².
- To disable the deceleration limit, set LimitDecelEnable, parameter 1232 to zero.

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4648 | The parameter number does not exist for the specified axis - OR The parameter number requires the other function block (e.g. MC_WriteParameter vs MC_WriteBoolParameter) |
| 10030 | Positive Acceleration Limit must be greater than 0. |
| 10031 | Negative Acceleration Limit must be less than 0. |
| 10032 | Positive Deceleration Limit must be greater than 0. |
| 10033 | Negative Deceleration Limit must be less than 0. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |



Axes_Interlock



This function block checks MC_ReadAxisError and the actual position of both axes to verify that they are both free of alarms and within the position tolerance specified. It is intended for use with axes that operate on the same mechanical load and must remain within tolerance to avoid equipment damage, such as an X, X Prime gantry system. The Locked output will be high to indicate that the axes are synchronized and free of errors.

Support for axes configured in rotary mode requires controller firmware 1.2.3 and PLCopen Toolbox v021.

Library

PLCopen Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|--------------------------|---|
| VAR_IN_OUT | | | |
| B | Axis1 | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| B | Axis2 | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute while enable is held high. FALSE |

| | | | | |
|-------------------|-----------|-------|--|-----------|
| V | Tolerance | LREAL | The allowable position difference between the two axes in user units. | LREAL#0.0 |
| V | Offset | LREAL | Offset between the two axes. This value will be considered when comparing the positions | LREAL#0.0 |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the outputs of the function are valid. | |
| V | Locked | BOOL | Indicates TRUE if neither axis has an alarm and the position deviation is less than the specified tolerance. | |
| V | Deviation | BOOL | The amount of positional difference between the two axes. | |
| B | Error | BOOL | Set high if error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

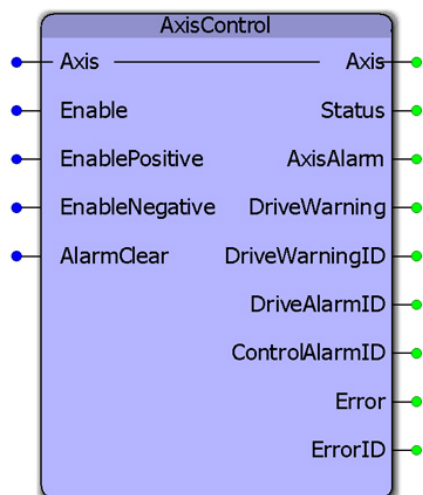
- It is assumed that the axes have the same user units because they are operating the same load.
- See the [AxesInterlock eLearning Module](#) on Yaskawa's YouTube channel.

Error Description

| ErrorID | Meaning |
|-----------------------|---|
| 0 | No error |
| 4378 | The function block is not applicable for the external axis specified |
| 4625 | Axis ID does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. Troubleshooting info on our Youtube channel. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties?" to determine which parameters are ANY type. |



AxisControl



This function block combines MC_Power, MC_ReadAxisError, and MC_Reset and provides separate outputs for controller and drive alarms and warnings.

Library

PLCopen Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|----------------|--------------------------|---|
| VAR_IN_OUT | | | |
| B | Axis | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| E | EnablePositive | BOOL | Not Supported |
| E | EnableNegative | BOOL | Not Supported |
| V | AlarmClear | BOOL | Clears axis related alarms using MC_Reset. |

| VAR_OUTPUT | | | |
|------------|-------------------|-------|--|
| B | Status | BOOL | TRUE if the drive is enabled. This output is derived from the Status output of MC_Power. |
| V | AxisAlarm | BOOL | Indicates if there is an axis specific alarm on either the controller or drive. |
| V | DriveWarning | BOOL | Indicates a warning on the drive, such as any A.9x display on a ServoPack. |
| V | DriveWarningID | UINT | Indicates the drive warning number, such as 95 (overload warning). Refer to the drive manual for troubleshooting. |
| V | DriveAlarmID | UINT | Indicates the drive alarm number, such as C9 (encoder disconnected). Refer to the drive manual for troubleshooting. |
| V | ControllerAlarmID | UDINT | Indicates the controller alarm ID number, such as 3302 0018. (shown in hex.) Refer to the Controller AlarmID list in the PLCopenPlus manual for troubleshooting. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

- When attempting to clear an alarm, the enable input must be FALSE or the alarm reset function will be blocked from executing.
- We recommend viewing the alarm and warning output ID's in Hex, because all Yaskawa ServoPack documentation lists the amplifier alarm codes in Hex. This simplifies alarm identification. Note that MotionWorks IEC may show the value at the output in decimal. For example, a DriveAlarmID of 2064 converted to hex is 810, which is the ServoPack alarm for the absolute encoder. "A81" will be displayed on the front of the ServoPack.
- This function only reports axis specific alarms and warnings. For general system alarms, use the Y_ReadAlarms function block from the PLCopenPlus firmware library.

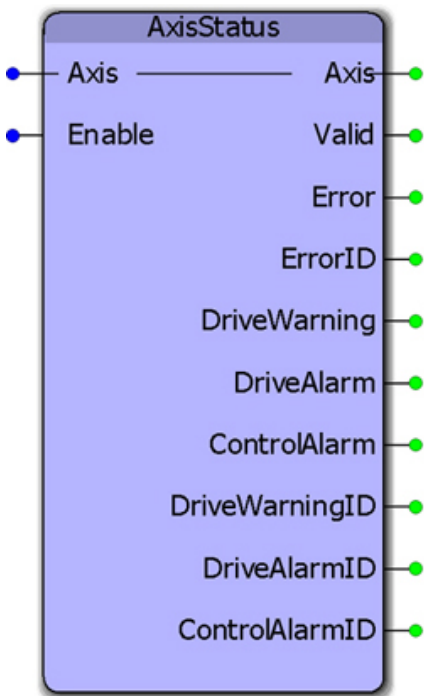
Error Description

| ErrorID | Meaning |
|----------------------|--|
| 0 | No error. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4371 | The servo drive failed to enable or disable. Check the amplifier wiring for L1 / L2 / L3. The amplifier could be e-stopped or has an alarm. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4399 | The L1 / L2 / L3 power inputs on the drive may not be supplied with power, possibly due to an E-Stop condition. |
| 4400 | The safety input (HBB on the CN8 connector) is preventing the drive from enabling. |
| 4414 | MECHATROLINK communications to the drive was disrupted. Execute MC_Reset to restore the connection. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |

| | |
|-----------------------|--|
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 4894 | The specified virtual axis may not be used with this function block. |
| 45332 | Sending clear alarms command to servo drive failed. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |
| 61713 | This function block caused an internal error. Possible causes: MC_Power – Check if multiple instances of this block are executed for the same axis. Y_CamIn - Check in the cam table if the master values are the same for two datapoints or decreasing. Y_CamStructSelect – Y_MS_CAM_TABLE.Header.DataSize must not be zero. |



AxisStatus



This function block uses MC_ReadAxisError to provide further breakdown of the ErrorClass and AxisErrorID by providing BOOL and UINT outputs for the drive faults, and a DINT value for the controller alarm which is consistent with the 32 bit controller alarm reporting in the web server. This function was created for use inside the AxisControl function block in the PLCopen Toolbox. This function's outputs are available at the output of the AxisControl function block.

Library

PLCopen Toolbox

Parameters

| * | Parameter | Data Type | Description |
|------------|-----------|--------------------------|---|
| VAR_IN_OUT | | | |
| B | Axis | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| VAR_INPUT | | | Default |

| | | | | |
|-------------------|-------------------|-------|--|-------|
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. | FALSE |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| V | DriveWarning | BOOL | Indicates a warning on the drive, such as any A.9x display on a ServoPack. | |
| V | DriveAlarm | BOOL | Indicates an alarm on the drive, such as A.71, overload. Refer to the appropriate drive manual for troubleshooting. | |
| V | ControllerAlarm | BOOL | Indicates a controller side axis alarm. | |
| V | DriveWarningID | UINT | Indicates the drive warning number, such as 95 (overload warning). Refer to the drive manual for troubleshooting. | |
| V | DriveAlarmID | UINT | Indicates the drive alarm number, such as C9 (encoder disconnected). Refer to the drive manual for troubleshooting. | |
| V | ControllerAlarmID | UDINT | Indicates the controller alarm ID number, such as 3302 0018. (shown in hex.) Refer to the Controller AlarmID list in the PLCopenPlus manual for troubleshooting. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

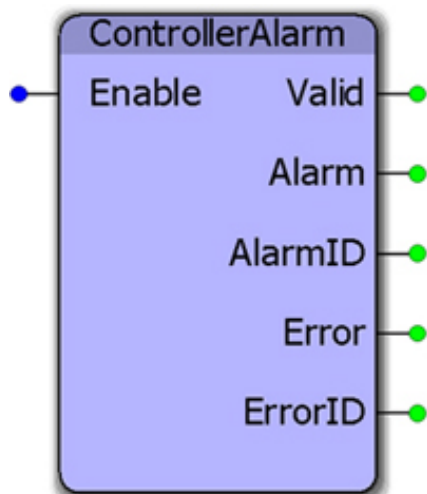
To simplify alarm identification, Yaskawa recommends viewing the alarm and warning output ID's in Hex, because all Yaskawa ServoPack documentation lists the amplifier alarm codes in Hex. Use the Debug Dialog menu in MotionWorks IEC to change the debug value display type. The controller alarm list in the webserver and in the PLCopenPlus help manual show the controller alarms in hex also.

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |



ControllerAlarm



This function block provides a BOOL output to indicate if there is a controller alarm not related to an axis. It uses the Y_ReadAlarm function block and determines if the AlarmID output is non-zero. This function is useful because the PLCopenPlus function Y_ReadAlarm does not have a Boolean output, just the AlarmID.

Library

PLCopen Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|-----------|--|
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| VAR_OUTPUT | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| V | Alarm | BOOL | Indicates if the controller has a non-axis related alarm. |
| V | AlarmID | UDINT | This output provides the Controller Alarm ID. This output is reset when execute goes low. |

| | | | |
|---|---------|------|---|
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

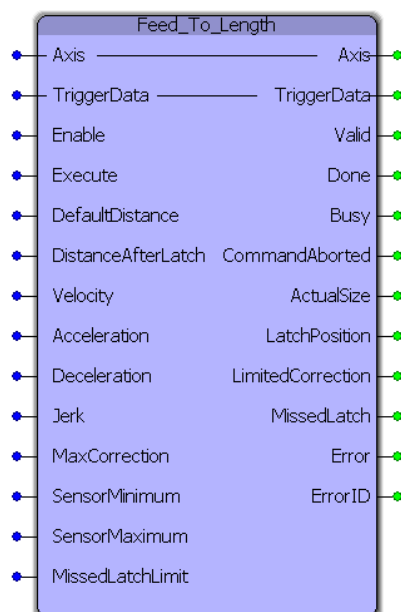
It is best to view the AlarmID in hex because the Controller AlarmID list in the PLCopenPlus manual displays all alarm codes in hex. This simplifies alarm category identification.

Error Description

| ErrorID | Meaning |
|----------------------|--|
| 0 | No error. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POUs. |



Feed_To_Length



FeedToLength was designed for use with applications that index forward in one direction, and require on the fly adjustments of the actual index length based on a sensor input that occurs while the axis is moving. This block is a hybrid function block, meaning it use both types of PLCopen behaviors: Enable and Execute. The reason for this is so the function can monitor for consecutive latches and flag an Error for that condition. The Enable input allows this feature to operate. The Execute input initiates each move.

Library

PLCopen Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-------------|-----------------------------|---|
| VAR_IN_OUT | | | |
| B | Axis | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| V | TriggerData | TRIGGER_REF | Reference to the trigger signal source. |
| VAR_INPUT | | | Default |

| | | | | |
|-------------------|--------------------|-------|--|-----------|
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. | FALSE |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. | FALSE |
| V | DefaultDistance | LREAL | The default product length. This is the distance the axis will travel if a registration mark is not detected. | LREAL#0.0 |
| V | DistanceAfterLatch | LREAL | The desired additional travel distance after the registration mark is detected | LREAL#0.0 |
| B | Velocity | LREAL | Absolute value of the velocity in user units/second. | LREAL#0.0 |
| B | Acceleration | LREAL | Value of the acceleration in user units/second ² (acceleration is applicable with same sign of torque and velocity) | LREAL#0.0 |
| B | Deceleration | LREAL | Value of the deceleration in user units/second ² (deceleration is applicable with opposite signs of torque and velocity.) | LREAL#0.0 |
| E | Jerk | LREAL | <i>Not supported; reserved for future use. Value of the jerk in [user units / second³].</i> | LREAL#0.0 |
| V | MaxCorrection | LREAL | Limits the amount of correction that can be applied. This prevents the machine from trying to make correction that is too large to occur and still make a good product. This is the most amount of change to the DefaultDistance that will be made to any one product index. | LREAL#0.0 |
| V | SensorMinimum | LREAL | The earliest slave position where a sensor position is valid for correction. | LREAL#0.0 |
| V | SensorMaximum | LREAL | The latest slave position where a sensor position is valid for correction. | LREAL#0.0 |
| V | MissedLatchLimit | UINT | The number of consecutive DefaultDistances allowed to occur without seeing a registration mark in the window, and not cause an Error. Valid registration marks will reset the internal counter. | UINT#0 |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. | |
| V | ActualSize | LREAL | The actual indexed distance. | |
| V | LatchPosition | LREAL | The slave's position in the CamTable when the latch occurred. | |
| V | LimitedCorrection | BOOL | Indicates that the MaxCorrection is limiting the required correction. | |
| V | MissedLatch | BOOL | Flag which indicates that the controller did not find a valid registration mark within the SensorMinimum and SensorMaximum positions. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

- This function block is designed to use a high speed registration sensor wired into the ServoPack's latch input hardware. Use the [TRIGGER_REF](#) input to specify the input on the amplifier where the sensor is wired (EXT1, EXT2, or EXT3.) The sensor must be wired to one of these inputs for this function block.

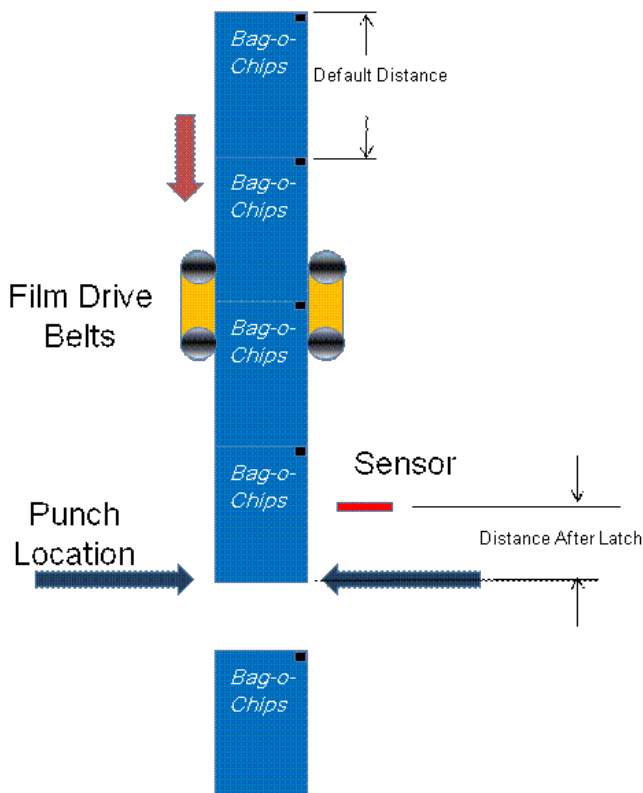
Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4391 | The function block cannot be used with a virtual axis. |
| 4396 | Axis latch function already in use. |
| 4402 | The scan compensation delay parameter 1305 is only valid for external encoders. |
| 4403 | The High Speed Output functionality is only available on external encoders. |
| 4406 | Continuous Latch Mode is not supported on Sigma II, Sigma III, or external encoders. |
| 4624 | RESERVED - General structure value error. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4630 | Trigger reference is not valid. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4642 | Direction does not correspond to a valid enumeration value. |
| 4648 | The parameter number does not exist for the specified axis - OR The parameter number requires the other function block (e.g. MC_WriteParameter vs MC_WriteBoolParameter) |
| 4658 | Velocity parameter is less than or equal to zero. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 4676 | The time value must be within 0 to 10 MECHATROLINK cycles. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 4894 | The specified virtual axis may not be used with this function block. |
| 10020 | ProductSize cannot be less than or equal to zero. |
| 10021 | Maximum allowed consecutive missed registration marks reached. |
| 10025 | SensorMinimum must be less than SensorMaximum. |
| 10036 | Latch Error. LatchReference was negative. This situation should never occur. Verify that the normal axis movement is in a positive direction. Use PLCopen Toolbox v340 which contains improved code for applications with registration marks near the end of the default move. DCR 1183 |

| | |
|-------|--|
| 57617 | Instance object is NULL. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |

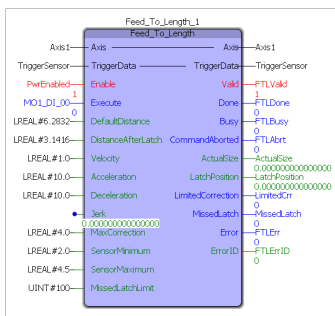
Example

Consider a case where the default distance between successive products is 6.2832 units. Let the distance between the sensor (wired to the high speed registration input) and the target position where the product will be processed be 3.1416 units. DistanceAfterLatch = 3.1416.

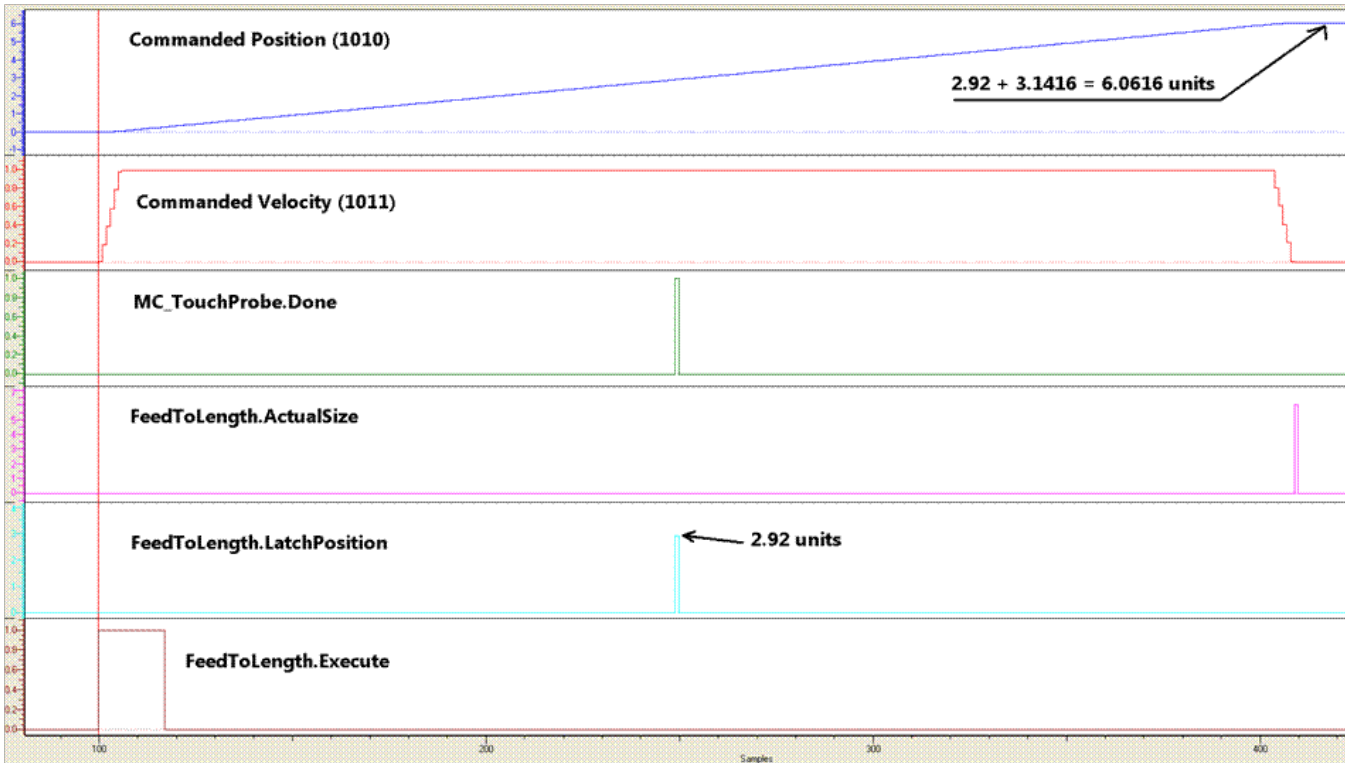


MaxCorrection limits the correction if an erroneous registration mark is captured and the calculation results in a large correction distance.

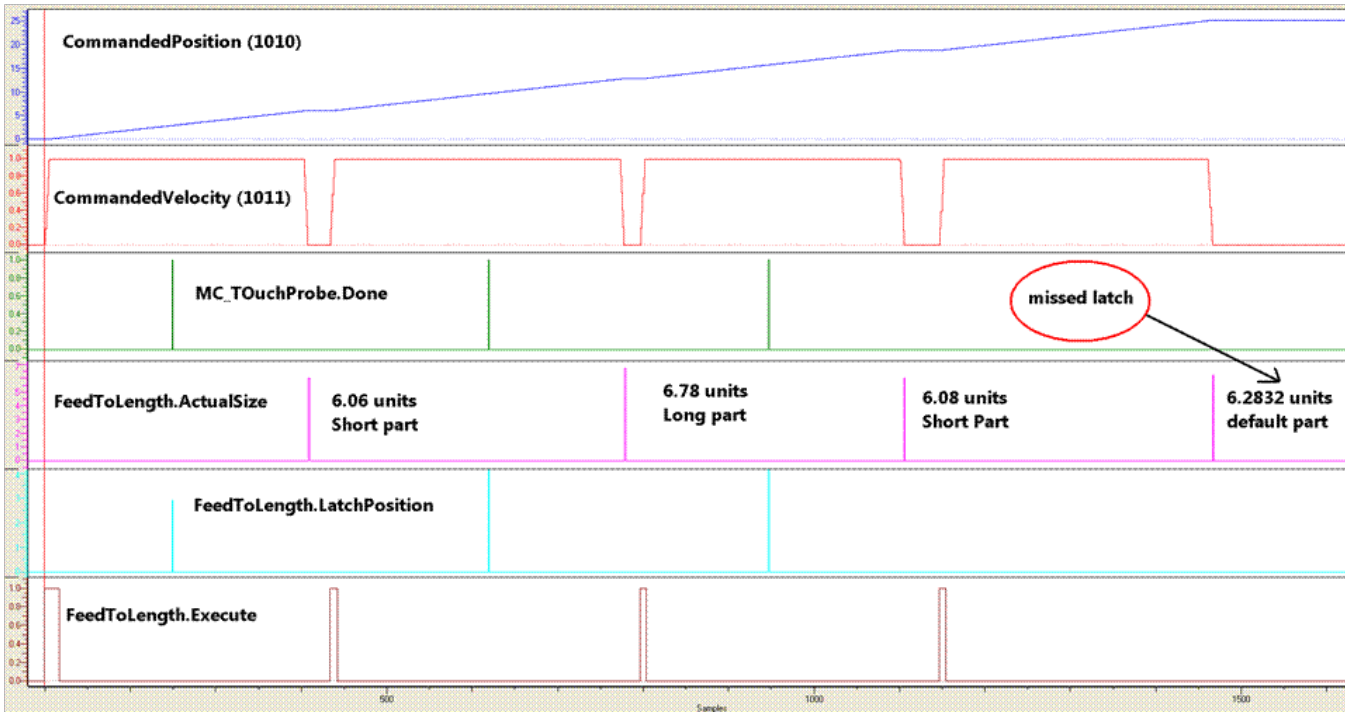
SensorMinimum and SensorMaximum provide window in which a registration mark must be detected to be considered a valid registration mark. In this example, the mark is expected around 3.1416 units, and only marks detected between 2.0 to 4.5 are accepted. Set the window as small as appropriate for the application.



The Feed_To_Length function block will position the axis exactly 3.1416 units (DistanceAfterLatch) after the registration mark was detected.

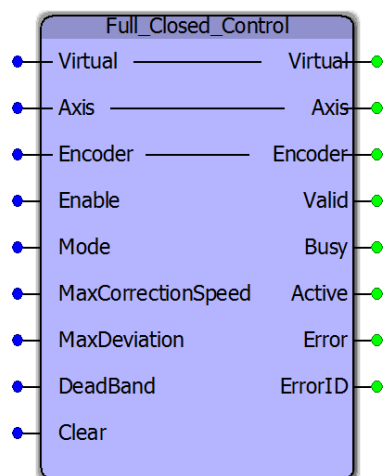


The Feed_To_Length function block will position the axis exactly 3.1416 units (DistanceAfterLatch) after the registration mark is detected for varying product lengths.





Full_Closed_Control



This function block uses an external encoder position to provide improved positioning for machines that have loose mechanics or applications that must account for material slippage. This function block is very useful for MP2600iec applications which cannot take advantage of the FC100 option card. Other features include the ability to switch from full closed to normal motor encoder feedback, which is useful for applications where the external encoder is tracking a product which may not be present at all times.

Library

PLCopen Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|--------------------------|---|
| VAR_IN_OUT | | | |
| V | Virtual | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| B | Axis | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| V | Encoder | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |

| | | | | |
|-------------------|--------------------|-------|---|-----------|
| V | Mode | BOOL | This turns on and off full closed loop operation. Set FALSE to select Full closed operation, set TRUE to disable Full Closed operation. | FALSE |
| V | MaxCorrectionSpeed | LREAL | Limit the Maximum correction applied to prevent overshoot and instability. Set this value in user units/sec. It applies only to the correction portion of the command. For example, if the virtual axis is commanded to operate at a velocity of 2000 user units/sec and the MaximumCorrectionSpeed is set to 250 user units/sec, the axis may achieve a velocity of 2250 user units / sec. | LREAL#0.0 |
| V | MaxDeviation | LREAL | If the absolute difference between the axis position and the full closed encoder position exceeds MaxDeviation, the function block will report Error and stop operating the axis. Set this value in user units. | LREAL#0.0 |
| V | DeadBand | LREAL | When the absolute difference between the axis and the full closed encoder is less than this amount, no correction will be applied. Set this value in user units. | LREAL#0.0 |
| V | Clear | BOOL | Resets the internal measurement of the difference between the motor encoder and the full closed encoder. | FALSE |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |
| B | Active | BOOL | For buffered modes, this output is set high at the moment the block takes control of the axis. For non buffered modes, the outputs Busy and Active have the same value. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

- The Yaskawa Toolbox v300 or higher is required when using the Full_Closed_Control function block. The Yaskawa Toolbox must be included and placed above PLCOpen Toolbox in the Libraries folder of your MotionWorks IEC project.
- For the best performance, this function block must be executed in a task running at the same interval as the Mechatrolink (or MP2600iec DP ram) update rate. Ideally, the function is executed in a task at 4 mSec or faster.
- The user application must pre-set the position of the Virtual axis and the Encoder axis before enabling this function. The two positions must be less than MaxDeviation, or an Error will be generated immediately.
- For applications where the full closed encoder is in contact with product fed into the machine and may experience slip due to feed roll pressure, etc. the Clear input can be used in conjunction with the cycle of the machine, or each index motion. For example, if up to 1 mm of slip is known to occur normally while indexing 25 cm, set the MaxDeviation input to 2 or 3 mm, and trigger the Clear input after each index is finished. This will allow the function to monitor for excessive slippage and generate an error only if it exceeds 2 mm during a single index, but will allow for much more deviation to accumulate over long periods of operation.
- Mode can be set TRUE for situations when the material monitored by the full closed encoder is not in contact with the full closed encoder. This may be when the machine is being set up, or a jam is being cleared. The Full_Closed_Control function block can operate the motor using the motor encoder alone. If during the time that Mode=TRUE the MaxDeviation is exceeded, it will not cause an Error, however, when Mode is again set to FALSE, the difference between the Virtual axis and the Encoder must be within MaxDeviation, or an Error will be generated. The application program must

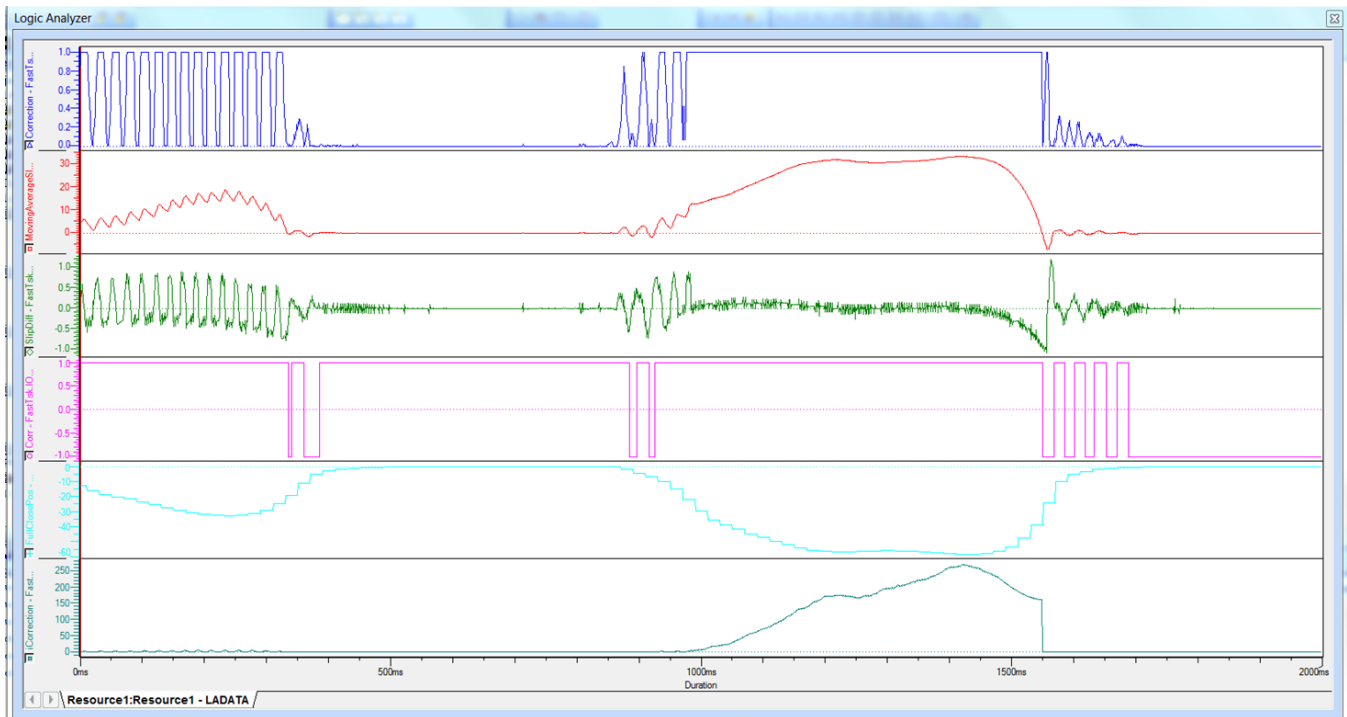
set the two positions accordingly. It may be necessary to disable this function block and re-Enable it after using the Mode which doesn't close the position around the Encoder.

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4380 | MC_SetPosition cannot be executed while the axis is already moving. |
| 4382 | When an axis is configured for rotary mode, and the MC_SetPosition tries to set a position that is equal to or greater than the MachineCycle, this error is generated, and the position is not set. |
| 4390 | Position cannot be defined while the axis is in a master / slave relationship. To redefine the position, use the MC_Stop function block for slave axis, then execute MC_SetPosition. If attempting the redefine a master position, execute MC_Stop for all slaves first. |
| 4392 | The function block can not be used with an inverter axis. |
| 4402 | The scan compensation delay parameter 1305 is only valid for external encoders. |
| 4403 | The High Speed Output functionality is only available on external encoders. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4646 | Mode does not correspond to a valid enumeration value or the enumeration is not supported. |
| 4648 | The parameter number does not exist for the specified axis - OR The parameter number requires the other function block (e.g. MC_WriteParameter vs MC_WriteBoolParameter) |
| 4676 | The time value must be within 0 to 10 MECHATROLINK cycles. |
| 10170 | Position Error between Axis Position and Encoder Position is more than Max Deviation. Increase Max Deviation, or set position to limit position error. |
| 57617 | Instance object is NULL. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |
| 57873 | InvalidStructureSize. The structure size does not match. Check all the variables connected to the function block. A common mistake is to connect a structure element, not the entire structure. Example: EngageData.StartMode is connected instead of just EngageData |
| 57874 | Argument data is NULL. The EngageData input must be connected. |

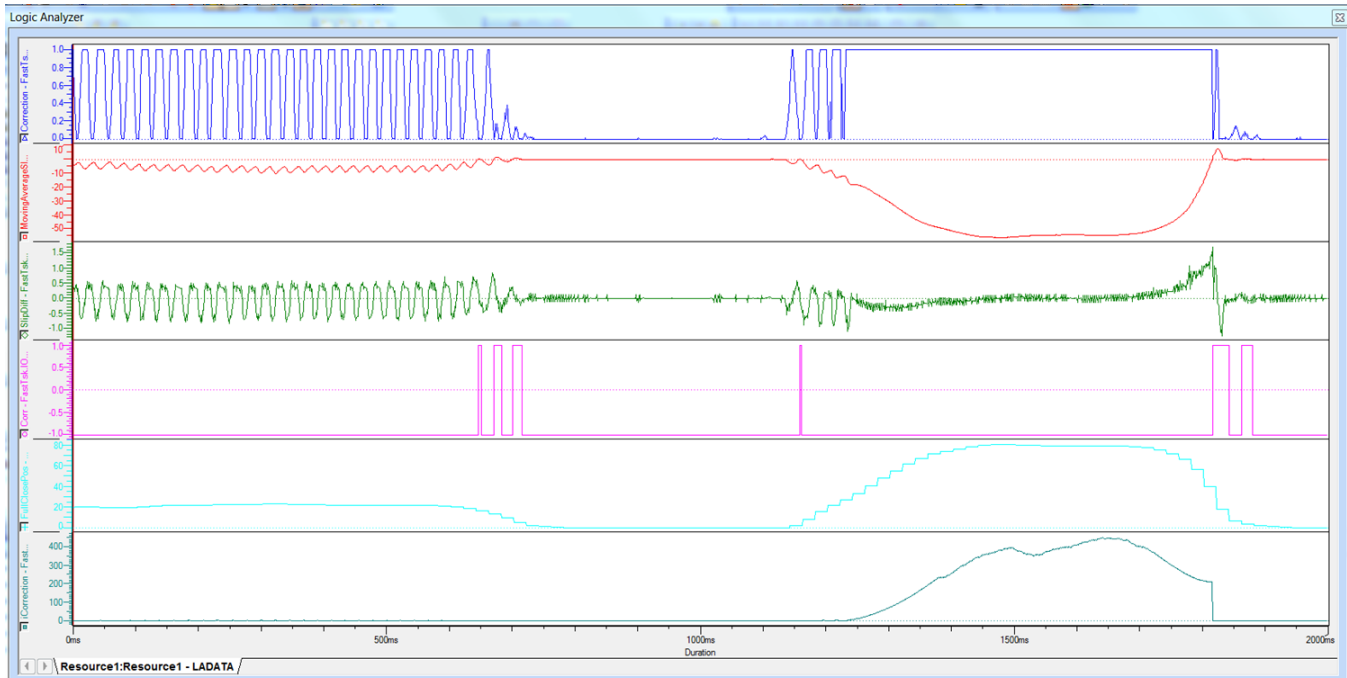
Example 1

In this example, the Logic Analyzer is showing when positive slip happens, correction is added to the Axis and how the moving average slip changes during the correction.



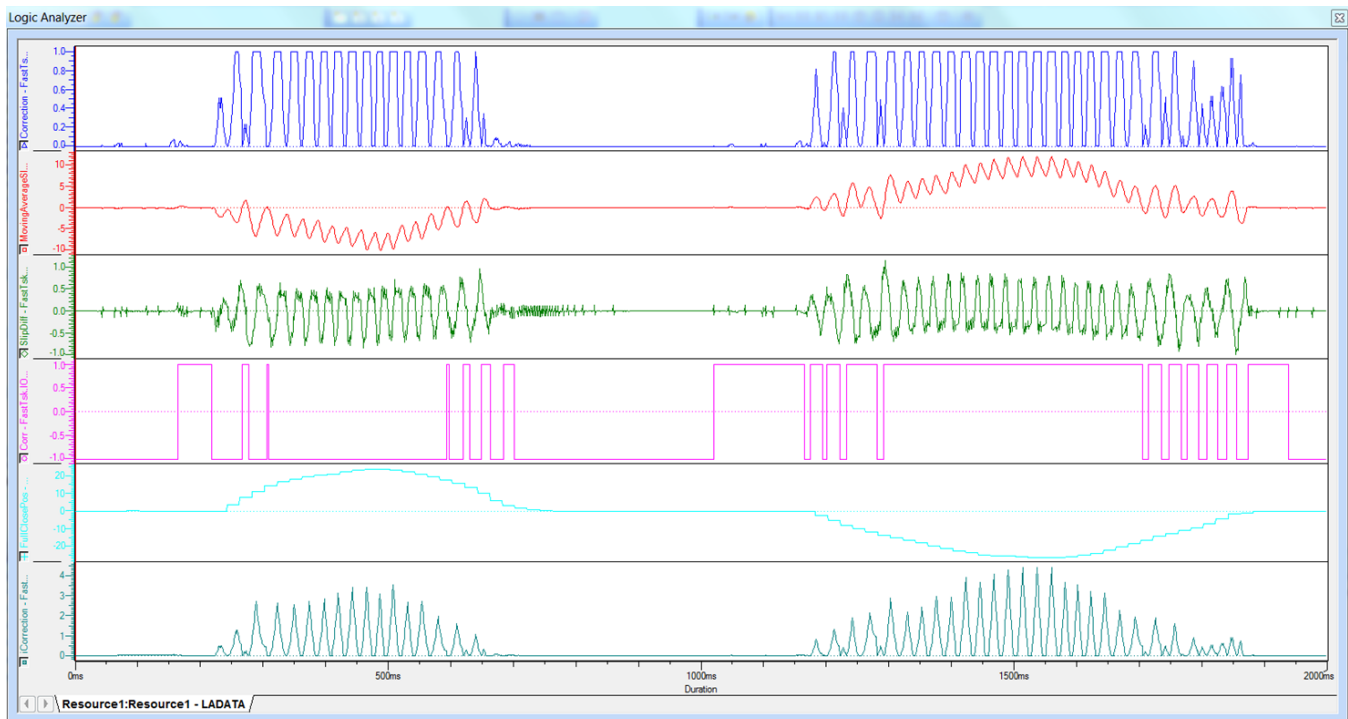
Example 2

In this example, the Logic Analyzer shows negative slip, and the correction added to Axis.



Example 3

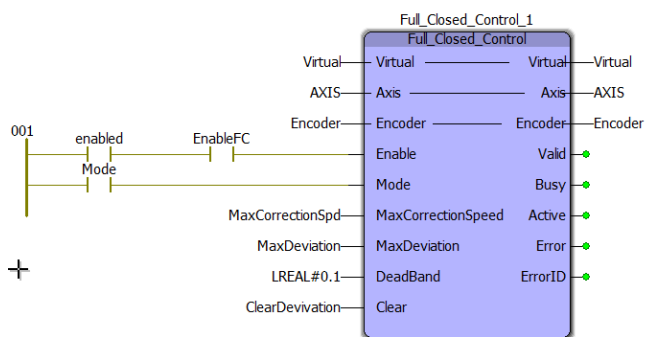
In this example, the Logic Analyzer shows both positive and negative slip.



Example 4

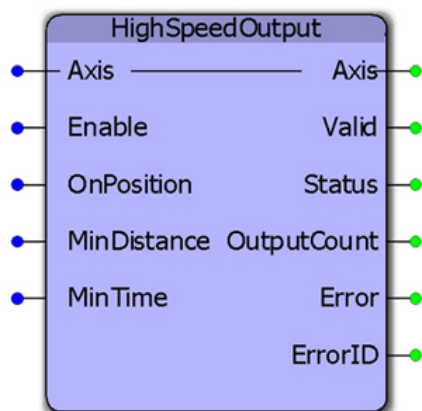
When Mode is ON, full closed loop function is disabled.

When Mode is OFF, full closed loop function operates.





HighSpeedOutput



This function block combines several of the parameters for use with the High Speed Output function available on the LIO-01, LIO-02, LIO-06, and MP2600iec. It allows changing the "OnPosition" value on the fly. While the "OnPosition" will be triggered at the hardware level with a response time of 13us, the output will be turned off when either the MinDistance has been travelled or the MinTime has elapsed, which will be based on the application scan in which this function is operating.

Library

PLCopen Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-------------|--------------------------|---|
| VAR_IN_OUT | | | |
| B | Axis | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. FALSE |
| V | OnPosition | LREAL | Position at which output must turn on. LREAL#0.0 |
| V | MinDistance | LREAL | Minimum distance that must occur before the output turns off. LREAL#0.0 |
| V | MinTime | TIME | Minimum time that must elapse before the output must turn off. T#0s |
| VAR_OUTPUT | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| V | Status | BOOL | Indicates the status of the hardware. |

| | | | |
|---|-------------|-------|---|
| V | OutputCount | UDINT | Indicates the number of times the output turned on. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

High Speed Output Quick Reference

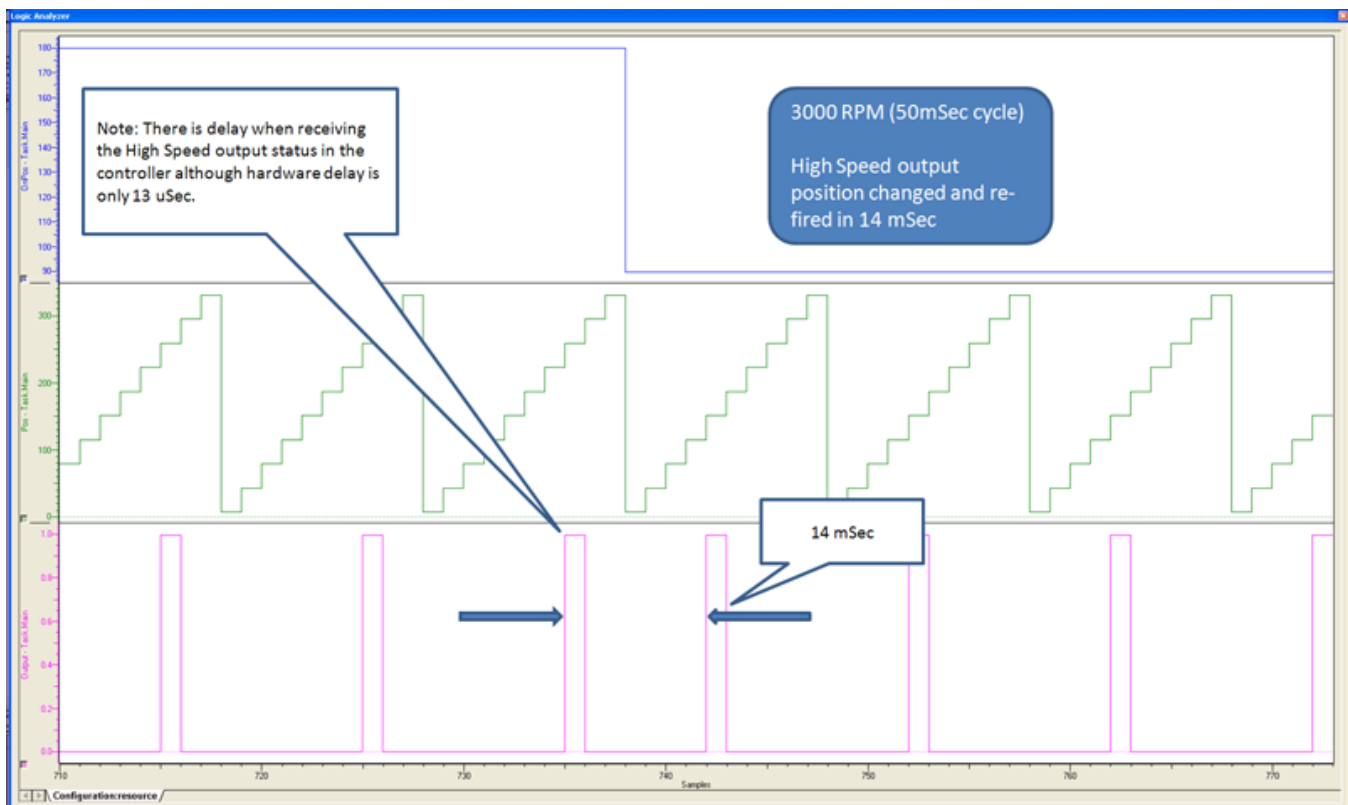
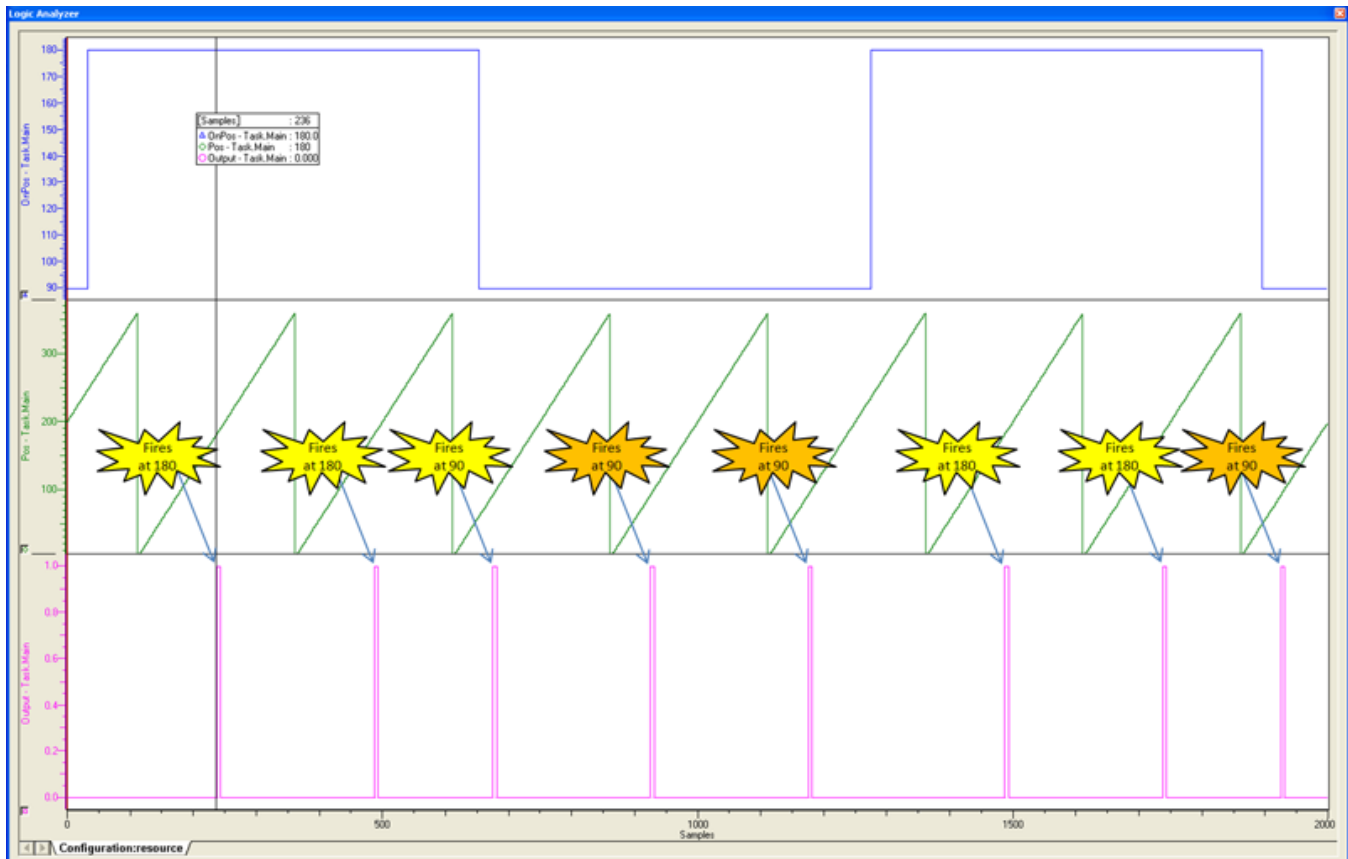
| Device | Output Number | Pin Number | Software Default Name |
|--------|---------------|------------|-----------------------|
| LIO-01 | DO-01 | A14 | Mpp_DO_01 |
| LIO-02 | DO-01 | A14 | Mpp_DO_01 |
| LIO-06 | DO-07 | 49 | Mpp_DO_07 |
| MP2600 | DO-07 | 44, 49 | MO1_DO_01 |

- See the [HighSpeedOutput eLearning Module](#) on Yaskawa's YouTube channel.

Error Description

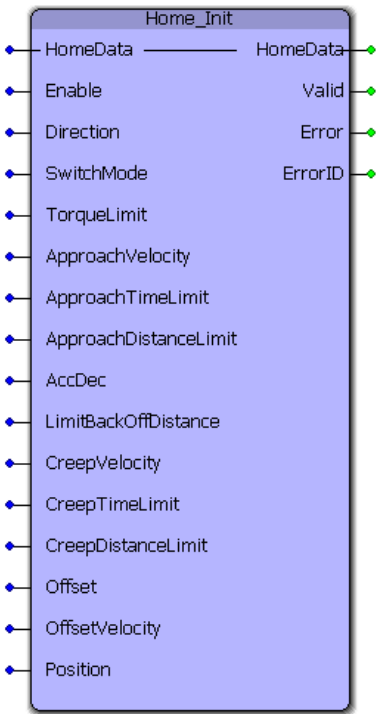
| ErrorID | Meaning |
|----------------------|---|
| 0 | No error. |
| 4401 | The controller cannot communicate with the drive. It may be disconnected from the MECHATROLINK network. |
| 4402 | The scan compensation delay parameter 1305 is only valid for external encoders. |
| 4403 | The High Speed Output functionality is only available on external encoders. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |

Timing Diagram





Home_Init



This function block provides a method to initialize the HomeStruct data for use with all HOME_** function blocks. It is useful for programmers who prefer to avoid structured text for initializing HomeStruct values.

Library

PLCopen Toolbox

Parameters

| * | Parameter | Data Type | Description |
|------------|-----------|----------------------------|---|
| VAR_IN_OUT | | | |
| V | HomeData | HomeStruct | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| VAR_INPUT | | | Default |

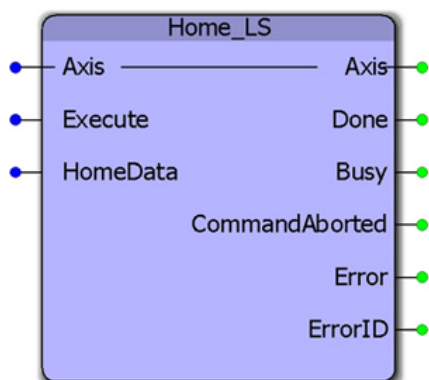
| | | | | |
|-------------------|-----------------------|-------------------------------|--|-----------|
| B | Enable | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. | FALSE |
| B | Direction | MC_Direction | Direction of travel for homing. | |
| B | SwitchMode | MC_SwitchMode | Edge On is the only mode supported. | |
| B | TorqueLimit | LREAL | Torque limit while attempting homing. In percentage of rated torque of the servo. | LREAL#0.0 |
| V | ApproachVelocity | LREAL | Velocity used to approach limit switch or c channel. | LREAL#0.0 |
| V | ApproachTimeLimit | LREAL | Time limit for the homing attempt in seconds . | LREAL#0.0 |
| V | ApproachDistanceLimit | LREAL | Distance limit for the homing attempt. | LREAL#0.0 |
| V | AccDec | LREAL | Acceleration/deceleration for offset moves. | LREAL#0.0 |
| V | LimitBackOffDistance | LREAL | Distance limit for back off move after a limit switch is encountered. | LREAL#0.0 |
| V | CreepVelocity | LREAL | Velocity to creep to theC channel. | LREAL#0.0 |
| V | CreepTimeLimit | LREAL | Time limit for the creep attempt in seconds . | LREAL#0.0 |
| V | CreepDistanceLimit | LREAL | Distance limit for the creep attempt | LREAL#0.0 |
| V | Offset | LREAL | Offset distance to move after the limit switch or C channel. | LREAL#0.0 |
| V | OffsetVelocity | LREAL | Velocity of the offset move after the limit switch or C channel. | LREAL#0.0 |
| B | Position | LREAL | Position to be defined as the home position. | LREAL#0.0 |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Error Description

No Errors will be generated.



Home_LS



This function block combines the PLCopen function blocks MC_StepLimitSwitch, MC_MoveRelative, and MC_SetPosition to make a sequence that detects the limit switch, performs an offset move away from the limit, and sets a home position.

Library

PLCopen Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|----------------------------|--|
| VAR_IN_OUT | | | |
| B | Axis | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| V | HomeData | HomeStruct | User defined Data Type in the PLCopen Toolbox, contains all related homing parameters. |
| VAR_OUTPUT | | | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |

| | | | |
|---|----------------|------|--|
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

- This function is intended to operate only with a ServoPack's POT or NOT signal detection. HomeData.SwitchMode only supports "EdgeOn." Configure the ServoPack Pn 50A and 50B appropriately.

Error Description

| ErrorID | Meaning |
|----------------------|--|
| 0 | No error. |
| 1 | Time limit exceeded. |
| 2 | Distance limit exceeded. |
| 3 | Torque limit exceeded. |
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4379 | A homing sequence is already in progress. |
| 4380 | MC_SetPosition cannot be executed while the axis is already moving. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4382 | When an axis is configured for rotary mode, and the MC_SetPosition tries to set a position that is equal to or greater than the MachineCycle, this error is generated, and the position is not set. |
| 4383 | Axis must be commanded at standstill when homing is attempted. Refer to the Motion State Diagram and MC_ReadStatus. Maybe the axis is not enabled using MC_Power? |
| 4390 | Position cannot be defined while the axis is in a master / slave relationship. To redefine the position, use the MC_Stop function block for slave axis, then execute MC_SetPosition. If attempting the redefine a master position, execute MC_Stop for all slaves first. |
| 4396 | Axis latch function already in use. |
| 4397 | Over travel is limit still ON after attempting to move away from it. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |

| | |
|-----------------------|--|
| 4642 | Direction does not correspond to a valid enumeration value. |
| 4646 | Mode does not correspond to a valid enumeration value or the enumeration is not supported. |
| 4658 | Velocity parameter is less than or equal to zero. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 10037 | Offset cannot be in the same direction as the original motion into the limit switch. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |
| 61713 | This function block caused an internal error. Possible causes: MC_Power – Check if multiple instances of this block are executed for the same axis. Y_CamIn - Check in the cam table if the master values are the same for two datapoints or decreasing. Y_CamStructSelect – Y_MS_CAM_TABLE.Header.DataSize must not be zero. |

Example

Use a ST POU to initialize the data required for HomeData. To save time, copy & paste the example initialization into your project.

(** Copy & Paste, then search & replace the headings in the following section to speed the initialization of the homing data. **)

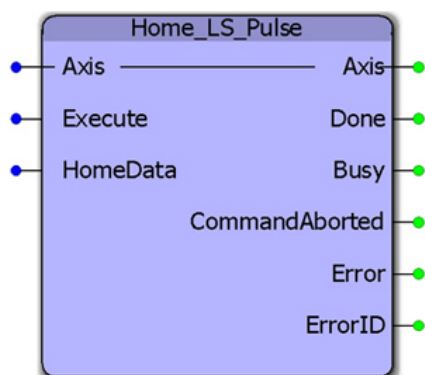
```

HomeStruct_ReplaceMe.AccDec:=LREAL#500.0; (* In User units /sec2 as set in the Hardware Configuration *)
HomeStruct_ReplaceMe.ApproachDistanceLimit:=LREAL#500.0; (* In User units as set in the Hardware Configuration *)
HomeStruct_ReplaceMe.ApproachTimeLimit:=LREAL#500.0; (* In seconds *)
HomeStruct_ReplaceMe.ApproachVelocity:=LREAL#500.0; (* In User units / sec as set in the Hardware Configuration *)
HomeStruct_ReplaceMe.CreepDistanceLimit:=LREAL#500.0; (* In User units as set in the Hardware Configuration *)
HomeStruct_ReplaceMe.CreepTimeLimit:=LREAL#500.0; (* In seconds *)
HomeStruct_ReplaceMe.CreepVelocity:=LREAL#500.0; (* In User units / sec as set in the Hardware Configuration *)
HomeStruct_ReplaceMe.Direction:=INT#0; (* MC_Direction#Positive_Direction; *)
HomeStruct_ReplaceMe.Offset:=LREAL#500.0; (* In User units as set in the Hardware Configuration *)
HomeStruct_ReplaceMe.OffsetVelocity:=LREAL#500.0; (* In User units / sec as set in the Hardware Configuration *)
HomeStruct_ReplaceMe.Position:=LREAL#500.0; (* In User units as set in the Hardware Configuration *)
HomeStruct_ReplaceMe.SwitchMode:=INT#2; (* MC_SwitchMode#EdgeOn; *)
HomeStruct_ReplaceMe.TorqueLimit:=LREAL#500.0; (* In percentage of rated torque of the servo *)

```




Home_LS_Pulse



This function block combines the PLCopen function blocks MC_StepLimitSwitch, MC_StepRefPulse, MC_MoveRelative, and MC_SetPosition to make a sequence that detects the limit switch, reverses to the C channel, performs and offset move away from the limit, and sets a home position.

Library

PLCopen Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|----------------------------|--|
| VAR_IN_OUT | | | |
| B | Axis | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| VAR_INPUT | | | |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| V | HomeData | HomeStruct | User defined Data Type in the PLCopen Toolbox, contains all related homing parameters. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |

| | | | |
|---|----------------|------|--|
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

- This function is intended to operate only with a ServoPack's POT or NOT signal detection. HomeData.SwitchMode only supports "EdgeOn." Configure the ServoPack Pn 50A and 50B appropriately.
- See the [Home_LS_Pulse eLearning Module](#) on Yaskawa's YouTube channel.

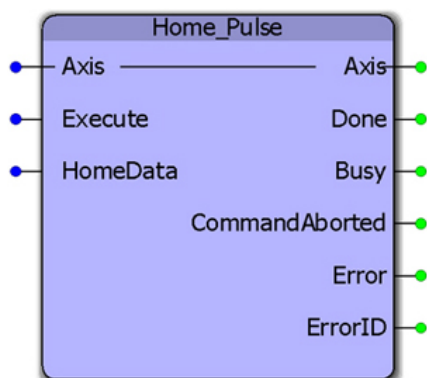
Error Description

| ErrorID | Meaning |
|----------------------|--|
| 0 | No error. |
| 1 | Time limit exceeded. |
| 2 | Distance limit exceeded. |
| 3 | Torque limit exceeded. |
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4379 | A homing sequence is already in progress. |
| 4380 | MC_SetPosition cannot be executed while the axis is already moving. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4382 | When an axis is configured for rotary mode, and the MC_SetPosition tries to set a position that is equal to or greater than the MachineCycle, this error is generated, and the position is not set. |
| 4383 | Axis must be commanded at standstill when homing is attempted. Refer to the Motion State Diagram and MC_ReadStatus. Maybe the axis is not enabled using MC_Power? |
| 4390 | Position cannot be defined while the axis is in a master / slave relationship. To redefine the position, use the MC_Stop function block for slave axis, then execute MC_SetPosition. If attempting the redefine a master position, execute MC_Stop for all slaves first. |
| 4396 | Axis latch function already in use. |
| 4397 | Over travel is limit still ON after attempting to move away from it. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |

| | |
|-----------------------|--|
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4642 | Direction does not correspond to a valid enumeration value. |
| 4646 | Mode does not correspond to a valid enumeration value or the enumeration is not supported. |
| 4658 | Velocity parameter is less than or equal to zero. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 10037 | Offset cannot be in the same direction as the original motion into the limit switch. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |
| 61713 | This function block caused an internal error. Possible causes: MC_Power – Check if multiple instances of this block are executed for the same axis. Y_CamIn - Check in the cam table if the master values are the same for two datapoints or decreasing. Y_CamStructSelect – Y_MS_CAM_TABLE.Header.DataSize must not be zero. |



Home_Pulse



This function block combines the PLCopen function blocks MC_StepRefPulse, MC_MoveRelative, and MC_SetPosition to make a sequence that detects the limit switch, reverses to the C channel, performs an offset move away from the limit, and sets a home position.

Library

PLCopen Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|----------------------------|--|
| VAR_IN_OUT | | | |
| B | Axis | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| V | HomeData | HomeStruct | User defined Data Type in the PLCopen Toolbox, contains all related homing parameters. |
| VAR_OUTPUT | | | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |

| | | | |
|---|----------------|------|--|
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

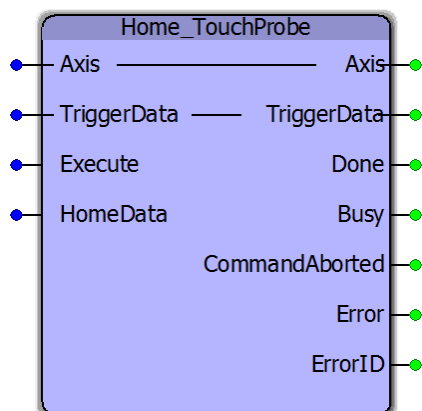
Error Description

| ErrorID | Meaning |
|----------------------|--|
| 0 | No error. |
| 1 | Time limit exceeded. |
| 2 | Distance limit exceeded. |
| 3 | Torque limit exceeded. |
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4379 | A homing sequence is already in progress. |
| 4380 | MC_SetPosition cannot be executed while the axis is already moving. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4382 | When an axis is configured for rotary mode, and the MC_SetPosition tries to set a position that is equal to or greater than the MachineCycle, this error is generated, and the position is not set. |
| 4383 | Axis must be commanded at standstill when homing is attempted. Refer to the Motion State Diagram and MC_ReadStatus. Maybe the axis is not enabled using MC_Power? |
| 4390 | Position cannot be defined while the axis is in a master / slave relationship. To redefine the position, use the MC_Stop function block for slave axis, then execute MC_SetPosition. If attempting the redefine a master position, execute MC_Stop for all slaves first. |
| 4396 | Axis latch function already in use. |
| 4397 | Over travel is limit still ON after attempting to move away from it. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4642 | Direction does not correspond to a valid enumeration value. |
| 4646 | Mode does not correspond to a valid enumeration value or the enumeration is not supported. |
| 4658 | Velocity parameter is less than or equal to zero. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |

| | |
|-----------------------|--|
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 10037 | Offset cannot be in the same direction as the original motion into the limit switch. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |
| 61713 | This function block caused an internal error. Possible causes: MC_Power – Check if multiple instances of this block are executed for the same axis. Y_CamIn - Check in the cam table if the master values are the same for two datapoints or decreasing. Y_CamStructSelect – Y_MS_CAM_TABLE.Header.DataSize must not be zero. |



Home_TouchProbe



This function block combines the PLCopen function blocks MC_MoveRelative, MC_TouchProbe, MC_MoveAbsolute and MC_SetPosition to make a sequence that initiates motion on the axis until a signal is detected on the sensor connected to the high speed latch input of the servo. The axis then performs an offset move from the latched position, and sets a home position.

Library

PLCopen Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-------------|-----------------------------|--|
| VAR_IN_OUT | | | |
| B | Axis | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| V | TriggerData | TRIGGER_REF | Reference to the trigger signal source. |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| V | HomeData | HomeStruct | User defined Data Type in the PLCopen Toolbox, contains all related homing parameters. |
| VAR_OUTPUT | | | |

| | | | |
|---|----------------|------|--|
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

Use HomeData.ApproachDistanceLimit to set the maximum travel distance while waiting for the TouchProbe function to detect the sensor. Enter a positive or negative value, this function block does not use HomeData.Direction.

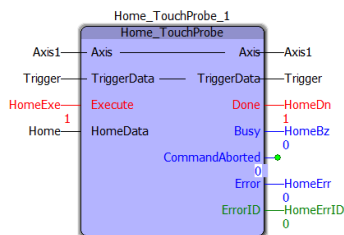
Error Description

| ErrorID | Meaning |
|----------------------|--|
| 0 | No error. |
| 1 | Time limit exceeded. |
| 2 | Distance limit exceeded. |
| 3 | Torque limit exceeded. |
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4379 | A homing sequence is already in progress. |
| 4380 | MC_SetPosition cannot be executed while the axis is already moving. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4382 | When an axis is configured for rotary mode, and the MC_SetPosition tries to set a position that is equal to or greater than the MachineCycle, this error is generated, and the position is not set. |
| 4383 | Axis must be commanded at standstill when homing is attempted. Refer to the Motion State Diagram and MC_ReadStatus. Maybe the axis is not enabled using MC_Power? |
| 4390 | Position cannot be defined while the axis is in a master / slave relationship. To redefine the position, use the MC_Stop function block for slave axis, then execute MC_SetPosition. If attempting the redefine a master position, execute MC_Stop for all slaves first. |
| 4396 | Axis latch function already in use. |
| 4397 | Over travel is limit still ON after attempting to move away from it. |

| | |
|-----------------------|--|
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4642 | Direction does not correspond to a valid enumeration value. |
| 4646 | Mode does not correspond to a valid enumeration value or the enumeration is not supported. |
| 4658 | Velocity parameter is less than or equal to zero. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 10037 | Offset cannot be in the same direction as the original motion into the limit switch. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |
| 61713 | This function block caused an internal error. Possible causes: MC_Power – Check if multiple instances of this block are executed for the same axis. Y_CamIn - Check in the cam table if the master values are the same for two datapoints or decreasing. Y_CamStructSelect – Y_MS_CAM_TABLE.Header.DataSize must not be zero. |

Example

The example below illustrates how the Home_TouchProbe function block homes an axis based on the latch detected on one of the three EXT channels on the servo. Plots of the commanded speed and positions are shown to describe a negative home offset of 360 units after the latch is detected.



```

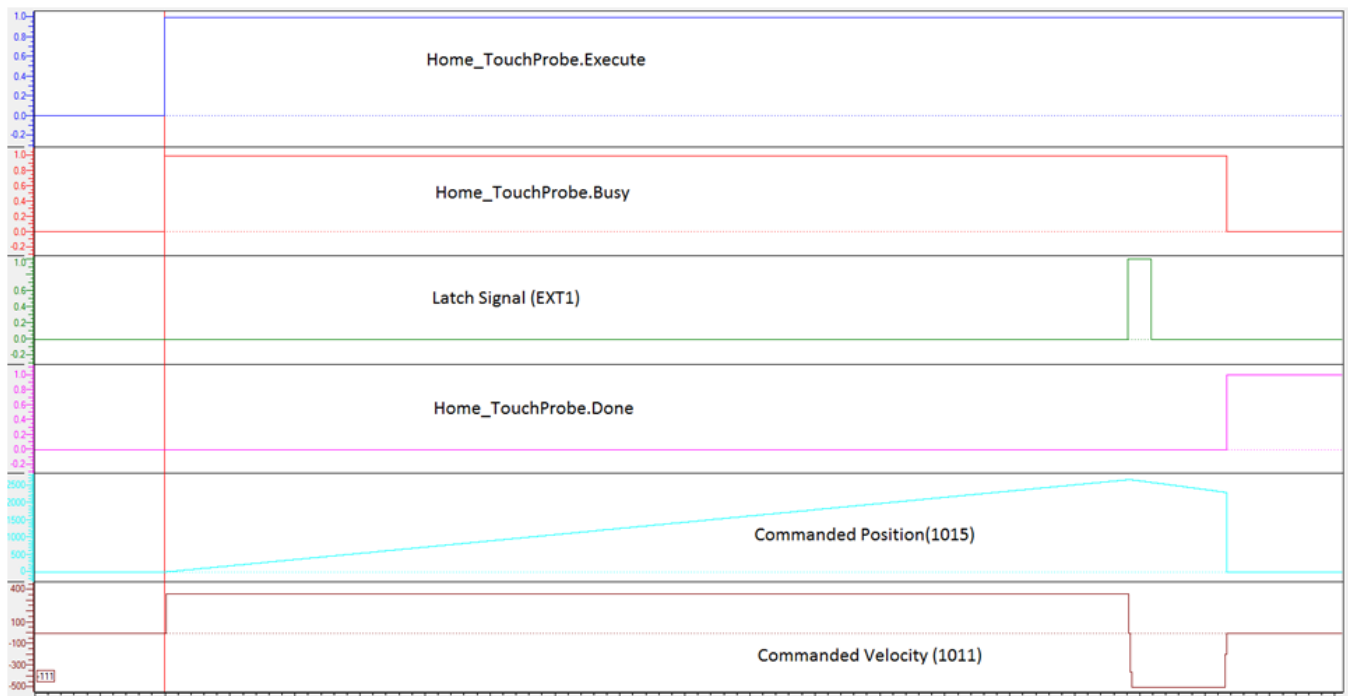
36000.0000000    Home.AccDec:=LREAL#36000.0;
20000.0000000    Home.ApproachDistanceLimit:=LREAL#20000.0;
500.0000000      Home.ApproachTimeLimit:=LREAL#500.0;
360.0000000      Home.ApproachVelocity:=LREAL#360.0;
2000.0000000     Home.CreepDistanceLimit:=LREAL#2000.0;
500.0000000     Home.CreepTimeLimit:=LREAL#500.0;
90.0000000       Home.CreepVelocity:=LREAL#90.0;
0                Home.Direction:=INT#0;
-360.0000000     Home.Offset:=LREAL#-360.0;
500.0000000     Home.OffsetVelocity:=LREAL#500.0;
0.0000000       Home.Position:=LREAL#0.0;
0                Home.SwitchMode:=INT#2;
300.0000000     Home.TorqueLimit:=LREAL#300.0;

```

```

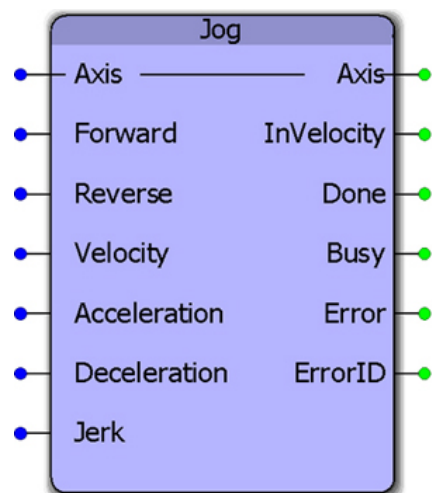
(* In User units /sec2 as set in the Hardware Configuration *)
(* In User units as set in the Hardware Configuration *)
(* In seconds *)
(* In User units / sec as set in the Hardware Configuration *)
(* In User units as set in the Hardware Configuration *)
(* In seconds *)
(* In User units / sec as set in the Hardware Configuration *)
(* MC_Direction#Positive_Direction; *)
(* In User units as set in the Hardware Configuration *)
(* In User units / sec as set in the Hardware Configuration *)
(* In User units as set in the Hardware Configuration *)
(* MC_SwitchMode#EdgeOn *)
(* In percentage of rated torque of the servo *)

```





Jog



This function block combines the PLCopen functions MC_MoveVelocity and MC_Stop to provide a jogging feature only while the Forward or Reverse inputs are TRUE. The function will default to stopping the axis when neither (or both) are high.

Library

PLCopen Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|--------------|--------------------------|---|
| VAR_IN_OUT | | | |
| B | Axis | AXIS REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| VAR_INPUT | | | Default |
| V | Forward | BOOL | Runs the axis in a forward direction when TRUE. FALSE |
| V | Reverse | BOOL | Runs the axis in a Reverse direction when TRUE. FALSE |
| B | Velocity | LREAL | Absolute value of the velocity in user unit-s/second. LREAL#0.0 |
| B | Acceleration | LREAL | Value of the acceleration in user unit-s/second^2 (acceleration is applicable with same sign of torque and velocity) LREAL#0.0 |

| | | | | |
|-------------------|--------------|-------|--|-----------|
| B | Deceleration | LREAL | Value of the deceleration in user unit-s/second ² (deceleration is applicable with opposite signs of torque and velocity.) | LREAL#0.0 |
| E | Jerk | LREAL | Not supported; reserved for future use. Value of the jerk in [user units / second ³]. | LREAL#0.0 |
| VAR_OUTPUT | | | | |
| B | InVelocity | BOOL | Set high when the axis first reaches the specified velocity (function is complete). If the function is re executed with a new velocity, the output will remain high. It will go low when an MC_Stop block is executed. If using the Jog function block from the PLCopen Toolbox, this output will go low when both the Forward and Reverse inputs are low. | |
| B | Done | BOOL | Turns on for one scan when the axis comes to a stop after both Forward and Reverse inputs go FALSE. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

- The velocity can be changed on the fly without toggling the Forward or Reverse input. The code inside this function block will detect if the velocity has changed, and automatically re trigger the MC_MoveVelocity function block inside. Starting in PLCopen Toolbox v202, changes in Acceleration and Deceleration are detected and can be changed on the fly.
- See the [Jog eLearning Module](#) on Yaskawa's YouTube channel.

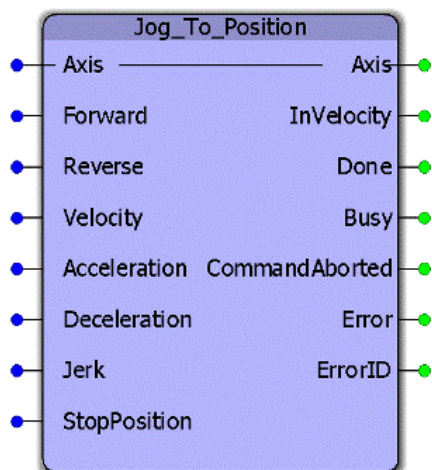
Error Description

| ErrorID | Meaning |
|----------------------|--|
| 0 | No error. |
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4642 | Direction does not correspond to a valid enumeration value. |
| 4659 | Acceleration is less than or equal to zero. |

| | |
|-----------------------|--|
| 4660 | Deceleration is less than or equal to zero. |
| 4665 | Velocity parameter is negative. (Conveyor moving in wrong direction.) |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |



Jog_To_Position



This function block combines the PLCopen functions MC_MoveVelocity and MC_MoveAbsolute to provide a jogging feature specifically for rotary axes that must stop at a specific position after an indefinite period of motion.

Library

PLCopen Toolbox

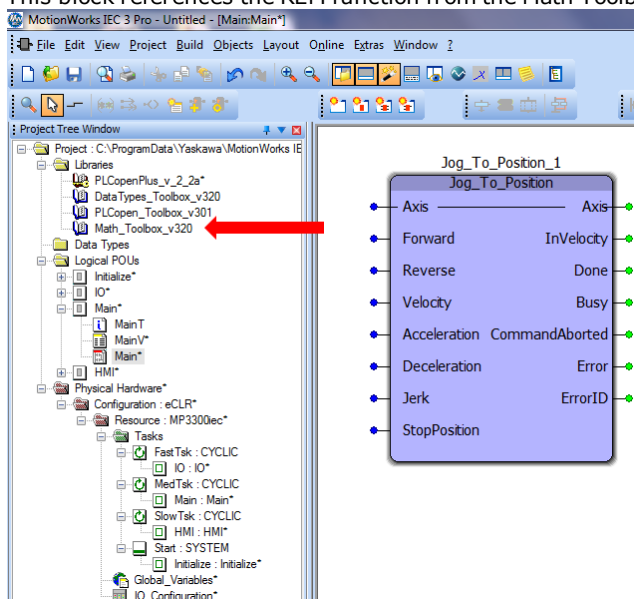
Parameters

| * | Parameter | Data Type | Description |
|-------------------|--------------|--------------------------|---|
| VAR_IN_OUT | | | |
| B | Axis | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| VAR_INPUT | | | |
| V | Forward | BOOL | Runs the axis in a forward direction when TRUE. |
| V | Reverse | BOOL | Runs the axis in a Reverse direction when TRUE. |
| B | Velocity | LREAL | Absolute value of the velocity in user units/second. |
| B | Acceleration | LREAL | Value of the acceleration in user units/second ² (acceleration is applicable with same sign of torque and velocity) |
| | | | Default |
| | | | FALSE |
| | | | FALSE |
| | | | LREAL#0.0 |
| | | | LREAL#0.0 |

| | | | | |
|-------------------|----------------|-------|--|-----------|
| B | Deceleration | LREAL | Value of the deceleration in user unit-s/second ² (deceleration is applicable with opposite signs of torque and velocity.) | LREAL#0.0 |
| E | Jerk | LREAL | Not supported; reserved for future use. Value of the jerk in [user units / second ³]. | LREAL#0.0 |
| V | StopPosition | LREAL | Once the Forward and Reverse inputs are false, the axis will decelerate to a stop at the specified StopPosition using the specified deceleration rate | LREAL#0.0 |
| VAR_OUTPUT | | | | |
| B | InVelocity | BOOL | Set high when the axis first reaches the specified velocity (function is complete). If the function is re executed with a new velocity, the output will remain high. It will go low when an MC_Stop block is executed. If using the Jog function block from the PLCopen Toolbox, this output will go low when both the Forward and Reverse inputs are low. | |
| B | Done | BOOL | Turns on for one scan when the axis comes to a stop after both Forward and Reverse inputs go FALSE. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

- The velocity, acceleration, and deceleration can be changed on the fly without toggling the Forward or Reverse input. The code inside this function block will detect if the input values have changed, and automatically re trigger the MC_MoveVelocity function block inside. Starting in PLCopen Toolbox v202, changes in Acceleration and Deceleration are detected and can be changed on the fly.
- This block references the REM function from the Math Toolbox, so it must be included in the project tree.

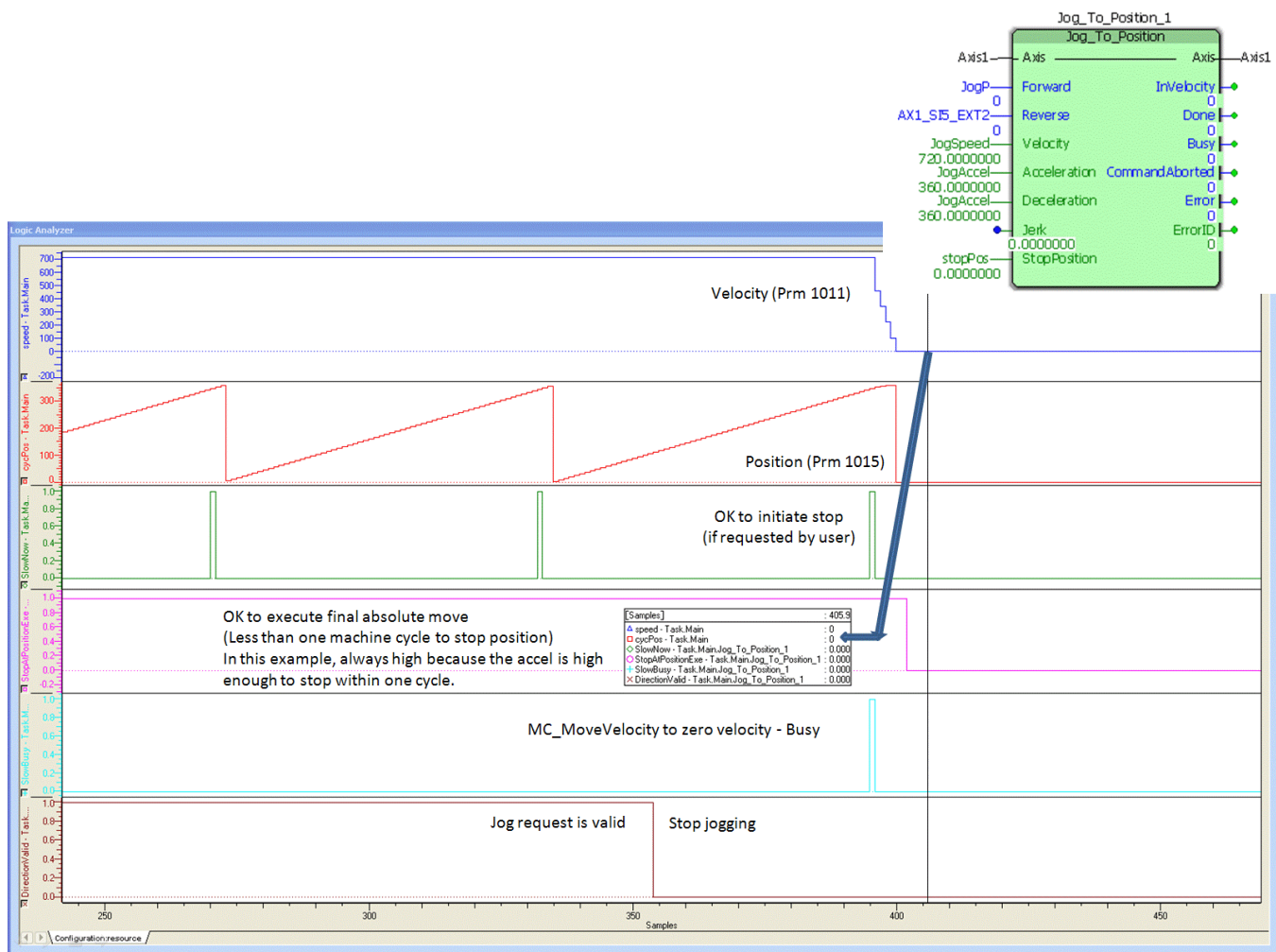


Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4642 | Direction does not correspond to a valid enumeration value. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4665 | Velocity parameter is negative. (Conveyor moving in wrong direction.) |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 10060 | The axis must be configured as a rotary type for this function block to be applicable. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |

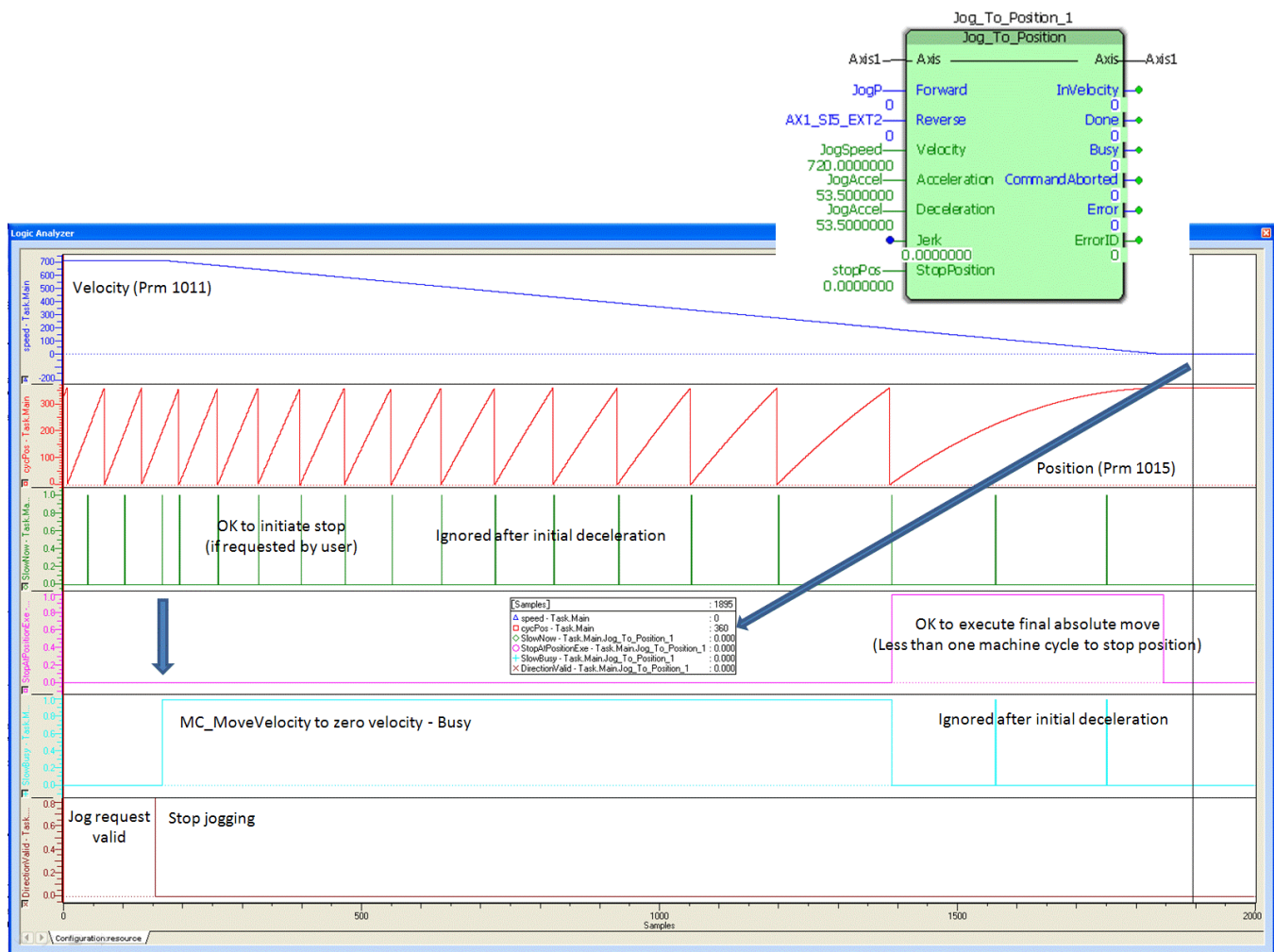
Example 1

In the first example the speed is low enough and the deceleration high enough that the axis can stop within one revolution. This is the easiest condition.



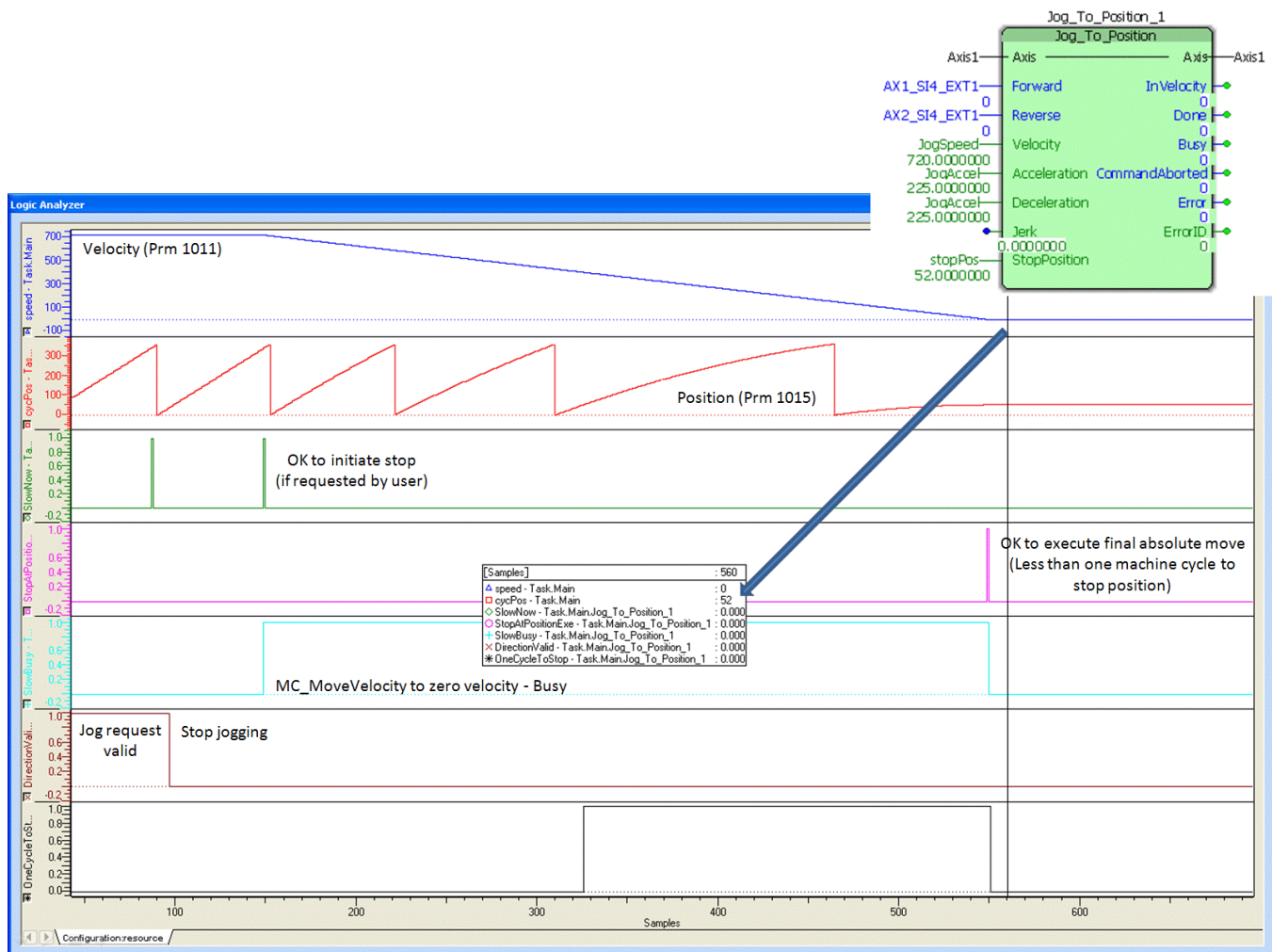
Example 2

In this example, the axis requires about 13 revolutions to come to a stop at the specified velocity and deceleration. The data "SlowNow" in green is an internal monitoring bit which results from a calculation made to determine a position that will allow the motion profile to follow the deceleration rate to the specified StopPosition. Notice there is a very brief delay between the time the Forward jog request is removed and the axis starts decelerating. This allow the axis to decelerate smoothly to the StopPosition. The pink data indicates when the MC_MoveAbsolute is active.



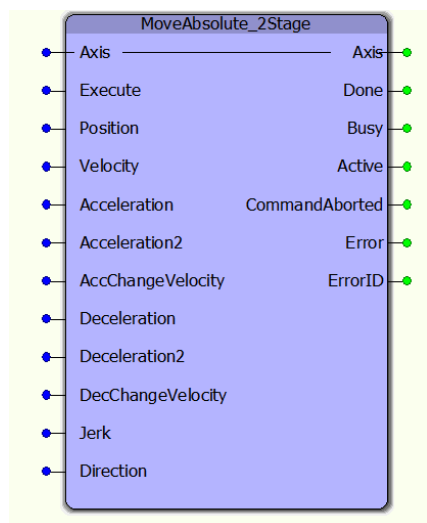
Example 3

The third example shows a deceleration to stop at 52 degrees.





MoveAbsolute_2Stage



This function block commands a move to an absolute position using a two staged acceleration and deceleration.

Library

PLCopen Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|--------------------------|--|
| VAR_IN_OUT | | | |
| B | Axis | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| B | Position | LREAL | A positive or negative value within the coordinate system in user units. |
| B | Velocity | LREAL | Absolute value of the velocity in user units/second. |

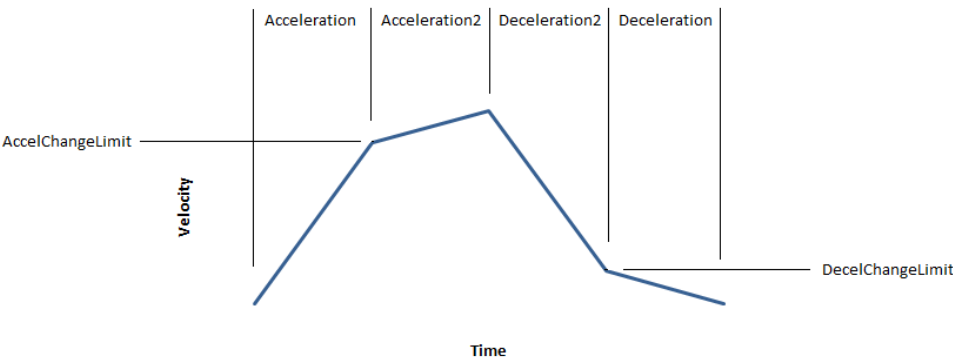
| | | | | |
|-------------------|-------------------|------------------------------|--|---------------------------------|
| B | Acceleration | LREAL | Value of the acceleration in user units/second ² (acceleration is applicable with same sign of torque and velocity) This acceleration will be applied when Velocity is less than AccChangeVelocity. | LREAL#0.0 |
| B | Acceleration2 | LREAL | Value of the acceleration in user units/second ² (acceleration is applicable with same sign of torque and velocity) This acceleration will be applied when Velocity is greater than AccChangeVelocity. | LREAL#0.0 |
| V | AccChangeVelocity | LREAL | Velocity at which motion will transition from using Acceleration to Acceleration2. | LREAL#0.0 |
| B | Deceleration | LREAL | Value of the deceleration in user units/second ² (deceleration is applicable with opposite signs of torque and velocity.) This deceleration will be used when Velocity is less than the DecChangeVelocity. | LREAL#0.0 |
| B | Deceleration2 | LREAL | Value of the deceleration in user units/second ² (deceleration is applicable with opposite signs of torque and velocity.) This deceleration will be used when Velocity is greater than the DecChangeVelocity. | LREAL#0.0 |
| V | DecChangeVelocity | LREAL | Velocity at which motion will transition from using Deceleration to Deceleration2. | LREAL#0.0 |
| E | Jerk | LREAL | Not supported; reserved for future use. Value of the jerk in [user units / second ³]. | LREAL#0.0 |
| B | Direction | MC_Direction | Specifies the direction of motion. Allowable modes are positive_direction, shortest_way, negative_direction, current_direction. | MC_Direction#Positive_Direction |
| VAR_OUTPUT | | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |
| B | Active | BOOL | For buffered modes, this output is set high at the moment the block takes control of the axis. For non buffered modes, the outputs Busy and Active have the same value. | |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

Error Description

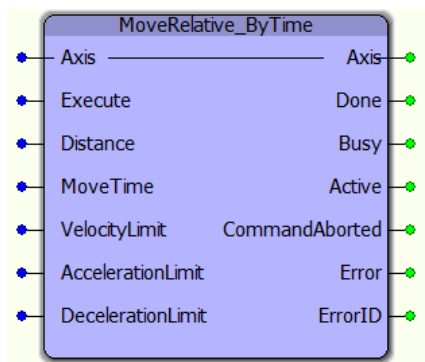
| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4642 | Direction does not correspond to a valid enumeration value. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4663 | Specified time was less than zero. |
| 4665 | Velocity parameter is negative. (Conveyor moving in wrong direction.) |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |

Example





MoveRelative_ByTime



This function block converts the MoveTime input into acceleration, velocity, and deceleration for a 1/3, 1/3, 1/3 trapezoidal move profile which will complete in the MoveTime specified. It uses the MC_MoveRelative function block.

Library

PLCopen Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|---------------|--------------------------|--|
| VAR_IN_OUT | | | |
| B | Axis | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| VAR_INPUT | | | |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| V | Distance | LREAL | A relative positive or negative value within the coordinate system in user units |
| V | MoveTime | LREAL | The time required (in seconds) for the move to complete. |
| V | VelocityLimit | LREAL | Maximum velocity used when moving. If left unconnected, no velocity limit will be applied during move. |
| | | | Default |
| | | | FALSE |
| | | | LREAL#0.0 |
| | | | LREAL#0.0 |

| | | | | |
|-------------------|-------------------|-------|--|-----------|
| V | AccelerationLimit | LREAL | Maximum acceleration used when moving. If left unconnected, no acceleration limit will be applied during move. | LREAL#0.0 |
| V | DecelerationLimit | LREAL | Maximum deceleration used when moving. If left unconnected, no deceleration limit will be applied during move. | LREAL#0.0 |
| VAR_OUTPUT | | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |
| B | Active | BOOL | For buffered modes, this output is set high at the moment the block takes control of the axis. For non buffered modes, the outputs Busy and Active have the same value. | |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

- Prior to v207, this function creates a 1/3, 1/3, 1/3 trapezoidal move, it may not be appropriate for very long moves, because the calculated commanded speed may be too high. New functionality was added for v207 which allows the function to calculate the move parameters to stay within the restraints of the new VAR_INPUTS VelocityLimit, AccelerationLimit, and DecelerationLimit.
- See the [MoveRelative_ByTime eLearning Module](#) on Yaskawa's YouTube channel.

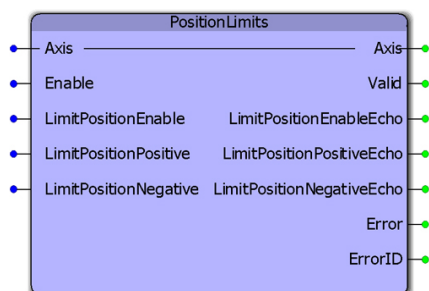
Error Description

| ErrorID | Meaning |
|----------------------|--|
| 0 | No error. |
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |

| | |
|-----------------------|--|
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4642 | Direction does not correspond to a valid enumeration value. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4663 | Specified time was less than zero. |
| 4665 | Velocity parameter is negative. (Conveyor moving in wrong direction.) |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 10180 | Velocity limit unable to be achieved with specified time constraint. |
| 10181 | Acceleration / deceleration limit unable to be achieved with specified time constraint. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |



PositionLimits



This function block enables or disables the position limit function. It also allows continuous streaming of new position limits. This block uses MC_WriteBoolParameter, MC_ReadBoolParameter, MC_WriteParameter, and MC_ReadParameter.

Library

PLCopen Toolbox

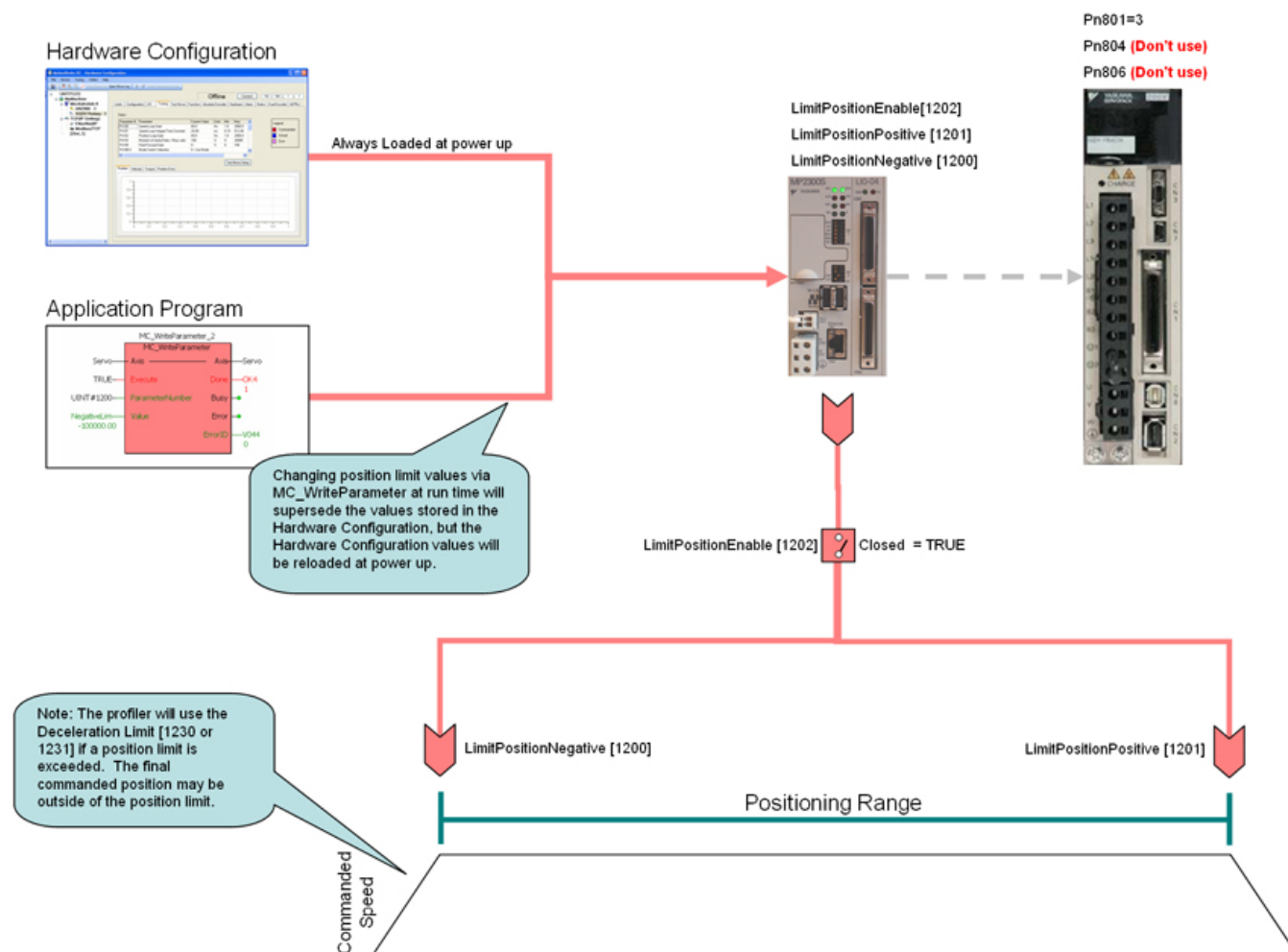
Parameters

| * | Parameter | Data Type | Description |
|-------------------|---------------------------|--------------------------|---|
| VAR_IN_OUT | | | |
| B | Axis | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| VAR_INPUT | | | |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | LimitPositionEnable | BOOL | Enables / Disables the position limit function in the motion engine. |
| V | LimitPositionPositive | LREAL | The maximum commanded position allowed |
| V | LimitPositionNegative | LREAL | The minimum commanded position allowed |
| VAR_OUTPUT | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| V | LimitPositionEnableEcho | BOOL | Status of the Position Limit function from the motion engine. |
| V | LimitPositionPositiveEcho | LREAL | Value used by the motion engine for the maximum allowed commanded position. |
| V | LimitPositionNegativeEcho | LREAL | Value used by the motion engine for the minimum allowed commanded position. |

| | | | |
|---|---------|------|---|
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

The function block uses MC_ReadBoolParameter, MC_WriteBoolParameter, MC_ReadParameter, and MC_WriteParameter.



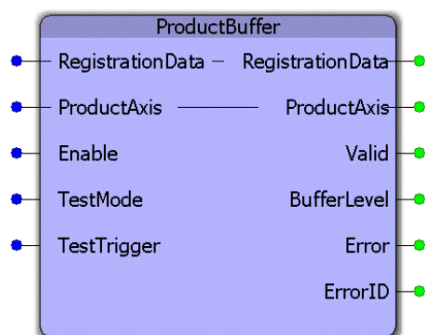
- The software position limits are managed by the MPiec controller. The parameters are called LimitPositionPositive and LimitPositionNegative, with values of UINT #1201 and UINT#1200 respectively. Use the MC_WriteParameter function block for these and all controller side parameters. Position limit parameters are in user units.
- When a position limit is exceeded, a controller alarm will be generated, obtainable via the MC_ReadAxisError function block, or the web server.
- The controller alarm will be 16#3202 0001 if the positive position limit is exceeded and 16#3202 0002 if the negative position limit is exceeded.
- To disable the position limits, set LimitPositionEnable, parameter 1202 to zero.
- LimitPositionPositive must be greater than LimitPositionNegative.
- LimitPositionNegative must be lower than LimitPositionPositive.
- See the [PositionLimits eLearning Module](#) on Yaskawa's YouTube channel.

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4648 | The parameter number does not exist for the specified axis - OR The parameter number requires the other function block (e.g. MC_WriteParameter vs MC_WriteBoolParameter) |
| 10026 | Positive Position Limit must be greater than Negative Position Limit. |
| 10027 | Negative Position Limit must be less than Positive Position Limit. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |



ProductBuffer



This function block uses MC_TouchProbe and provides a circular buffer of recorded latch positions for the axis specified. It is tailored for use specifically for applications that process random incoming products such as rotary knives or linear flying shear. Together, the application programmer and the ProductBuffer function block manage the RegistrationData structure which contains information pertaining to the product positions and other mechanical dimensions related to the application.

Library

PLCopen Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|------------------|-------------------------------------|--|
| VAR_IN_OUT | | | |
| V | ProductAxis | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| V | RegistrationData | ProductBufferStruct | Structure containing all information for the circular buffer to operate. |
| VAR_INPUT | | | |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | TestMode | BOOL | If TRUE, then the internal MC_TouchProbe is aborted, and the function block can be used to "dry cycle" the machine by simulating products using the TestTrigger input. |
| V | TestTrigger | BOOL | If TestMode is TRUE, then on the rising edge of TestTrigger, the actual position of the ProductAxis will be stored into the RegistrationData STRUCT. |
| VAR_OUTPUT | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |

| | | | |
|---|-------------|------|---|
| V | BufferLevel | INT | Indicates the number of products in the buffer by subtracting UsePointer from StorePointer. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

- The Math Toolbox v202 or higher is required when using the ProductBuffer. The Math Toolbox must be included and placed above the PLCopen Toolbox in the Libraries folder of your MotionWorks IEC project.
- The ProductBuffer function block manages only the storing activity and only updates the StorePointer. Another part of your application must update the UsePointer after the products have been processed. If the UsePointer is not updated, this function block will eventually generate the ErrorID 10022, buffer overrun.
- The StorePointer and UsePointer are the 'Head' and the 'Tail' of the circular buffer. If more than one 'Use' of the latch data is required, use the expanded sub structure added for v206 which supports a series of Use pointer activities.
- The cyclic (modularized) and non cyclic (unmodularized) latch position are stored into the RegistrationData simultaneously.
- TestMode can be toggled on the fly without re Enabling the function block. TestMode was added in v201.
- See the [ProductBuffer eLearning Module](#) on Yaskawa's YouTube channel.

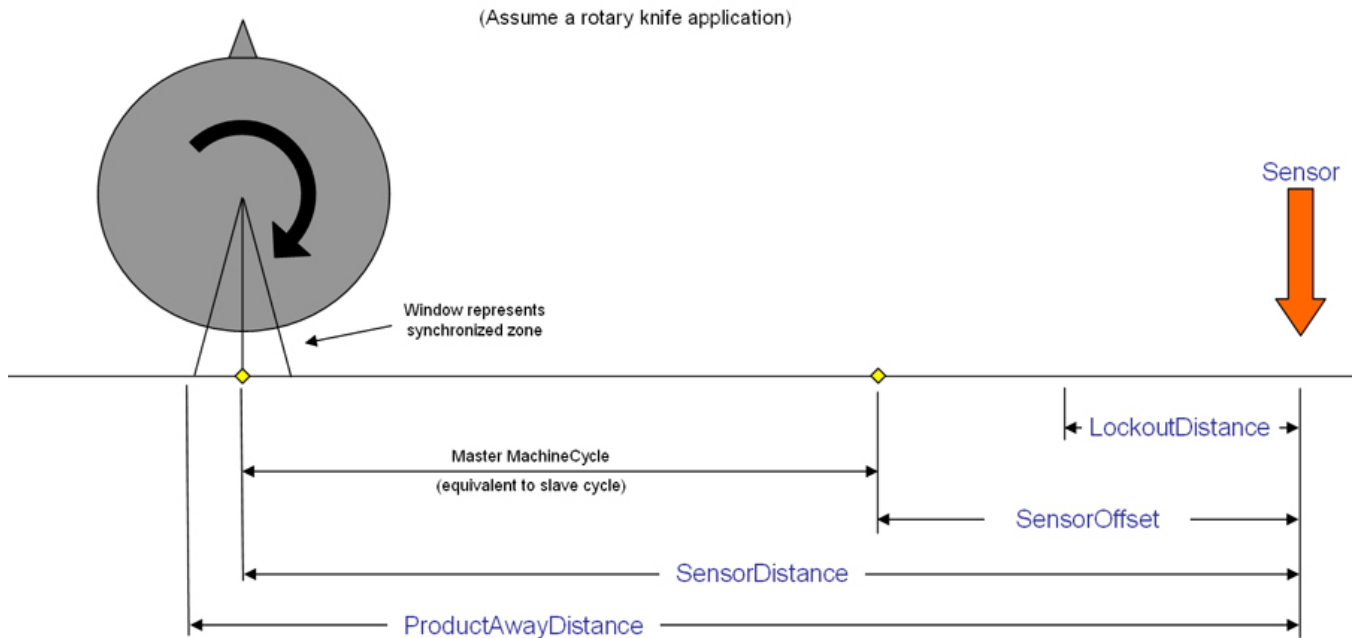
Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4396 | Axis latch function already in use. |
| 4624 | RESERVED - General structure value error. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4630 | Trigger reference is not valid. |
| 4894 | The specified virtual axis may not be used with this function block. |
| 10022 | Product or circular buffer overrun / full. |
| 10023 | Buffer size too small / cannot be zero. |
| 10099 | Latch Feature not supported for the specified Axis. If not using a servo or external encoder, you must set TestMode=TRUE, and provide a simulated registration input using the TestTrigger input. |
| 10173 | Duplicate latch values detected. Consider upgrading to firmware 3.4 or higher to avoid this issue. SCR 10736 |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |

Example 1:

Consider a rotary knife application as shown below.

ProductBufferStruct Definitions



(*Initialization of the ProductBufferStruct in an initialize program*)

```
Conveyor.Products.BufferSize:=INT#20;
```

```
Conveyor.Products.LockoutDistance:=LREAL#3.25; (* inches *)
```

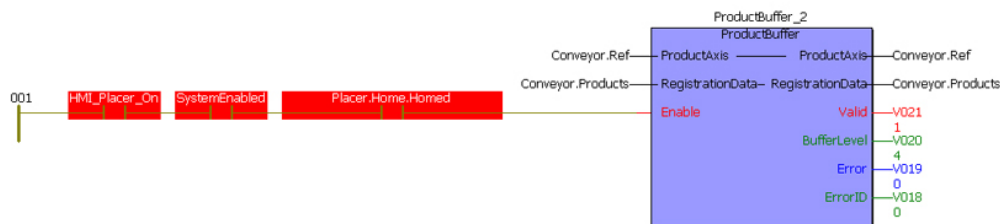
```
Conveyor.Products.ManualOffset:=LREAL#0.0;
```

```
Conveyor.Products.ProductAwayDistance:=LREAL#23.75;
```

```
Conveyor.Products.Sensor.Bit:=UINT#1; (* Equates to input1 on 2600 I/O, see MC_TouchProbe help for details *)
```

```
Conveyor.Products.SensorDistance:=LREAL#23.25; (* If product leads slave, increase this value *)
```

```
Conveyor.Products.SensorOffset:=REM(Conveyor.Products.SensorDistance, Conveyor.MachineCycle);
```

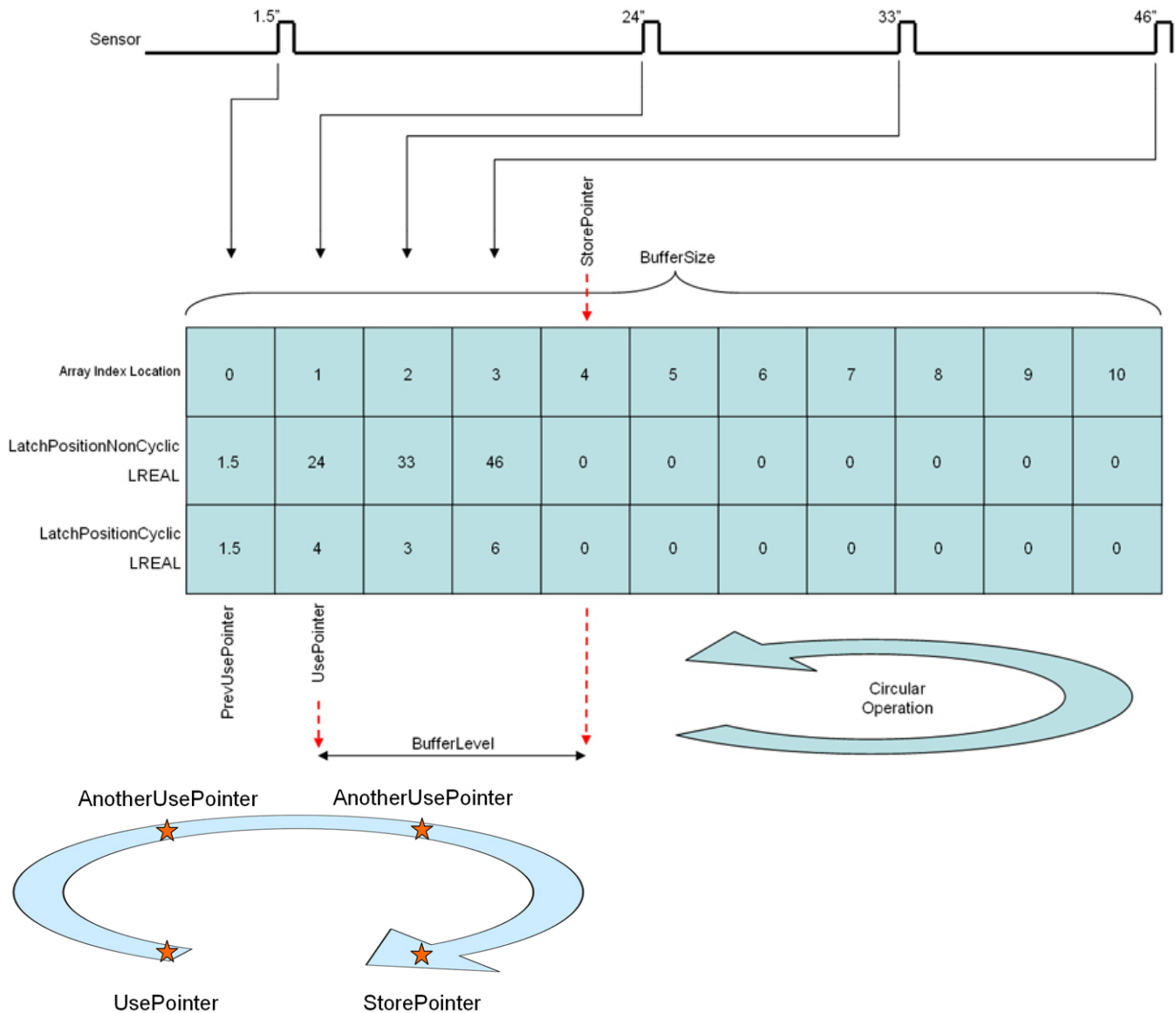


| Variable | Value | Default value | Type |
|---------------------|----------------|---------------|---------------------|
| Conveyor | | | ConveyorStruct |
| Ref | | | Axis_REF |
| Pm | | | AxisParameterStruct |
| Products | | | ProductBufferStruct |
| BufferSize | 20 | | INT |
| BufferNonCyclic | | | LatchBufferArray |
| BufferCyclic | | | LatchBufferArray |
| Sensor | | | TRIGGER_REF |
| Input | | | INPUT_REF |
| Bit | 1 | | UINT |
| Pattern | 0 | | INT |
| ID | 0 | | UINT |
| SensorDistance | 2.3250000E+001 | | LREAL |
| SensorOffset | 1.2588514E+000 | | LREAL |
| ManualOffset | 0.0000000E+000 | | LREAL |
| FilterDistance | 3.2500000E+000 | | LREAL |
| ProductAwayDistance | 2.3750000E+001 | | LREAL |
| StorePointer | 19 | | INT |
| UsePointer | 16 | | INT |
| PrevUsePointer | 15 | | INT |

| Variable | Value | Default value | Type |
|-----------------|----------------|---------------|------------------|
| BufferNonCyclic | | | LatchBufferArray |
| [0] | 7.0217149E+005 | | LREAL |
| [1] | 7.0217666E+005 | | LREAL |
| [2] | 7.0203970E+005 | | LREAL |
| [3] | 7.0204402E+005 | | LREAL |
| [4] | 7.0205855E+005 | | LREAL |
| [5] | 7.0206436E+005 | | LREAL |
| [6] | 7.0207238E+005 | | LREAL |
| [7] | 7.0207649E+005 | | LREAL |
| [8] | 7.0208167E+005 | | LREAL |
| [9] | 7.0209183E+005 | | LREAL |
| [10] | 7.0209664E+005 | | LREAL |
| [11] | 7.0210632E+005 | | LREAL |
| [12] | 7.0211436E+005 | | LREAL |
| [13] | 7.0211861E+005 | | LREAL |
| [14] | 7.0212569E+005 | | LREAL |
| [15] | 7.0212982E+005 | | LREAL |
| [16] | 7.0213470E+005 | | LREAL |
| [17] | 7.0215034E+005 | | LREAL |
| [18] | 7.0216219E+005 | | LREAL |
| [19] | 7.0216738E+005 | | LREAL |
| [20] | 0.0000000E+000 | | LREAL |

ProductBuffer Operation

(Assume a 10" Machine Cycle)



Example 2:

The configuration shown below is for a system which is used to detect rising and falling edge triggers for a product moving along a conveyor driven by a servo. the rising edge detection signal is wired to the EXT1 terminal of the ServoPack. The falling edge signal is wired to the EXT2 terminal of the ServoPack.

```
(*ProductBufferStruct for Registration Data *)
(*=====*)
20 Products.BufferSize           := INT#20;
90.0000000 Products.LockoutDistance := LREAL#90.0;
1580.0000000 Products.SensorDistance := LREAL#1580.0;

(*Products.Sensor.Bit := UINT#1; *)
1 Products.BufferPattern[0].Bit := UINT#1;
2 Products.BufferPattern[1].Bit := UINT#2;
2 Products.BufferPatternSize := INT#2;

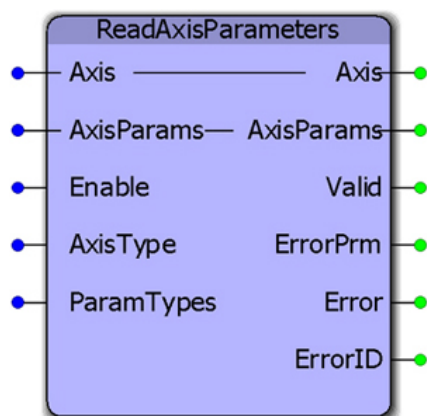
(*Products.ProductAwayDistance := LREAL#1730.0;*)
1730.0000000 Products.PatternAwayDistance[0] := LREAL#1730.0;
1930.0000000 Products.PatternAwayDistance[1] := LREAL#1930.0;
```

Products.BufferedPattern shows the trigger sequence in which latched data was captured.

| | | |
|-------------------------------------|-----------------|---|
| <input checked="" type="checkbox"/> | BufferNonCyclic | |
| <input checked="" type="checkbox"/> | BufferCyclic | |
| <input checked="" type="checkbox"/> | BufferedPattern | |
| | [0] | 1 |
| | [1] | 2 |
| | [2] | 1 |
| | [3] | 2 |
| | [4] | 1 |
| | [5] | 2 |
| | [6] | 1 |
| | [7] | 2 |
| | [8] | 1 |
| | [9] | 2 |
| | [10] | 1 |
| | [11] | 2 |
| | [12] | 1 |
| | [13] | 2 |
| | [14] | 1 |
| | [15] | 2 |
| | [16] | 1 |
| | [17] | 2 |
| | [18] | 0 |



ReadAxisParameters



This function block reads all axis parameters into the AxisParameterStruct. The Y_Motion firmware library must be included in a project that uses ReadAxisParameters.

Library

PLCopen Toolbox

Parameters

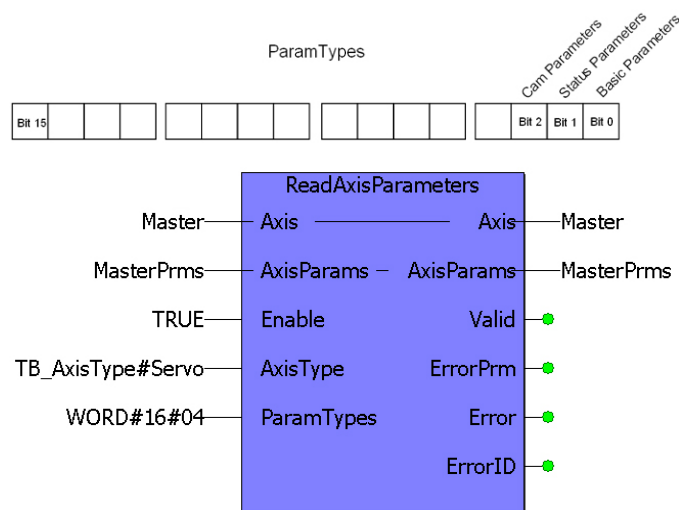
| * | Parameter | Data Type | Description |
|-------------------|------------|-------------------------------------|--|
| VAR_IN_OUT | | | |
| B | Axis | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| V | AxisParams | AxisParameterStruct | User Defined DataType declared in the PLCopen Toolbox. |
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. Inputs will be read only on the rising edge of enable. |
| V | AxisType | TB_AxisType | Indicates axis type: TB_AxisType#Servo TB_AxisType#VFD TB_AxisType#Stepper TB_AxisType#Virtual TB_AxisType#External |
| | | | INT#0 (TB_AxisType#Servo) |

| | | | | |
|-------------------|------------|------|--|--------|
| V | ParamTypes | WORD | Used to include additional parameter sets, such as camming. | WORD#0 |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| V | ErrorPrm | UINT | If there was an error while attempting to read one of the parameters listed in the ParamStruct, this output will contain the offending parameter number. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

Only AxisType#Servo, AxisType#External, AxisType#Virtual are supported.

By default, the function will update all parameter types in the AxisParamStruct. For efficiency, parameters are grouped into types. Basic, Status, and Cam. For axes that are not cam slaves, there is no need to read the cam parameters. To cause the function to skip the update of a parameter group, set the corresponding bit high. For example, the following function block will not read the cam parameters:



Parameters categorized as BasicMotion are always read.

| ParamType | ParameterName | Parameter # |
|-------------|----------------------------|-------------|
| BasicMotion | ActualPosition | 1000 |
| BasicMotion | ActualPositionCyclic | 1005 |
| BasicMotion | ActualPositionNonCyclic | 1006 |
| BasicMotion | ActualTorque | 1004 |
| BasicMotion | ActualVelocity | 1001 |
| BasicMotion | AtVelocity | 1141 |
| BasicMotion | CommandedPosition | 1010 |
| BasicMotion | CommandedPositionCyclic | 1015 |
| BasicMotion | CommandedPositionNonCyclic | 1016 |
| BasicMotion | CommandedTorque | 1014 |
| BasicMotion | CommandedVelocity | 1011 |
| BasicMotion | InPosition | 1140 |
| BasicMotion | LatchPositionNonCyclic | 1031 |
| BasicMotion | PositionError | 1130 |
| Cam | CamMasterCycle | 1512 |

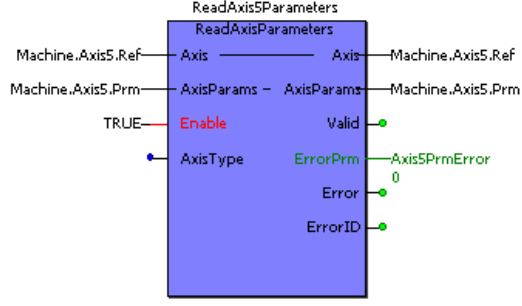
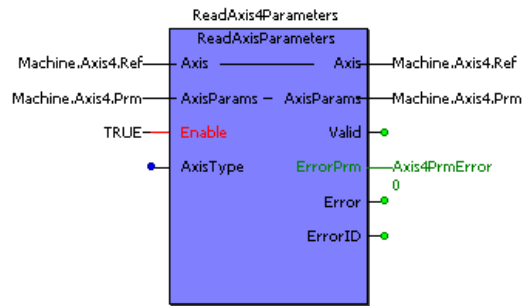
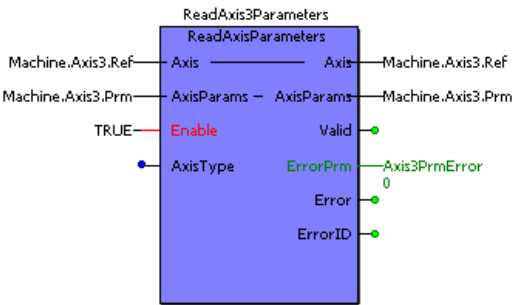
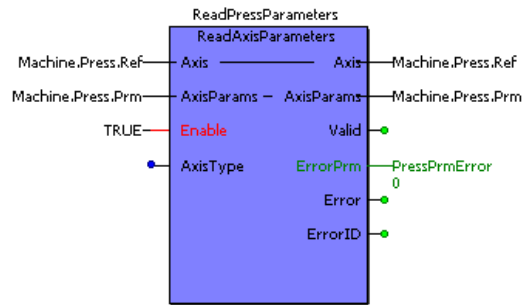
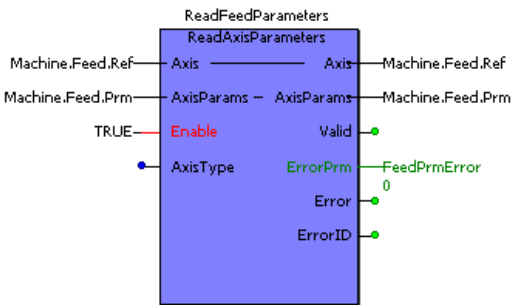
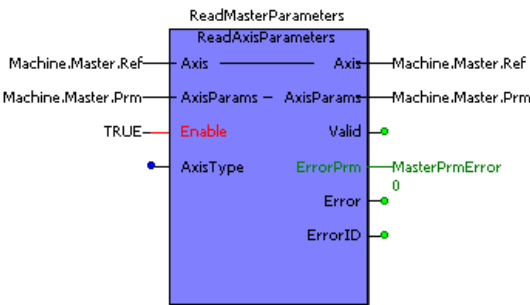
| | | |
|--------|--------------------------|------|
| Cam | CamMasterPosition | 1500 |
| Cam | CamMasterScale | 1510 |
| Cam | CamMasterShift | 1511 |
| Cam | CamMasterShiftedCyclic | 1502 |
| Cam | CamMasterShiftedPosition | 1501 |
| Cam | CamOffset | 1531 |
| Cam | CamScale | 1530 |
| Cam | CamShiftRemaining | 1513 |
| Cam | CamState | 1540 |
| Cam | CamTableIDEngaged | 1541 |
| Cam | CamTableOutput | 1520 |
| Status | BufferedMotionBlocks | 1600 |
| Status | CommandedAcceleration | 1012 |
| Status | PositionWindow | 1120 |

- See the [ReadAxisParameters eLearning Module](#) on Yaskawa's YouTube channel.

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4648 | The parameter number does not exist for the specified axis - OR The parameter number requires the other function block (e.g. MC_WriteParameter vs MC_WriteBoolParameter) |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |

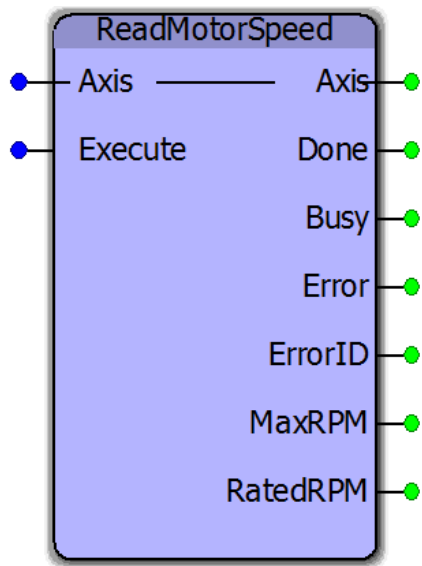
Example



| Watch Window | | | |
|--|---------|---------------------|---|
| Variable | Value | Type | Instance |
| Machine.Master.Prm | | AxisParameterStruct | Configuration.Resource.Task.Monitor.Machine.Master.Prm |
| ActualPosition | 1467.48 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.ActualPosition |
| ActualPositionCyclic | 1467.48 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.ActualPositionCyclic |
| ActualPositionNonCyclic | 1467.48 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.ActualPositionNonCyclic |
| ActualTorque | 0.00 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.ActualTorque |
| ActualVelocity | 60.00 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.ActualVelocity |
| AtVelocity | FALSE | BOOL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.AtVelocity |
| BufferedMotionBlocks | 1.00 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.BufferedMotionBlocks |
| CamMasterCycle | 1.00 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.CamMasterCycle |
| CamMasterPosition | 0.00 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.CamMasterPosition |
| CamMasterShiftedCyclic | 0.00 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.CamMasterShiftedCyclic |
| CamMasterShiftedPosition | 0.00 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.CamMasterShiftedPosition |
| CamMasterScale | 100.00 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.CamMasterScale |
| CamMasterShift | 0.00 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.CamMasterShift |
| CamOffset | 0.00 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.CamOffset |
| CamScale | 100.00 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.CamScale |
| CamShiftRemaining | 0.00 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.CamShiftRemaining |
| CamState | 0.00 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.CamState |
| CamTableDEngaged | 0.00 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.CamTableDEngaged |
| CamTableOutput | 0.00 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.CamTableOutput |
| CommandedAcceleration | 0.00 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.CommandedAcceleration |
| CommandedPosition | 1467.60 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.CommandedPosition |
| CommandedPositionCyclic | 1467.60 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.CommandedPositionCyc... |
| CommandedPositionNonCyclic | 1467.60 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.CommandedPositionNo... |
| CommandedTorque | 0.00 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.CommandedTorque |
| CommandedVelocity | 60.00 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.CommandedVelocity |
| InPosition | FALSE | BOOL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.InPosition |
| LatchPositionNonCyclic | 0.00 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.LatchPositionNonCyclic |
| PositionError | 0.00 | LREAL | Configuration.Resource.Task.Monitor.Machine.Master.Prm.PositionError |
| <div> <div>Watch 1</div> <div>Watch 2</div> <div>Watch 3</div> <div>Watch 4</div> </div> | | | |



ReadMotorSpeed



This function block reads the rated and peak speeds of a Sigma-5 motor connected to the controller.

Library

PLCopen Toolbox

Parameters

| * | Parameter | Data Type | Description |
|------------|-----------|--------------------------|--|
| VAR_IN_OUT | | | |
| B | Axis | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| FALSE | | | |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |

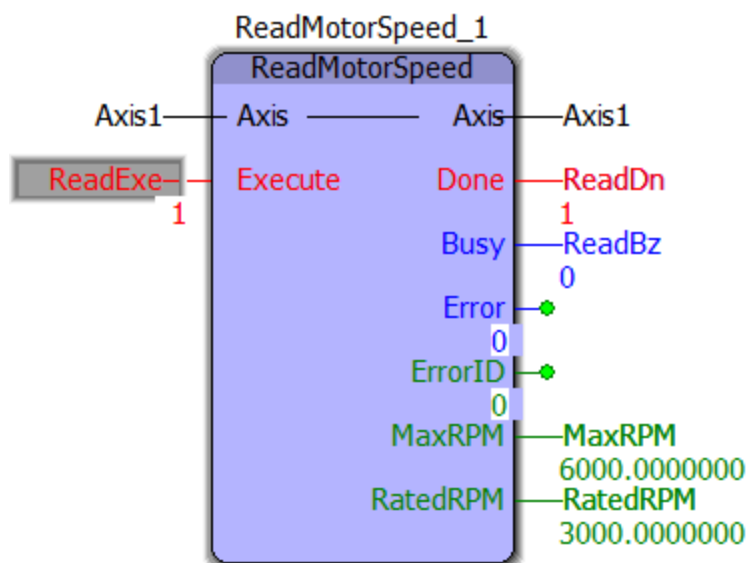
| | | | |
|---|----------|-------|--|
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |
| E | MaxRPM | LREAL | Peak speed of the motor |
| E | RatedRPM | LREAL | Rated speed of the motor |

Error Description

| ErrorID | Meaning |
|-----------------------|--|
| 0 | No error. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |

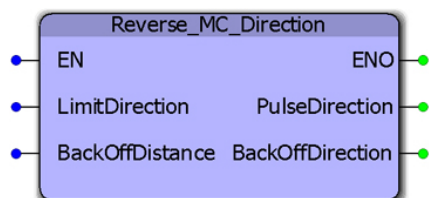
Example

The example below shows the ReadMotorSpeed function block reading the rated and peak speeds of an SGMAV motor.





Reverse_MC_Direction



This function block was designed for use with the [Home_LS_Pulse](#) function block in the PLCopen Toolbox. It changes the enumerated type MC_Direction#positive_direction to MC_Direction#negative_direction or vice versa so that the function can move the motor one direction into a limit switch with MC_StepRefLimit, and the other direction when searching for the Index Pulse with MC_StepRefPulse.

Library

PLCopen Toolbox

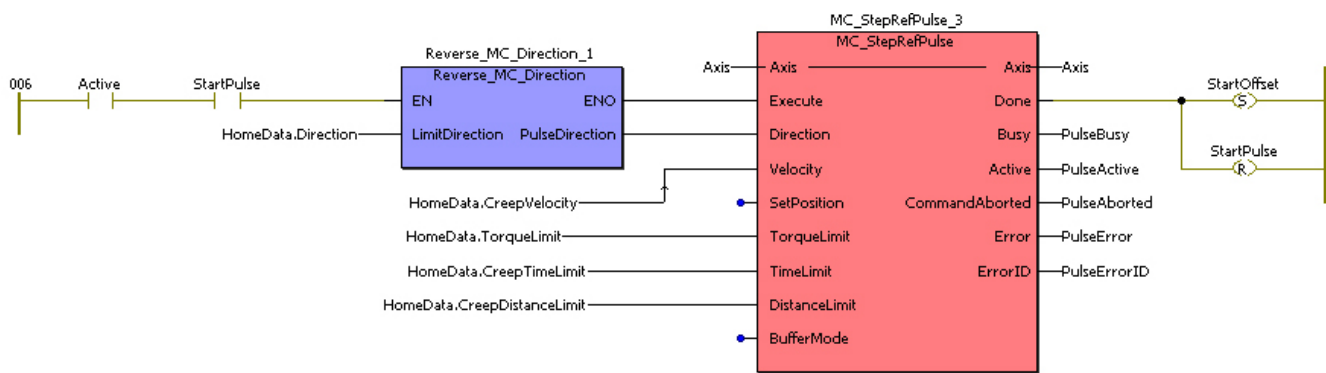
Parameters

| * | Parameter | Data Type | Description | |
|------------|------------------|-----------|---|--------|
| VAR_INPUT | | | Default | |
| B | EN | BOOL | Enables the function. | FALSE |
| V | LimitDirection | INT | INT / ENUM MC_Direction#positive_direction or MC_Direction#negative_direction | |
| V | BackOffDistance | LREAL | | INT #0 |
| VAR_OUTPUT | | | | |
| B | ENO | BOOL | High if the function is executing normally. | |
| V | PulseDirection | INT | INT / ENUM MC_Direction#positive_direction or MC_Direction#negative_direction | |
| V | BackOffDirection | LREAL | | |

Error Description

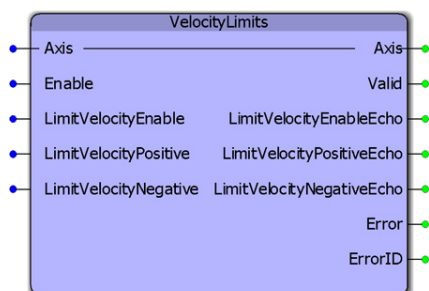
No Errors will result, but if there is a problem with the ENUM input for MC_Direction, then ENO will be FALSE.

Example





VelocityLimits



This function block enables or disables the velocity limit function. It also allows continuous streaming of new velocity limits. This block uses MC_WriteBoolParameter, MC_ReadBoolParameter, MC_WriteParameter, and MC_ReadParameter.

Library

PLCopen Toolbox

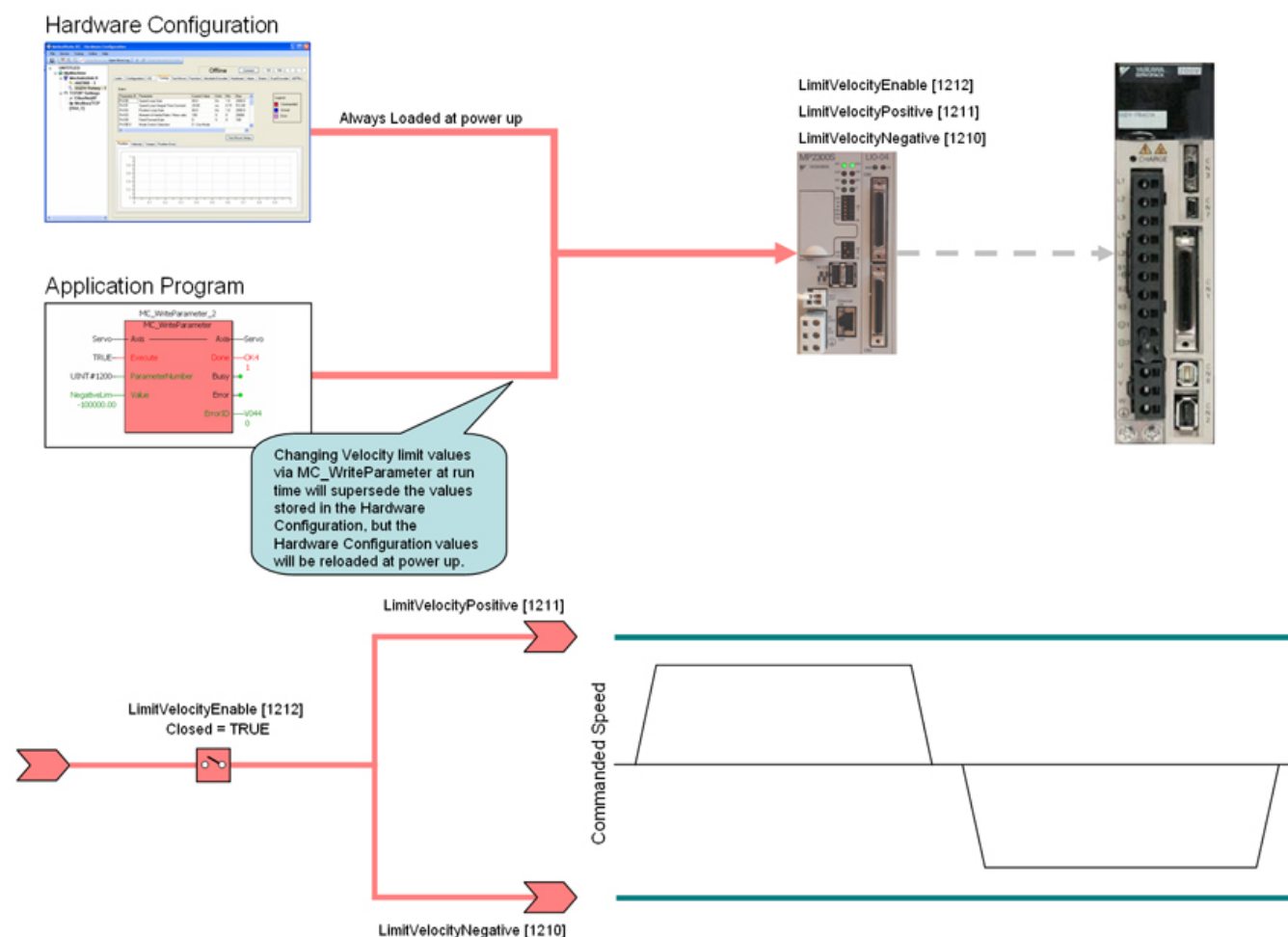
Parameters

| * | Parameter | Data Type | Description |
|-------------------|---------------------------|--------------------------|---|
| VAR_IN_OUT | | | |
| B | Axis | AXIS REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| VAR_INPUT | | | |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | LimitVelocityEnable | BOOL | Enables / Disables the velocity limit function in the motion engine. |
| V | LimitVelocityPositive | LREAL | The maximum commanded velocity allowed |
| V | LimitVelocityNegative | LREAL | The minimum commanded velocity allowed |
| VAR_OUTPUT | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| V | LimitPositionEnableEcho | BOOL | Status of the Velocity Limit function from the motion engine. |
| V | LimitPositionPositiveEcho | LREAL | Value used by the motion engine for the maximum allowed commanded velocity. |

| | | | |
|---|---------------------------|-------|---|
| V | LimitPositionNegativeEcho | LREAL | Value used by the motion engine for the minimum allowed commanded velocity. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

The function block uses MC_ReadBoolParameter, MC_WriteBoolParameter, MC_ReadParameter, and MC_WriteParameter.



- The software velocity limits are managed by the MPieci controller. The parameters are called `LimitVelocityPositive` and `LimitVelocityNegative`, with values of `UINT#1211` and `UINT#1210` respectively. Use the `MC_WriteParameter` function block for these and all controller side parameters. Velocity limit parameters are in user units / sec.
- When a velocity limit is exceeded, a controller alarm will be generated, obtainable via the `MC_ReadAxisError` function block, or the web server.
- The controller alarm will be `16#3202 0003` if the positive velocity limit is exceeded and `16#3202 0004` if the negative velocity limit is exceeded.
- To disable the velocity limits, set `LimitVelocityEnable`, parameter 1212 to zero.
- `LimitVelocityPositive` must be zero or greater.

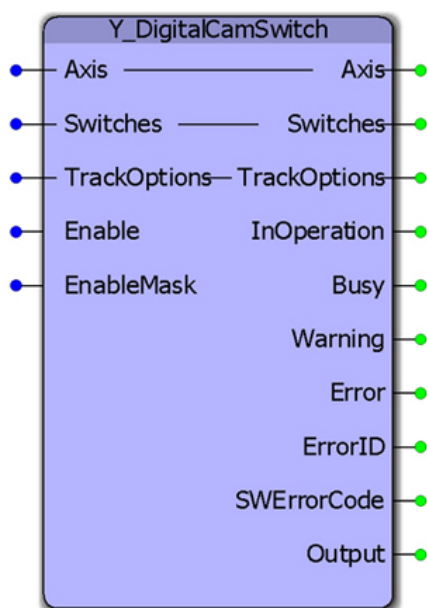
- LimitVelocityNegative must be zero or lower.

Error Description

| ErrorID | Meaning |
|-----------------------|---|
| 0 | No error. |
| 10028 | Positive Velocity Limit must be LREAL#0.0 or greater. |
| 10029 | Negative Velocity Limit must be LREAL#0.0 or lower. |



Y_DigitalCamSwitch



This function block commands a group of discrete output bits analogous to a set of mechanical cam controlled switches driven by a rotating shaft. Forward and backward movements are allowed. A maximum of 32 outputs and 256 switches are supported. Starting in v340, support was added to include the FT62, a specialized high speed output capability of the Sigma 7 ServoPack.

Library

PLCopen Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|--------------|-------------------------------|---|
| VAR_IN_OUT | | | |
| B | Axis | AXIS_REF | Logical axis reference. This value can be located on the Configuration tab in the Hardware Configuration (logical axis number). |
| B | Switches | CAMSWITCH_REF | Reference to the switching actions. 256 maximum switches. |
| E | TrackOptions | TRACK_REF | Reference to the track related properties. 32 maximum tracks. |
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute while enable is held high. FALSE |

| | | | | |
|-------------------|-------------|--------------------------------|--|---------|
| E | EnableMask | DWORD | Individually enables the tracks [0..31] per the bit pattern. Value of 1 means Enabled, 0 means disabled. Least significant bit corresponds to Track [0]. Default if not connected is All Tracks Enabled. | DWORD#0 |
| VAR_OUTPUT | | | | |
| B | InOperation | BOOL | Function Block Enable is ON and at least 1 track is enabled (EnableMask is <> 0). | |
| B | Busy | BOOL | Function Block Enable is ON but no tracks are enabled (EnableMask = 0). | |
| E | Warning | BOOL | Signals that a non-critical error has occurred within the function block. In this case, the block will continue to function. | |
| E | SWErrorCode | SWERROR STRUCT | Switch Error Code Structure that identifies particular warnings with switch settings. The user can monitor this ErrorCode if Warning output comes on. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |
| E | Output | DWORD | Resulting CamSwitch output for each track per the bit pattern. Least significant bit corresponds to Track [0]. This Output will need to be tied to physical outputs outside of the DigitalCamSwitch FB. | |

Notes

- This functionality is sometimes called PLS – Phase or Position or Programmable Limit Switch.
- Switches will be evaluated for both forward and reverse travel of the axis.
- OnCompensation and OffCompensation will only be applied when the axis is moving in the Positive Direction.
- Track Hysteresis is not supported.
- When change tracknumber and reverse signal of any switch, Sigma7_FT62 feature requires controller reboot.
- The function block 'Output' is not supported by Sigma7_FT62 and not output bit can be observed for this feature.
- More information about Sigma7_FT62 will be covered in the Application Note.

Restrictions

If the output specified in the PLS is also controlled somewhere else in the project then the last instruction wins. This would also be the case when a single output is used in two PLS blocks.

The PLS block will support a maximum of 256 switches and 32 outputs. This means that the block will react to a maximum of 512 positions (two for each switch).

If the cam-like lobes of multiple switches intersect with each other for a single track the net effect would be an OR-ing of the switches.

Example1 SW1: on at 10, off at 50, SW2: on at 20, off at 30; net effect on at 10 off at 50.

Example2 SW1: on at 10, off at 50, SW2: on at 40, off at 60; net effect on at 10 off at 60.

Operation

On the rising edge of Enable, the input data will be checked against restrictions. The busy output will remain on until at least 1 track is enabled and the FB is controlling the outputs, then the InOperation bit will be set and the busy bit reset.

While the Enable is on, the EnableMask value will be read each scan and effect the output control.

On the falling edge of Enable, all outputs will be reset (turn off), and the InOperation, Busy, and Error bits will be reset. ErrorID output will be set to 0.

Input Data that is read only on rising edge of Enable:

CAMSWITCH_STRUCT[.].TrackNumber

CAMSWITCH_STRUCT[].AxisDirection
 CAMSWITCH_STRUCT[].CamSwitchMode
 AXIS_REF
 CAMSWITCH_REF.MasterType
 CAMSWITCH_REF.MachineCycle
 CAMSWITCH_REF.LastSwitch

Input Data that is read continuously while Enabled:

CAMSWITCH_STRUCT[].FirstOnPosition
 CAMSWITCH_STRUCT[].LastOnPosition
 CAMSWITCH_STRUCT[].Duration
 CAMSWITCH_STRUCT[].FirstOnPosition
 TRACK_STRUCT[].OnCompensationScaler
 TRACK_STRUCT[].OffCompensationScaler
 Enable
 EnableMask
 Output Bits: Boolean Outputs are exclusive

AxisDirection must be 0, any other number will default to 0. (values 1 and 2 not supported.)

CamSwitchMode must be 0 or 1, any other number will default to 0.

Error Description

| ErrorID | Meaning |
|-----------------------|---|
| 0 | No error. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4673 | StartPosition is outside of master's range. |
| 10061 | MasterType is something other than 0 or 1. |
| 10062 | MachineCycle must be a positive value if MasterType = 0 |
| 10063 | LastSwitch is set outside the 0-255 range. Sigma7_FT62 feature supports switch with the range of 0-31 |
| 10064 | Track Number outside the 0-31 range. Sigma7_FT62 feature supports track(signal) with the range of 0- |
| 10065 | FirstOnPosition is not equal to 0. |
| 10066 | LastOnPosition is not equal to 0. |
| 10067 | AxisDirection is not equal to 0. Direction enumeration is ranging from 0 to 2. |
| 10068 | CamSwitchMode is not equal to 0. Sigma7_FT62 supports both position mode or time mode, which is 0 OR 1. |
| 10069 | Duration is set to 0 or a negative value. |
| 10070 | OnCompensationScaler is set to an invalid value. |
| 10071 | OffCompensationScaler is set to an invalid value. Sigma7_FT62 does not support this input, should set to zero all the time. |
| 10072 | ImproperOnPos_SetError. |
| 10073 | OnOffPosition_Error. In Sigma7_FT62 feature, when it is position mode, FirstOnPosition and LastOnPosition can't be the same value. |
| 10220 | Encoder ConfigurationError. Encoder must be configured as an absolute encoder for Sigma7_FT62 feature. Set Pn002.2 to 0. |

| | |
|-----------------------|--|
| 10221 | Invalid Enumeration. Sigma7_FT62 high speed output signal enumeration does not match acceptable values. |
| 10222 | Reboot Required Error. Reboot the controller to complete writing of non-volatile memory. |
| 10223 | Out Of SyncError. The current encoder position is out of sync with the current output and checkpoint positions. |
| 10224 | Output Delta Error. The output position cannot be changed by more than +/- 45 degrees in a single machine cycle. |

Example 1:

Consider the PLS requirement shown in the figure below. There are 4 tracks (0, 1, 2, 3) in the set up and a total of 5 switches (0, 1, 2, 3, 4).

Track 0 has 2 switches associated with it.

Switch 0: On Position : 2 degrees

Off Position : 10 degrees

Switch 1: On Position : 200 degrees

Off Position : 210 degrees

Track 1 has 1 switch associated with it

Switch 2: On Position : 20 degrees

Off Position : 30 degrees

Track 2 has 1 switch associated with it

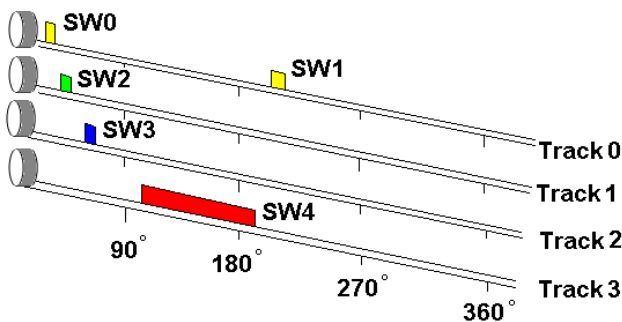
Switch 3: On Position : 50 degrees

Off Position : 60 degrees

Track 3 has 1 switch associated with it

Switch 4: On Position : 100 degrees

Off Position : 200 degrees



The switches can be defined and initialized as follows:

```

(*PLS initialization*)

4      PLS_Switches.LastSwitch :=INT#4;
360.00000000 PLS_Switches.MachineCycle :=LREAL#360.0;
0      PLS_Switches.MasterType :=INT#0;

0      PLS_Switches.Switch[INT#0].TrackNumber := 0;
0      PLS_Switches.Switch[INT#0].AxisDirection := INT#0;
0      PLS_Switches.Switch[INT#0].CamSwitchMode := INT#0; (* 0: Position, 1: Time *)
0      PLS_Switches.Switch[INT#0].Duration := DINT#0;
2.00000000 PLS_Switches.Switch[0].FirstOnPosition := LREAL#2.0;
10.00000000 PLS_Switches.Switch[0].LastOnPosition := LREAL#10.0;

0      PLS_Switches.Switch[INT#1].TrackNumber := 0;
0      PLS_Switches.Switch[INT#1].AxisDirection := INT#0;
0      PLS_Switches.Switch[INT#1].CamSwitchMode := INT#0; (* 0: Position, 1: Time *)
0      PLS_Switches.Switch[INT#1].Duration := DINT#0;
200.00000000 PLS_Switches.Switch[1].FirstOnPosition := LREAL#200.0;
210.00000000 PLS_Switches.Switch[1].LastOnPosition := LREAL#210.0;

1      PLS_Switches.Switch[INT#2].TrackNumber := 1;
0      PLS_Switches.Switch[INT#2].AxisDirection := INT#0;
0      PLS_Switches.Switch[INT#2].CamSwitchMode := INT#0; (* 0: Position, 1: Time *)
0      PLS_Switches.Switch[INT#2].Duration := DINT#0;
20.00000000 PLS_Switches.Switch[2].FirstOnPosition := LREAL#20.0;
30.00000000 PLS_Switches.Switch[2].LastOnPosition := LREAL#30.0;

2      PLS_Switches.Switch[INT#3].TrackNumber := 2;
0      PLS_Switches.Switch[INT#3].AxisDirection := INT#0;
0      PLS_Switches.Switch[INT#3].CamSwitchMode := INT#0; (* 0: Position, 1: Time *)
0      PLS_Switches.Switch[INT#3].Duration := DINT#0;
50.00000000 PLS_Switches.Switch[3].FirstOnPosition := LREAL#50.0;
60.00000000 PLS_Switches.Switch[3].LastOnPosition := LREAL#60.0;

3      PLS_Switches.Switch[INT#4].TrackNumber := 3;
0      PLS_Switches.Switch[INT#4].AxisDirection := INT#0;
0      PLS_Switches.Switch[INT#4].CamSwitchMode := INT#0; (* 0: Position, 1: Time *)
0      PLS_Switches.Switch[INT#4].Duration := DINT#0;
100.00000000 PLS_Switches.Switch[4].FirstOnPosition := LREAL#100.0;
200.00000000 PLS_Switches.Switch[4].LastOnPosition := LREAL#200.0;

```

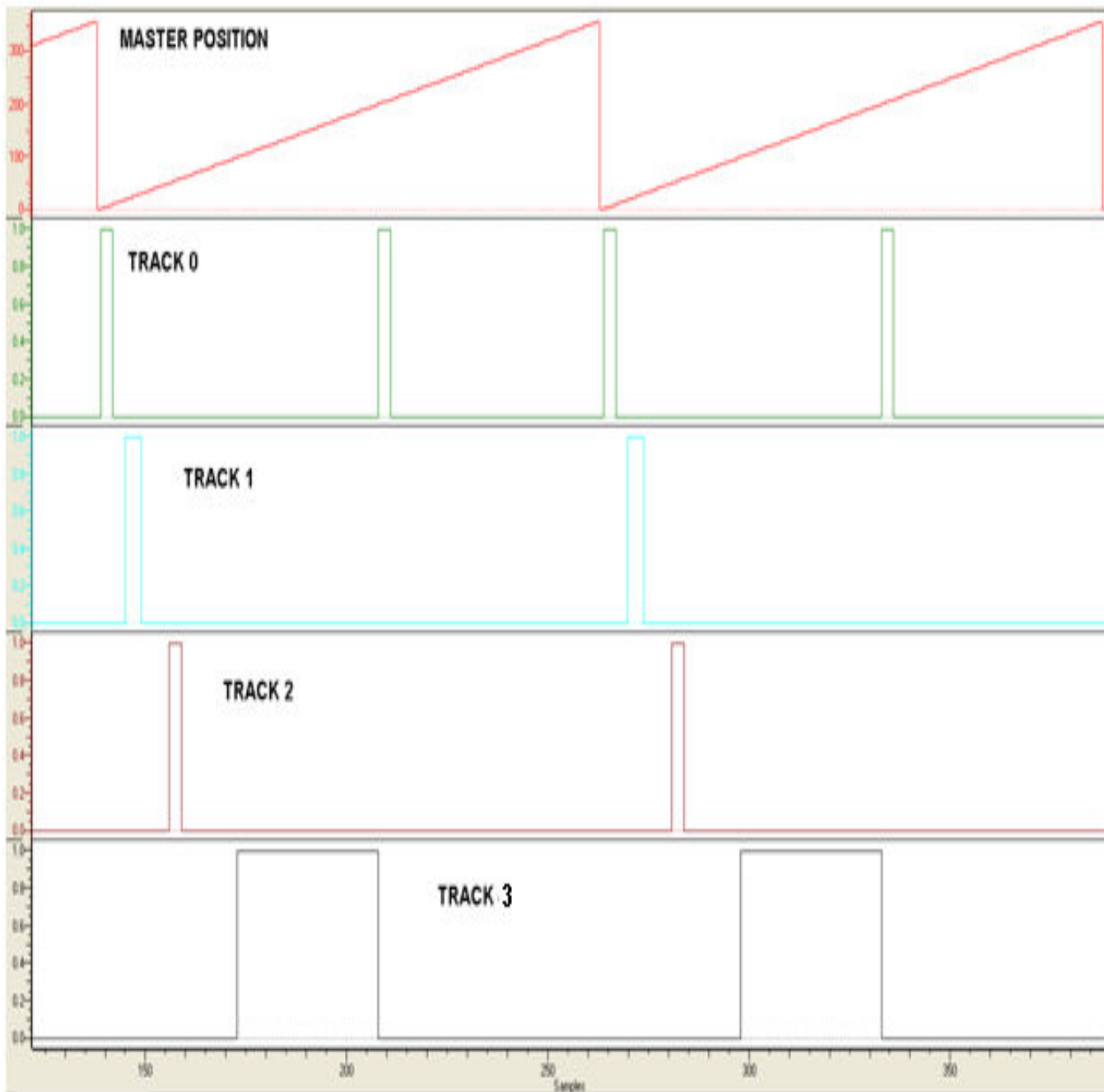
Variable Properties

Name:

Data Type:

Usage:
 ☐ RETAIN

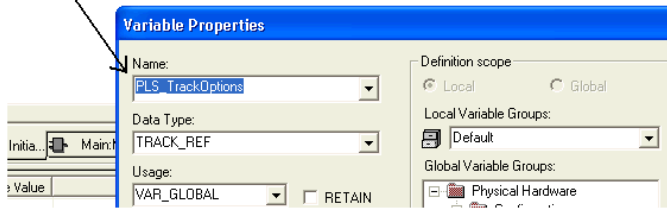
Once the Y_DigitalCamSwitch is enabled and is in operation, the track output states will be as shown in the logic analyzer plot given below. Note that the outputs will correspond to the position of the axis.



Example 2:

If speed compensation needs to be applied to individual tracks, it can be accomplished by specifying either `OnCompensationScaler` or `OffCompensationScaler` in the `TRACK_REF` data type (`TrackOptions` in `Y_DigitalCamSwitch`). An example of applying a -0.06 `OffCompensation` on track 1 and 0.05 `OnCompensation` on track 3 is shown below.

```
PLS_TrackOptions.Track[3].OnCompensationScaler := LREAL#0.05;
```



```

(*PLS initialization*)

4      PLS_Switches.LastSwitch :=INT#4;
360.00000000 PLS_Switches.MachineCycle :=LREAL#360.0;
0      PLS_Switches.MasterType :=INT#0;

0      PLS_Switches.Switch[INT#0].TrackNumber := 0;
0      PLS_Switches.Switch[INT#0].AxisDirection := INT#0;
0      PLS_Switches.Switch[INT#0].CamSwitchMode := INT#0; (* 0: Position, 1: Time *)
0      PLS_Switches.Switch[INT#0].Duration := DINT#0;
2.00000000 PLS_Switches.Switch[0].FirstOnPosition := LREAL#2.0;
10.00000000 PLS_Switches.Switch[0].LastOnPosition := LREAL#10.0;

0      PLS_Switches.Switch[INT#1].TrackNumber := 0;
0      PLS_Switches.Switch[INT#1].AxisDirection := INT#0;
0      PLS_Switches.Switch[INT#1].CamSwitchMode := INT#0; (* 0: Position, 1: Time *)
0      PLS_Switches.Switch[INT#1].Duration := DINT#0;
200.00000000 PLS_Switches.Switch[1].FirstOnPosition := LREAL#200.0;
210.00000000 PLS_Switches.Switch[1].LastOnPosition := LREAL#210.0;

1      PLS_Switches.Switch[INT#2].TrackNumber := 1;
0      PLS_Switches.Switch[INT#2].AxisDirection := INT#0;
0      PLS_Switches.Switch[INT#2].CamSwitchMode := INT#0; (* 0: Position, 1: Time *)
0      PLS_Switches.Switch[INT#2].Duration := DINT#0;
20.00000000 PLS_Switches.Switch[2].FirstOnPosition := LREAL#20.0;
30.00000000 PLS_Switches.Switch[2].LastOnPosition := LREAL#30.0;

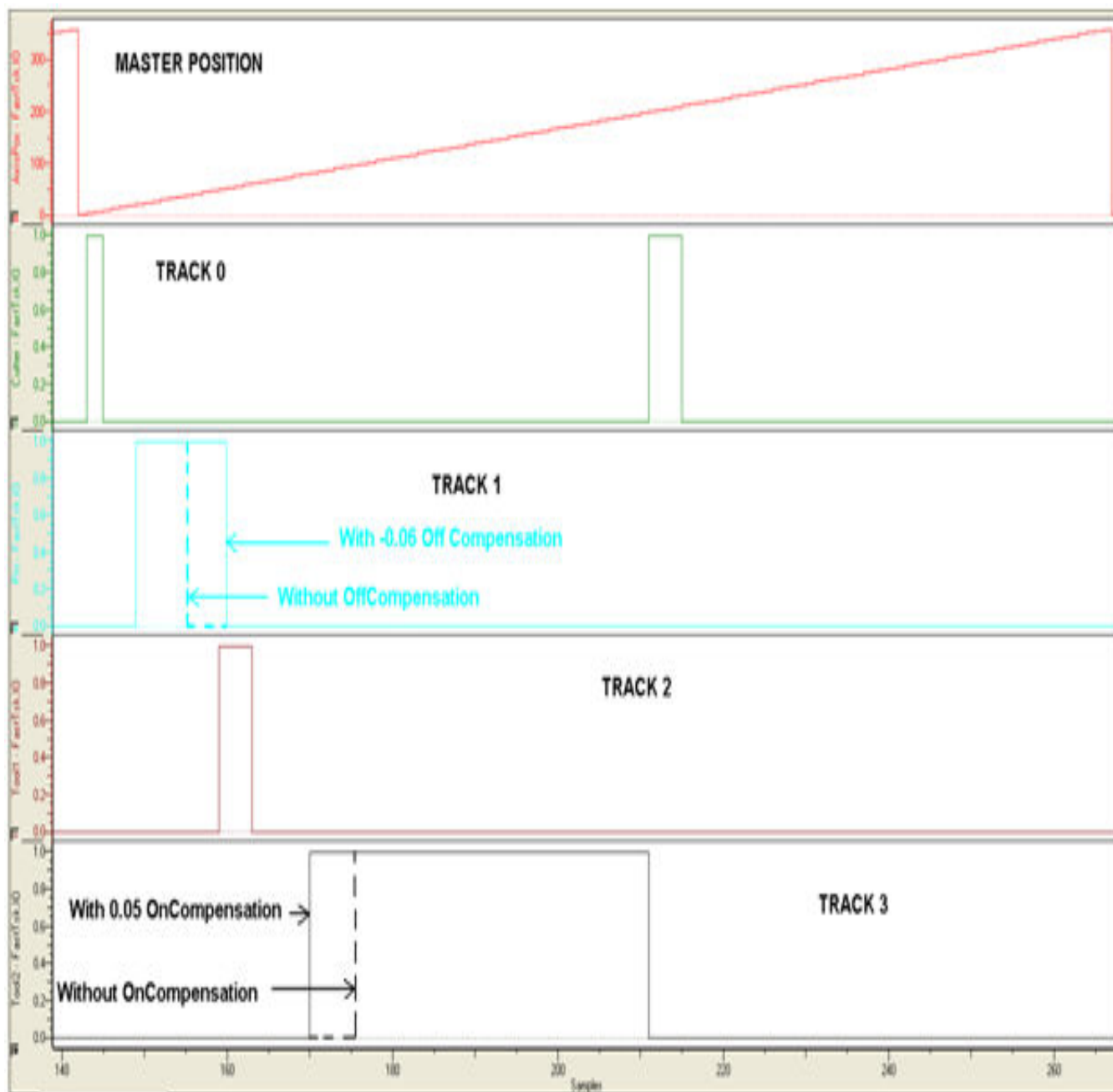
-0.06000000 PLS_TrackOptions.Track[1].OffCompensationScaler := LREAL#-0.06;

2      PLS_Switches.Switch[INT#3].TrackNumber := 2;
0      PLS_Switches.Switch[INT#3].AxisDirection := INT#0;
0      PLS_Switches.Switch[INT#3].CamSwitchMode := INT#0; (* 0: Position, 1: Time *)
0      PLS_Switches.Switch[INT#3].Duration := DINT#0;
50.00000000 PLS_Switches.Switch[3].FirstOnPosition := LREAL#50.0;
60.00000000 PLS_Switches.Switch[3].LastOnPosition := LREAL#60.0;

3      PLS_Switches.Switch[INT#4].TrackNumber := 3;
0      PLS_Switches.Switch[INT#4].AxisDirection := INT#0;
0      PLS_Switches.Switch[INT#4].CamSwitchMode := INT#0; (* 0: Position, 1: Time *)
0      PLS_Switches.Switch[INT#4].Duration := DINT#0;
100.00000000 PLS_Switches.Switch[4].FirstOnPosition := LREAL#100.0;
200.00000000 PLS_Switches.Switch[4].LastOnPosition := LREAL#200.0;

0.05000000 PLS_TrackOptions.Track[3].OnCompensationScaler := LREAL#0.05;

```



Example 3(Sigma7_FT62):

Relationships between Y_DigitalCamSwitch and Sigma7-FT62 required variables:

| Y_DigitalCamSwitch | Sigma7_FT62 |
|--------------------------------------|----------------|
| PLS_Switches.LastSwitch | N/A |
| PLS_Switches.MachineCycle | N/A |
| PLS_Switches.MasterType | N/A |
| PLS_Switches.Switch[0].TrackNumber | OutputFunction |
| PLS_Switches.Switch[0].AxisDirection | OutputFunction |

| | |
|---|-------------------------------|
| PLS_Switches.Switch[0].CamSwitchMode | Pn660 |
| PLS_Switches.Switch[0].Duration | OutputTime |
| PLS_Switches.Switch[0].FirstOnPosition | OutputPosition |
| PLS_Switches.Switch[0].LastOnPosition | OutputPosition/OutputDistance |
| PLS_TrackOptions.Track[0].OnCompensationScaler | OutputPositionCompensation |
| PLS_TrackOptions.Track[0].OffCompensationScaler | N/A |
| PLS_TrackOptions.Track[0].Value | N/A |

Other POU

Toolbox Help Documentation

Help version created 1/31/2018

YASKAWA



PTB_Initialize

This is not a function block but a Program POU in the PLCOpen Toolbox. Its purpose is to reduce the time required to enter initialization code into your project. If you use the provided datatypes, time can be saved by copying and pasting structured text code from this POU into your Initialization POU, then replacing the string "Replace_Me" with another name meaningful to the application.

This POU is not intended to be selected for execution in a task in your application program.

Yaskawa Toolbox

Toolbox Help Documentation

Help version created 1/31/2018

YASKAWA



Getting Started with Yaskawa Toolbox

Requirements for v340

To use the Yaskawa Toolbox, your project must also contain the following:

Firmware libraries:

- YDeviceComm
- PROCONOS

User libraries:

- None



Yaskawa Revision History

Current Version:

***** 2017-12-08 v341 released (filename is still 340, using new project version control numbering) *****

1) StripSpaces - New FB added. DCR 1304.

***** 2017-08-14 v340 released *****

- 1) STRING_TO_BOOL - New FB added. DCR 1068. converts false, FALSE, true, TRUE, 0, 1, BOOL#1, BOOL#0 to BOOL datatype
- 2) GetTaskInterval - New FB added. DCR 1196.
- 3) Blink - DCR 1221. Add handling for Rollover of uSec DINT value from +2147483647 to -2147483648. At 2msec MLink, rollover occurs every approx 70 minutes. Without this fix, the output freezes.

Previous Versions:

(***** 2016-06-21 v301 released *****)

- 1) Blink - Support Mechatrolink rates less than one millesecond. DCR 825.
- 2) PLCuSec - New function block to provide a microsecond counter.

(***** 2015-01-31 v300 released *****)

- 1) Identical to v205, but recompiled specifically for MotionWorks IEC v3.x.

(***** 2014-11-17: v205 released. Requires firmware 2.1.0 or higher *****)

- 1) DEC_TO_HEX and HEX_TO_DEC - Added new function blocks.
- 2) CheckSumCalculate and CheckSumValidate - Updated to include a new method for two's compliment in hexadecimal.
- 3) XYLookup - Added support for decreasing X values.
- 4) YaskawaDatatypes - Added YTB_DINT32 as an Array of 32 DINT.

(***** 2013-09-01: v204 released. Requires firmware 2.1.0 *****)

- 1) More string and byte array datatypes added to be used across the Toolbox family
- 2) LAU - new function block added. Creates a linear profile from current value to target value based on rate/scan input
- 3) SLAU - new function block added. Creates an s-curve (moving average profile) from a current value to target value.

4) PControl - new function block added. Subset of PID block

5) Removed references to the Math Toolbox to simplify usage. NOTE: This change makes version 204 and higher incompatible with MP2600iec firmware versions 2.0, 2.1, and 2.2!

6) RateCalculator - new function block added.

(***** 2012-08-16: v203 released. Requires firmware 2.1.0 *****)

1) CheckSumValidate_BYTE - Removed the Result output and added the Method input to select a calculation method to use. There will now be a function block error if the checksum is not valid.

2) CheckSumCalculate_BYTE - Added the Method input.

(***** 2012-06-19: v202 released. Requires firmware 2.1.0 *****)

1) Sweep function improved by adding Trigger and Stream inputs.

2) Explicit_Message - new function block added. Y_DeviceComm firmware library added

3) CheckSumCalculate_BYTE - new function block added.

4) CheckSumValidate_BYTE - new function block added.

4) Blink function - resolution improved.

(***** 2011-11-16: v201 released *****)

1) Reduced the size of the DataType definition for MovingAverageArray back down to 1000 as it was in v008. 30000 is too large, and causing "Data Area Exceeded" error for some users.

(***** 2011-07-29: v200 released *****)

1) Built from v010beta for MotionWorks IEC 2.0.

2) Upgraded to Math Toolbox v200

3) Changed Scaler FB to allow negative slope

4) Fixed bug in XY Lookup (Min and Max were not getting reset for each scan.)

(***** 2011-04-27: v010 beta created *****)

1) Updated to Math_Toolbox_v004

2) Removed spaces in filename and replaced with underscores

3) Changed MovingAverage to always divide by the number of samples specified by the user. Old methods divided by the number of actual samples until the entire buffer had been filled.

4) Changed the Blink functions frequency input to REAL datatype and the value now accepts a frequency. (Before it was TIME datatype)

5) Added RTCString as output of RealTimeClock FB

6) Added error checking to WindowCheck FB to ensure Window value is greater than zero.

(***** 2011-03-25: v009 released *****)

1) Added Error logic to PControl

2) Improved MovingAverage to not require a FOR LOOP to initialize the buffer at rising edge of ENABLE

3) Moved Math Functions to Math Toolbox

4) Included ProConOS firmware library to use the Real Time Clock function, provided FB to convert RTC from STRING TO STRUCT

- 5) Added DateCompare FB, STILL UNDER TEST in v009.
- 6) Moved REM function to the Math Toolbox v002.
- 7) Added XYLookup, which is equivalent to the FGN function in the standard MP series
- 8) Added DataSort, to arrange the data for use with XYLookup if it has been collected out of order.
- 9) Added DataRecord to capture XY data by either streaming or when the Trigger input goes high.
- 10) Fixed MovingAverage - it was not properly subtracting old and adding new values.

(***** 2010-02-03: v008 released *****)

Added REM function to return the remainder of LREAL division.

Added Pack & Unpack of Byte and Word.

Added RangeCheck function block.

Added WindowCheck function.

Added Sweep function, useful for testing a range of values.

(***** 2009-10-29: v007 released *****)

Added ErrorID and outputs to MovingAverage.

Removed ErrorWatchDog functions.

Improved templates with new, reduced logic that does not use SET or RESET coils.

Added template functions for Enable in ST and LD.

Changed functions for MP2600 compatibility by removing EN / ENO and adding MOVE_UINT.

Added Valid output to PID function.

(***** 2009-04-03: v006 released *****)

Added CommHeartbeat Function

(***** 2009-03-27: v005 released *****)

Added MovingAverage Function

(***** 2009-02-06: v004 released *****)

Added the Blink function for toggling an output at a TIME interval.

Added FB_Error_Capture, FB_Error_WatchDog, FB_Error_Clear for trapping function block errors

Corrected and improved PIDControl FB based on Eric Kelley's modifications

Under Construction! - FBError trapping functions blocks, Timestamp not implemented.

(***** 2008-10-17: v002 released *****)

Added PIDControl Function Block and associated DataType structure

(***** 2008-09-26 v001 released *****)

Execute_FB_Template:

Shell code with all logic to replicate the behavior of PLCOpen FB with Execute, Busy, Done, Error, & ErrorID outputs

Behavior and variables match the ST version.

Execute_ST_Template:

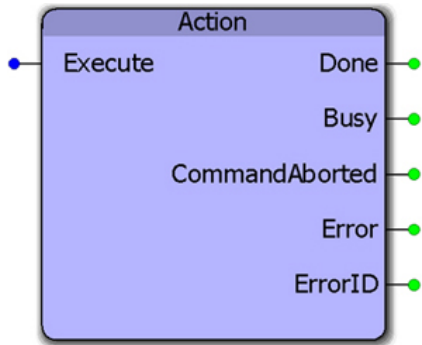
Shell code with all logic to replicate the behavior of PLCOpen FB with Execute, Busy, Done, Error, & ErrorID outputs

Behavior and variables match the FB version.

Action:

Dummy FB to show simulation of the template function blocks.

Action



This function block is only for demonstration purposes. It is applied in the Enable_F_Template, Enable_ST_Template, Execute_FB_Template, and Execute_ST_Template function blocks to show how the inputs and outputs of nested functions can be interlocked to apply the PLCopen standards for I/O behavior.

Library

Yaskawa Toolbox

Parameters

| * | Parameter | Data Type | Description |
|------------|-----------|-----------|--|
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |

| | | | |
|---|----------------|------|--|
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Error Description

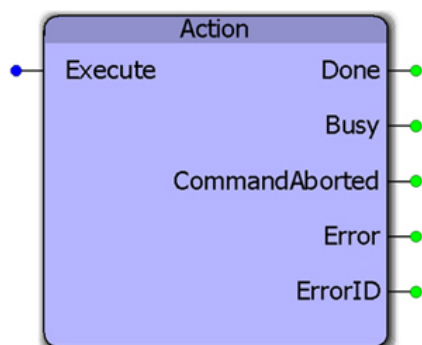
This function provides no Errors.

Example

See the Enable_F_Template, Enable_ST_Template, Execute_FB_Template, and Execute_ST_Template function blocks.



Action



This function block is only for demonstration purposes. It is applied in the Enable_F_Template, Enable_ST_Template, Execute_FB_Template, and Execute_ST_Template function blocks to show how the inputs and outputs of nested functions can be interlocked to apply the PLCopen standards for I/O behavior.

Library

Yaskawa Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|----------------|-----------|--|
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Error Description

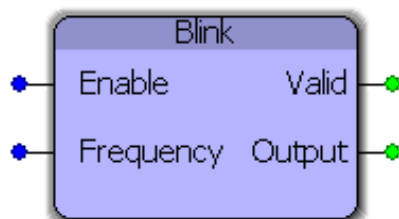
This function provides no Errors.

Example

See the Enable_F_Template, Enable_ST_Template, Execute_FB_Template, and Execute_ST_Template function blocks.



Blink



This function block will toggle the Output at the frequency specified at the input. If Frequency is set to 1.0, then the output will be on for 500 mSec and off for 500 mSec. Note that the actual frequency may be affected by the application scan rate in which this function block is placed.

Library

Yaskawa Toolbox

Parameters

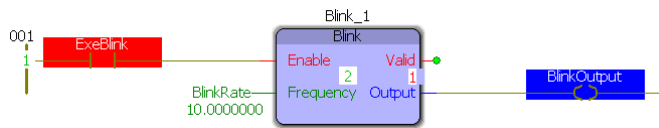
| Parameter | | Data Type | Description | |
|-------------------|-----------|-----------|---|----------------|
| VAR_INPUT | | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. | FALSE |
| V | Frequency | REAL | The cycle rate in Hertz. | REAL#0.0 |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates if the function is operating. | |
| V | Output | BOOL | Toggled at the specified frequency when the function is enabled. | |

Error Description

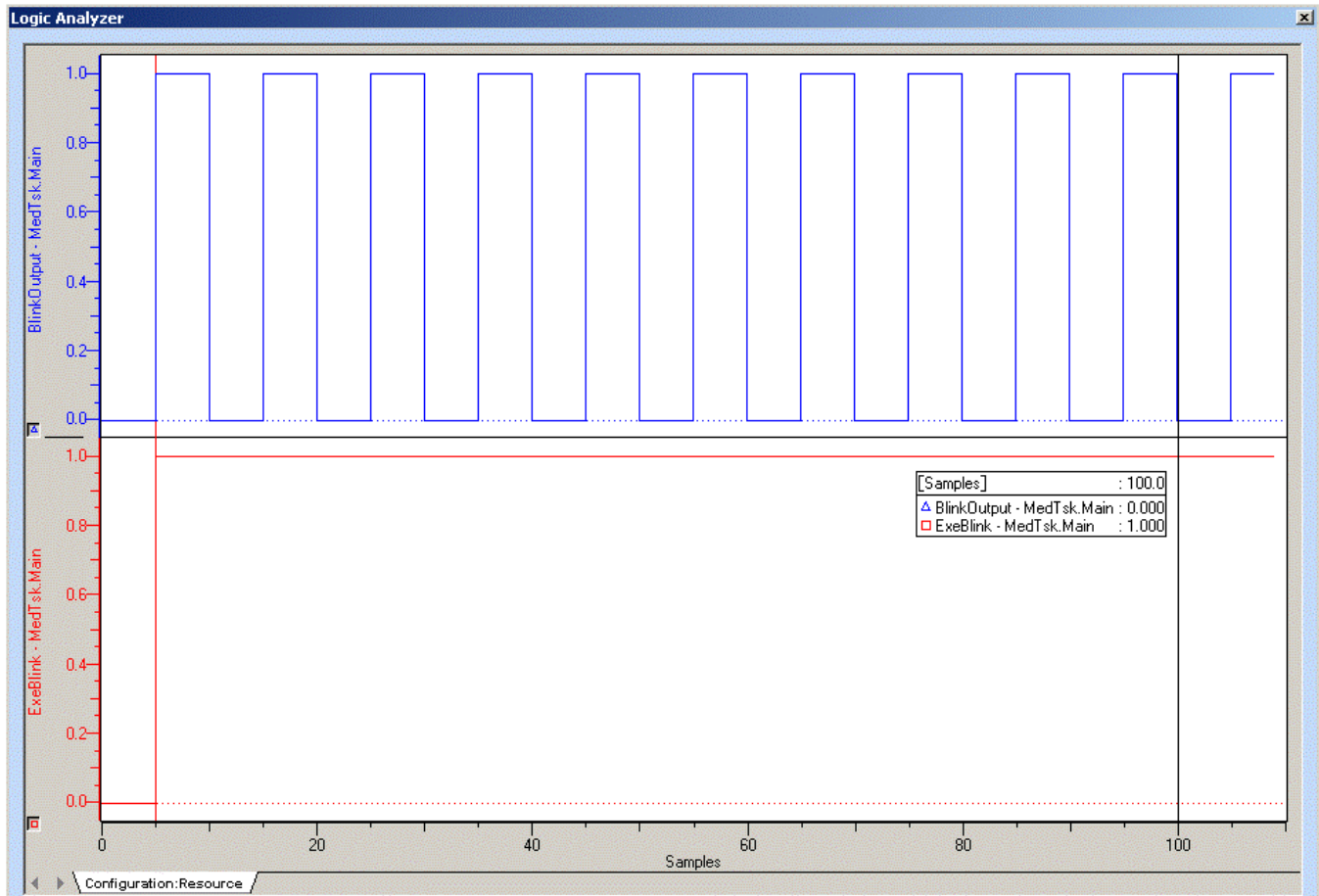
The valid output will be high if the function is operating. If Enable is held high and the Frequency is not greater than zero, the valid output will be low.

Example

Blink_1 was placed in a 10 mSec task so the expected output is 50 mSec on and 50 mSec off which corresponds to 10 cycles.



Logic Analyzer output:





ByteSwap



This function block swaps the upper and lower byte of a word.

Library

Yaskawa Toolbox

Parameters

| Parameter | | Data Type | Description | |
|------------|---------|-----------|-------------|---------|
| VAR_INPUT | | | | Default |
| V | WordIn | WORD | Input word | WORD#0 |
| VAR_OUTPUT | | | | |
| V | WordOut | WORD | Output word | |

Error Description

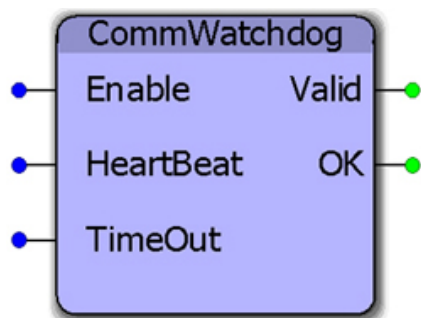
This block will not produce any errors.

Example:





CommWatchDog



This function block allows the application program to monitor data being transmitted from a master device. If the data does not change within the TimeOut period, then the OK output goes off to indicate that the communications is not being updated by the master.

Library

Yaskawa Toolbox

Parameters

| * | Parameter | Data Type | Description | |
|-------------------|-----------|-----------|--|----------------|
| VAR_INPUT | | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. | FALSE |
| V | HeartBeat | DINT | Value that the master changes and sends to the MPiec controller. | DINT #0 |
| V | WatchDog | DINT | The HeartBeat input must change value within the WatchDog period for communications to be considered OK. | DINT #0 |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| V | OK | BOOL | Indicates if the HeartBeat input has changed within the TimeOut period. | |

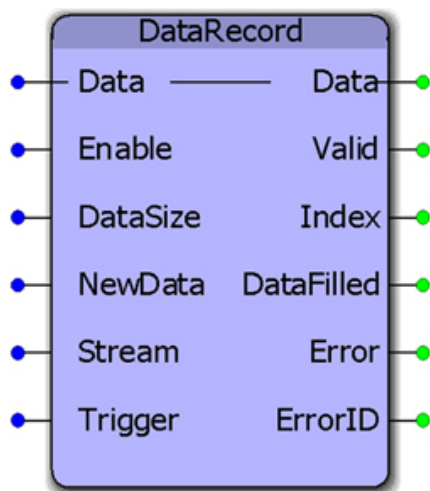
Error Description

The Valid Output will be high when the function is executing. If the WatchDog value is not greater than zero, the function will not operate.

Example



DataRecord



This function block will record Data into the array. Data can be stored continuously or intermittently. The default datatype for Data to be recorded can be customized by the user to satisfy other recording needs.

Library

Yaskawa Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|--------------|--|
| VAR_IN_OUT | | | |
| V | Data | XYDataStruct | Structure where recorded data is stored. |
| VAR_INPUT | | | |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | DataSize | INT | The maximum amount of data to be stored, which must be less than or equal to the datatype definition for Data. |
| V | NewData | XYData | Structure containing a single pair of X and Y data to be added to the XYDataStruct. |
| V | Stream | BOOL | If TRUE, the function will store NewData every application scan. |
| V | Trigger | BOOL | If Stream is FALSE, then the function will store new Data only upon the rising edge of Trigger. |
| | | | Default |
| | | | FALSE |
| | | | INT #0 |
| | | | n/a |
| | | | FALSE |
| | | | FALSE |

| VAR_OUTPUT | | | |
|------------|------------|------|---|
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| V | Index | INT | Indicates the last array index recorded. |
| V | DataFilled | BOOL | Indicates when the Data recording has reached the DataSize. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

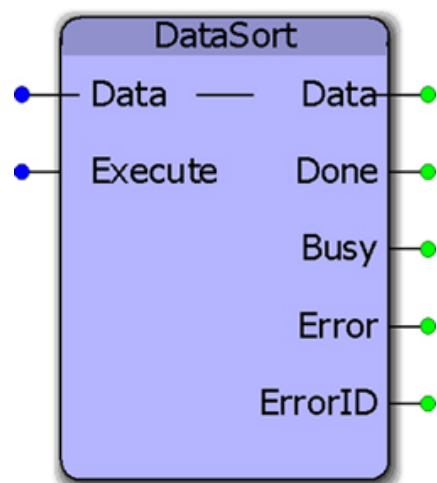
Error Description

| ErrorID | Meaning |
|-----------------------|------------------------------------|
| 0 | No error. |
| 10024 | DataSet must be greater than zero. |

Example



DataSort



This function block will sort data from the lowest to highest value of X data. This generic function can be customized for other sorting needs.

Library

Yaskawa Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|--------------|--|
| VAR_IN_OUT | | | |
| V | Data | XYDataStruct | Structure where recorded data is stored. |
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |

| | | | |
|---|---------|------|---|
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

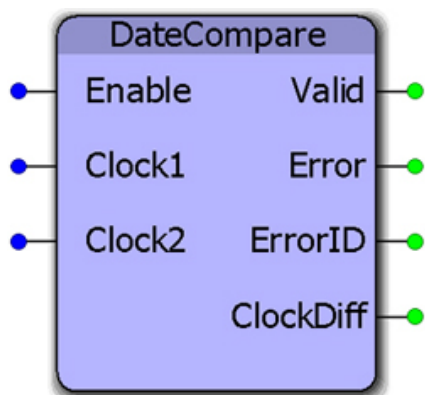
This function is designed to sort by the X data in ascending order only.

Error Description

The default version of this block produces no errors (customizing this block may add errors depending on what functions are used internally).



DateCompare



This function block will calculate the difference between two real time clock values and provide the difference as a real time clock value. The clock values may be obtained using the RealTimeClock function block.

Library

Yaskawa Toolbox

Parameters

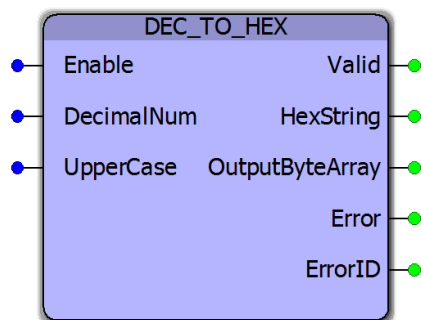
| * | Parameter | Data Type | Description |
|-------------------|-----------|-----------|---|
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | Clock1 | RTCStruct | The more recent real time clock value. |
| V | Clock2 | RTCStruct | The older real time clock value. |
| VAR_OUTPUT | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |
| V | ClockDiff | RTCStruct | Outputs the time difference between Clock1 - Clock2. |

Error Description

There will be no Errors reported.



DEC_TO_HEX



This function block converts DINT numeric input into a hexadecimal STRING output.

Library

Yaskawa Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------------|----------------|--|
| VAR_INPUT | | | |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | DecimalNum | DINT | Input value to be converted. |
| V | UpperCase | BOOL | If True, the output string will contain upper case ASCII characters. If False, the output string will contain lower case ASCII characters. |
| VAR_OUTPUT | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| V | HexString | STRING | String containing the hexadecimal representation of DecimalNum. |
| V | OutputByteArray | YTB_ByteArray8 | Byte array containing the same ASCII values as in the OutputString. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

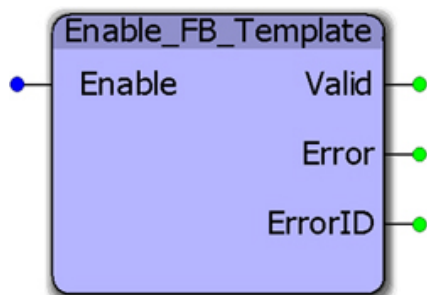
Notes

Error Description

This function block will output ErrorIDs from the BUF_TO_STRING function.



Enable_FB_Template



This function block is a template which can be used when developing functions which adhere to the PLCOpen output behavior.

Library

Yaskawa Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|-----------|---|
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| VAR_OUTPUT | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Error Description

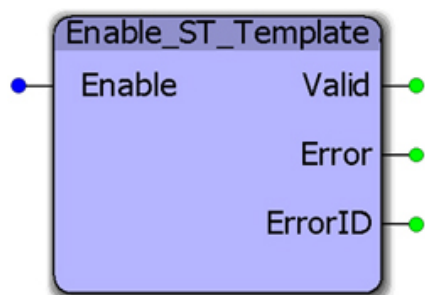
This is an example function block template with no specific errors of its own.

Example

For full documentation about how to create PLCOpen compliant function blocks, see this [application note](#) (AN.MWIEC.01) on www.yaskawa.com.



Enable_ST_Template



This function block is a template which can be used when developing functions which adhere to the PLCopen output behavior.

Library

Yaskawa Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|-----------|---|
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| VAR_OUTPUT | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Error Description

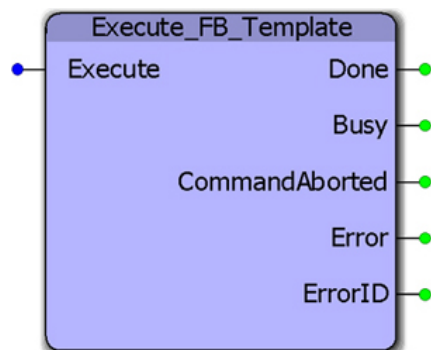
This is an example function block template with no specific errors of its own.

Example

For full documentation about how to create PLCopen compliant function blocks, see this [application note](#) (AN.MWIEC.01) on www.yaskawa.com.



Execute_FB_Template



This function block is a template which can be used when developing functions which adhere to the PLCopen output behavior.

Library

Yaskawa Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|----------------|-----------|--|
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

Depending on the exact usage, there may be outputs in the template that will not apply, such as CommandAborted. Determine what outputs are necessary for your situation and make modifications accordingly.

Error Description

This is an example function block template with no specific errors of its own.

Example

For full documentation about how to create PLCopen compliant function blocks, see this [application note](#) (AN.MWIEC.01) on www.yaskawa.com.



Execute_ST_Template



This function block is a template which can be used when developing functions which adhere to the PLCopen output behavior.

Library

Yaskawa Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|----------------|-----------|--|
| VAR_INPUT | | | Default |
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. |
| VAR_OUTPUT | | | |
| B | Done | BOOL | Set high when the commanded action has completed successfully. If another block takes control before the action is completed, the Done output will not be set. This output is reset when Execute goes low. |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | CommandAborted | BOOL | Set high if motion is aborted by another motion command or MC_Stop. This output is cleared with the same behavior as the Done output. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

This template contains supporting code for:

- Initialization
- Main code body
- Output status updates

Depending on the exact usage, there may be outputs in the template that will not apply, such as CommandAborted. Determine what outputs are necessary for your situation and make modifications accordingly.

Error Description

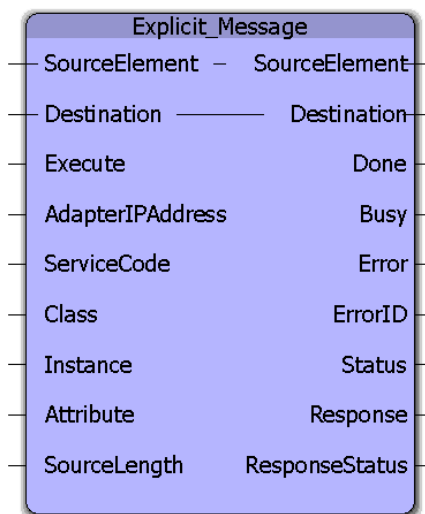
This is an example function block template with no specific errors of its own.

Example

For full documentation about how to create PLCopen compliant function blocks, see this [application note](#) (AN.MWIEC.01) on www.yaskawa.com.



Explicit_Message



This function block will write/read a block of data to/from an Ethernet/IP Target (Adapter) device via Explicit Messaging. Unlike Implicit Messaging (a built in feature of the MPiec Series Controllers) which uses the UDP protocol, Explicit Messaging uses TCP/IP.

This function block emulates the MSG function block in the AB RSLogix platform. The Explicit_Message function block is best suited when an application requires unscheduled and less frequent updates like recipe transfer, cam table transfer, job transfer etc. Explicit Messaging makes use of a request/response format for communication.

Library

Yaskawa Toolbox

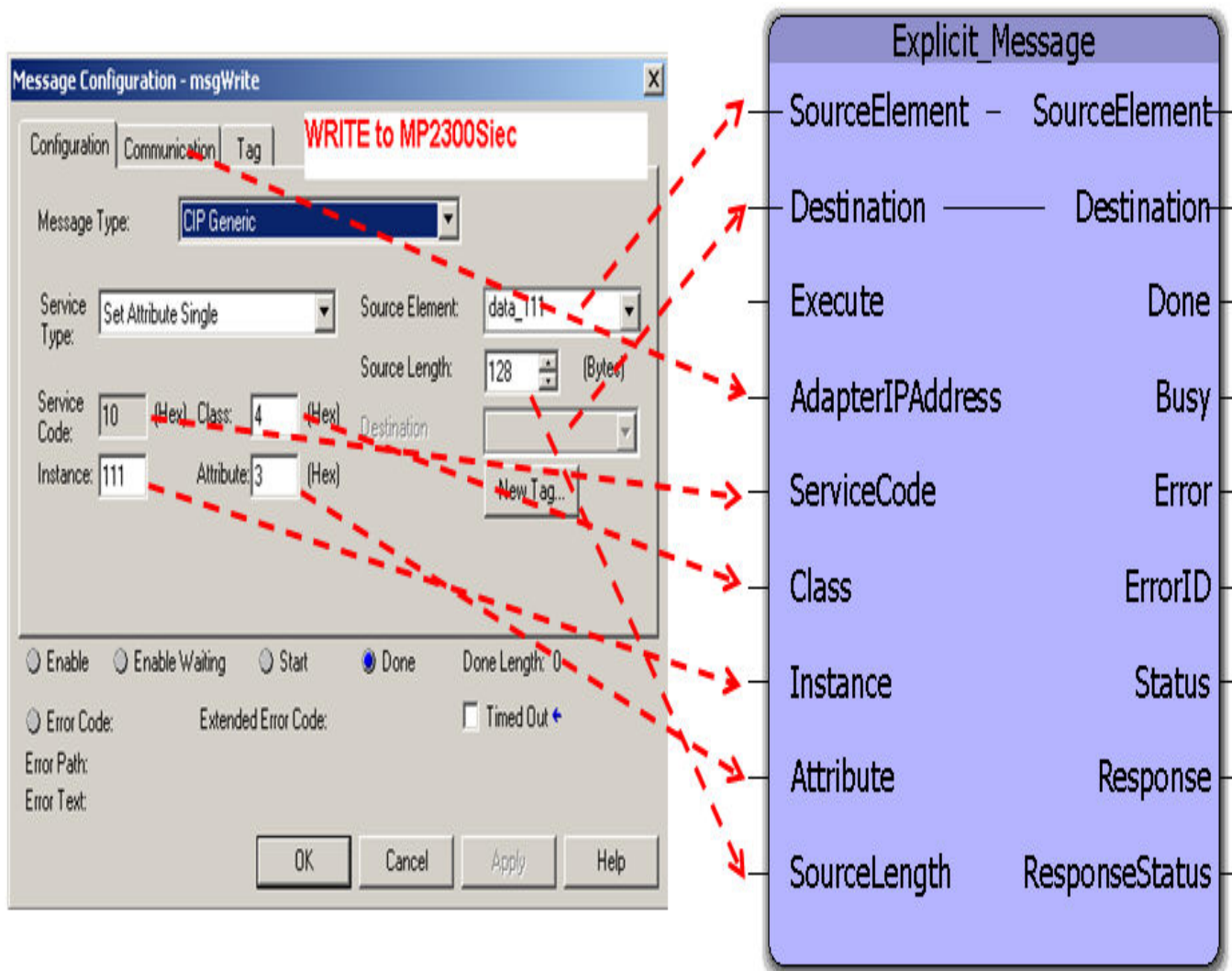
Parameters

| * | Parameter | Data Type | Description |
|-------------------|---------------|------------------------------|---|
| VAR_IN_OUT | | | |
| V | SourceElement | ExplicitData | When writing a message to the Target (Adapter), SourceElement is the data (as an array of bytes) that the Scanner (MPiec Controller) will send to the Target. |
| V | Destination | ExplicitData | When reading a message from the Target (Adapter), the Destination Element is the data (as an array of bytes) where the Scanner (MPiec Controller) will copy the data from the Target. |
| VAR_INPUT | | | Default |

| | | | | |
|-------------------|------------------|--------|--|----------|
| B | Execute | BOOL | Upon the rising edge, all other function block inputs are read and the function is initiated. To modify an input, change the value and re-trigger the execute input. | FALSE |
| V | AdapterIPAddress | STRING | IP Address of the Target device. | STRING#" |
| V | ServiceCode | BYTE | Code for the particular service type as defined for a CIP message. The value can be obtained from the Target's (Adapter's) documentation. | BYTE#0 |
| V | Class | BYTE | Class parameter of a CIP Generic message. The value can be obtained from the Target's (Adapter's) documentation. | BYTE#0 |
| V | Instance | BYTE | Instance parameter of a CIP Generic message. The value can be obtained from the Target's (Adapter's) documentation. | BYTE#0 |
| V | Attribute | BYTE | Attribute parameter of a CIP Generic message. The value can be obtained from the Target's (Adapter's) documentation. | BYTE#0 |
| V | SourceLength | INT | The number of bytes to be written to the Target. This is the actual data size required, not the full size of the SourceData DataType. | BYTE#0 |
| VAR_OUTPUT | | | | |
| B | Done | BOOL | The done bit is set high when the last packet of the message is successfully transferred. | |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |
| V | Status | DWORD | Indicates if the Target was able to execute the requested command. A value of zero indicates successful execution of the command by the remote device. | |
| V | Response | WORD | Response from the Target. | |
| V | ResponseStatus | WORD | Status of the response from the Target. | |

Notes

- The Explicit_Message function block uses the Y_DeviceComm firmware library. This firmware library must be added to your project. Y_DeviceComm was incorporated into firmware version 2.1.0 and has been included as a firmware library starting in MotionWorks IEC v2.1.0.
- Enter parameters as entered in Message Configuration for the MSG function block in AB RSLogix software.
- See Yaskawa's Youtube webinar - [EtherNet/IP Explicit Messaging](#) for more info.



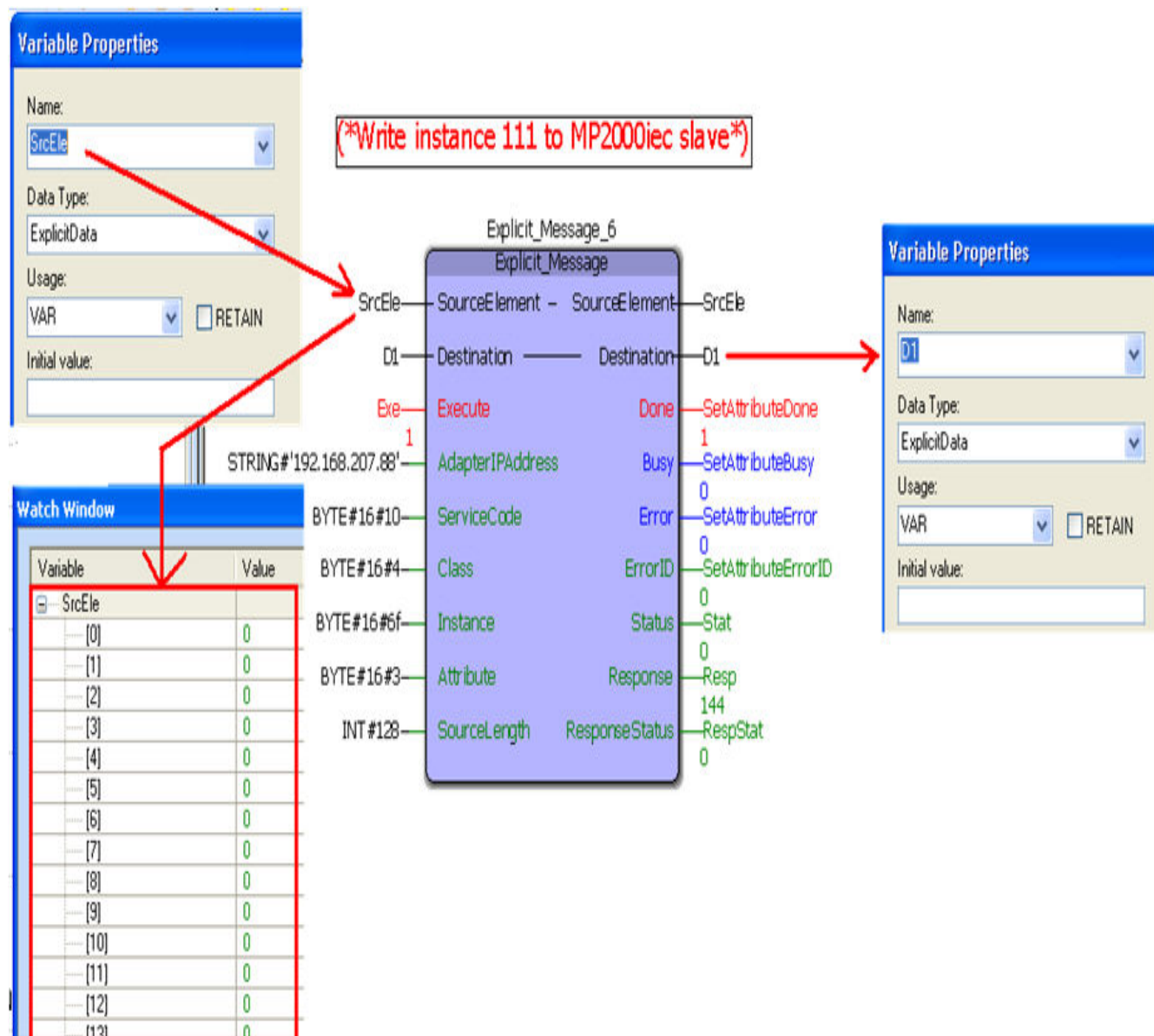
Error Description

| ErrorID | Meaning |
|----------------------|--|
| 0 | No error. |
| 8705 | The maximum number of concurrently open user sockets/IO device handles has been reached or exceeded. |
| 8706 | The socket/IO device handle was invalid. Invalid IP address. |
| 8707 | The IP address string was not in a valid format. |
| 8708 | The socket/IO device handle could not be created. |
| 8709 | The specified address or port is already in use on the local network. |
| 8710 | The specified address or port is not available for use. (Maybe the IP address specified is not assigned to one of the networks available on this MPiec?) |
| 8711 | Unable to accept new socket/IO device handle connection. |
| 8712 | Unable to bind to the specified address. |
| 8713 | The socket/IO device handle type argument was invalid. |
| 8714 | The local address or port was not valid. |
| 8715 | Connecting to the socket/IO device handle failed. |
| 8716 | The remote IP address is unreachable. Check the default gateway. |

| | |
|----------------------|--|
| 8717 | The socket/IO device handle is already connected to another endpoint. |
| 8718 | The socket/IO device handle connection attempt was actively refused by the remote device. |
| 8719 | The socket/IO device handle was not connected to a remote endpoint. Call Y_ConnectSocket prior to Y_ReadDevice or Y_WriteDevice. |
| 8720 | An error occurred trying to get or set the device option. |
| 8721 | The communication device could not be read. |
| 8722 | The communication device could not be written. |
| 8723 | A valid buffer argument to WriteDevice and ReadDevice is required. |
| 8724 | Invalid Device Option ID. |
| 8725 | The device option value was not the right size or the data was out of range. |
| 8726 | The serial port ID was not a valid serial port. |
| 8727 | The serial port specified could not be opened. |

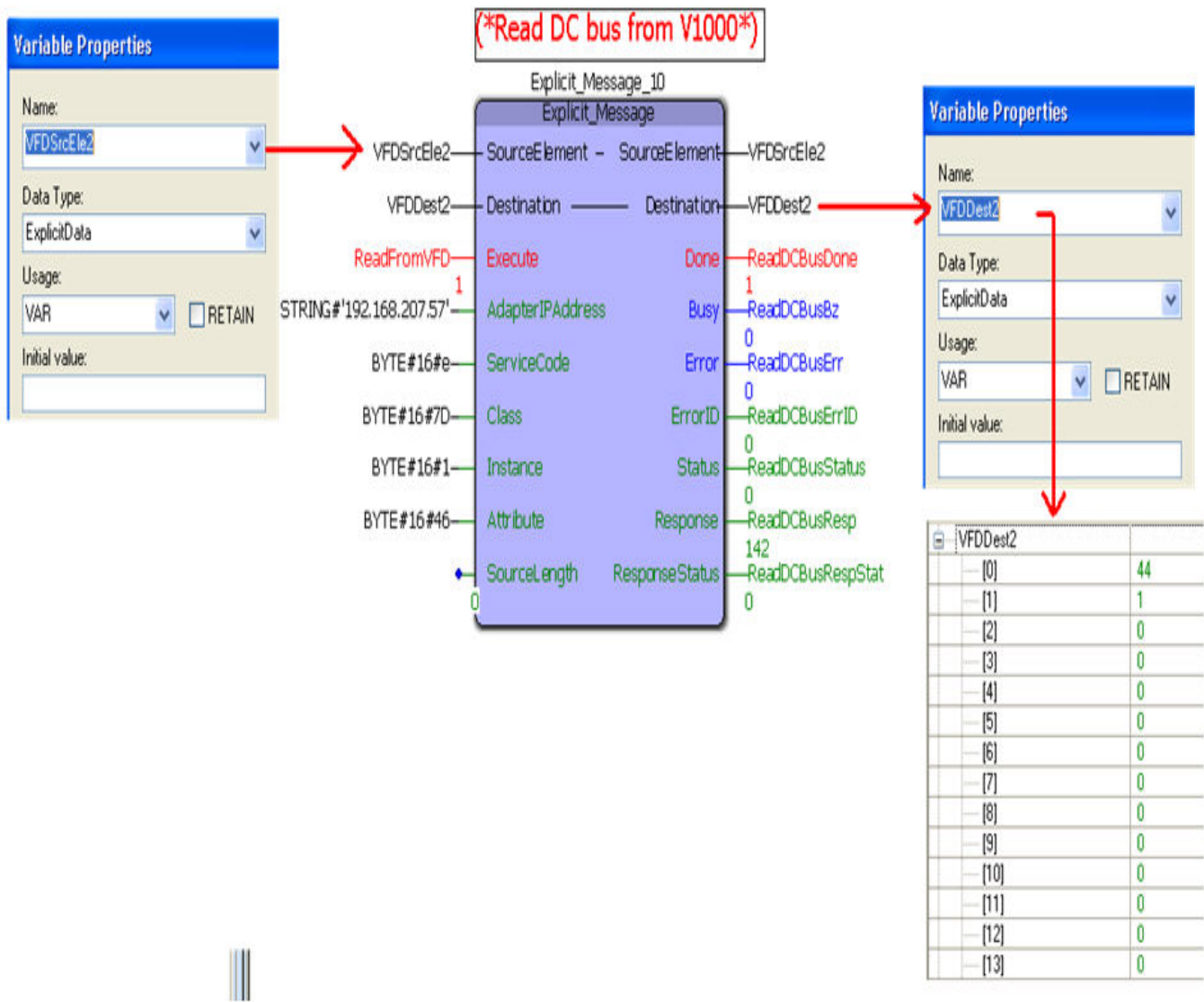
Example 1

Set single attribute.



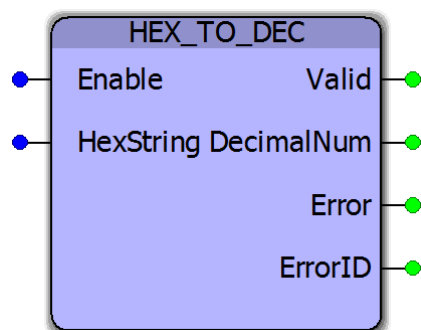
Example 2

Get single attribute.





HEX_TO_DEC



This function block converts a hexadecimal STRING into a base 10 output value as a DINT.

Library

Yaskawa Toolbox

Parameters

| * | Parameter | Data Type | Description | |
|------------|------------|-----------|---|-----------|
| VAR_INPUT | | | Default | |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. | FALSE |
| V | HexString | STRING | Input hexadecimal string. Can only contain values 0-9, A-F, and a-f. A maximum of 8 characters is allowed, because this would represent the maximum value of a DINT as STRING#'FFFFFFF' | STRING#'' |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| V | DecimalNum | DINT | Output value from hexadecimal conversion. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

- Converts both upper and lower case ASCII characters to a DINT value.

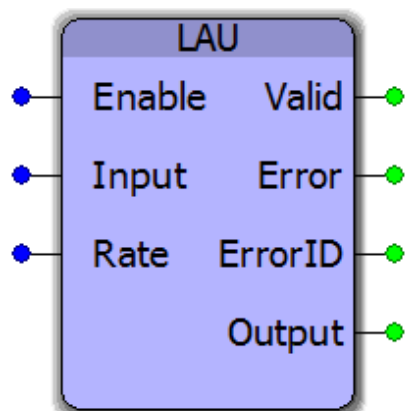
Error Description

| ErrorID | Meaning |
|---------|-----------|
| 0 | No error. |

This function may output ErrorIDs from the STRING_TO_BUF Status output.



LAU



This function block generates a linear ramp from a current value to the target value with a slope based on the Rate input on the function block. The input can be continuously update on the fly.

Library

Yaskawa Toolbox

Parameters

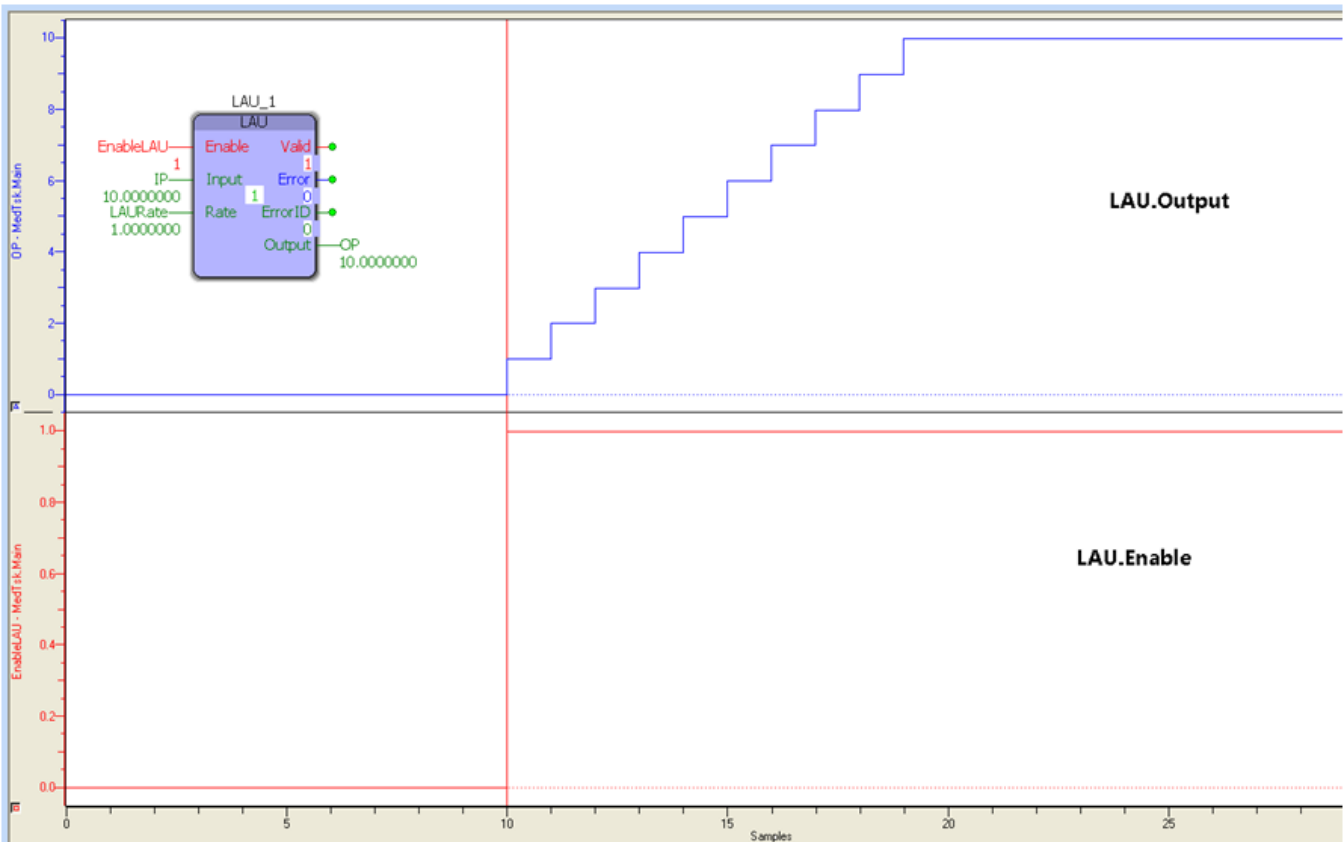
| * | Parameter | Data Type | Description | |
|-------------------|-----------|-----------|---|----------------|
| VAR_INPUT | | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. | FALSE |
| V | Input | LREAL | Target value. | LREAL#0.0 |
| V | Rate | LREAL | Acceleration/Deceleration per scan. The time required for the Output to become the Input value profile depends on the Rate Input and the interval (Application task rate) at which the LAU function block is being run. | LREAL#0.0 |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |
| V | Output | LREAL | Output value. | |

Error Description

| ErrorID | Meaning |
|---------|--|
| 10093 | Rate cannot be less than or equal to zero. |

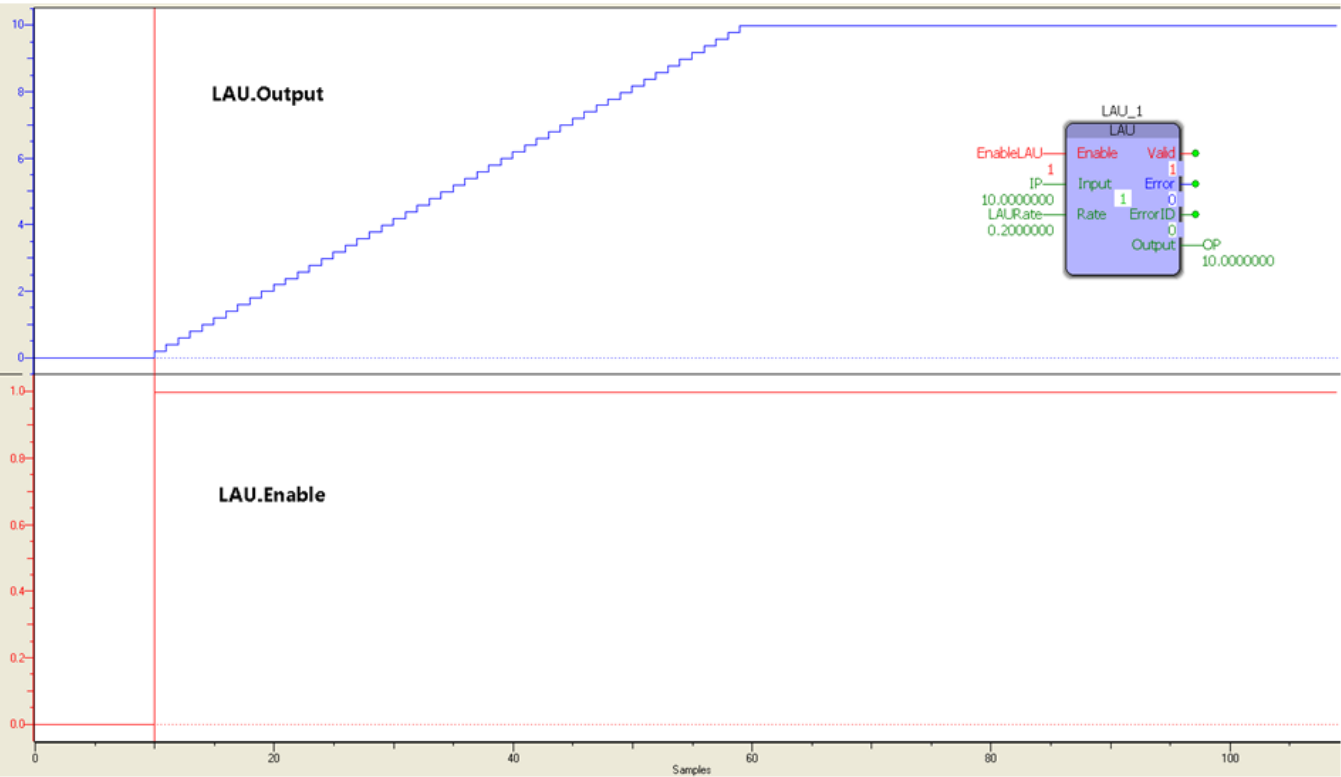
Example 1

The figure shown below illustrates how the LAU block can generate a ramp output even if the Input value instantaneously changes from 0 to 10. The rate of 1 unit specifies that the output value is expected to increase at the rate of 1 unit per application scan.



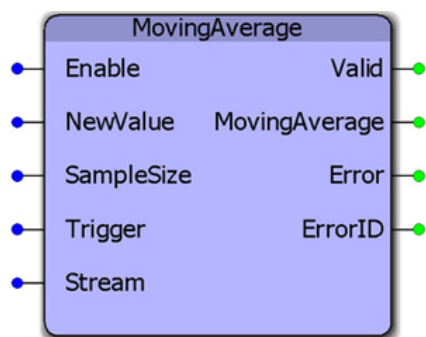
Example 2

The figure shown below shows the effect of a ramp of 0.2 units per scan. The signal takes 50 application scans to reach 10 units from an initial value of 0.





MovingAverage



This function block will provide the MovingAverage of a series of samples. The NewValue can either be streamed continuously or updated only when the Trigger input goes high.

Library

Yaskawa Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|---------------|-----------|---|
| VAR_INPUT | | | |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | NewValue | LREAL | The new value to be added to the total |
| V | SampleSize | UINT | The total number of values to total |
| V | Trigger | BOOL | To indicate when a NewValue should be added to the total |
| V | Stream | BOOL | To indicate if the NewValues should be added to the total every scan. |
| VAR_OUTPUT | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| V | MovingAverage | LREAL | The moving average of all the samples. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

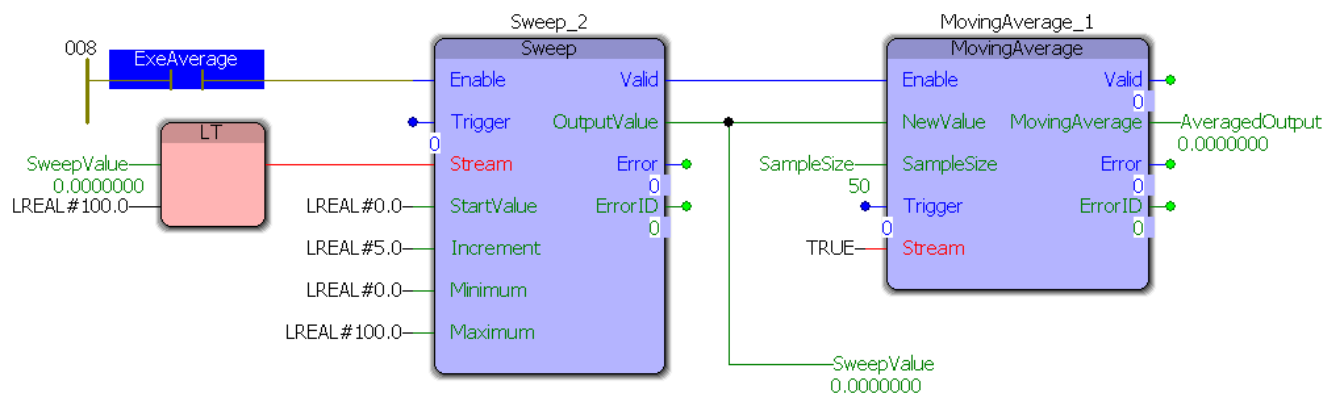
- See Yaskawa's Youtube webinar - [MPiec Web Tension Control Applications](#) for more info on using this function block.

Error Description

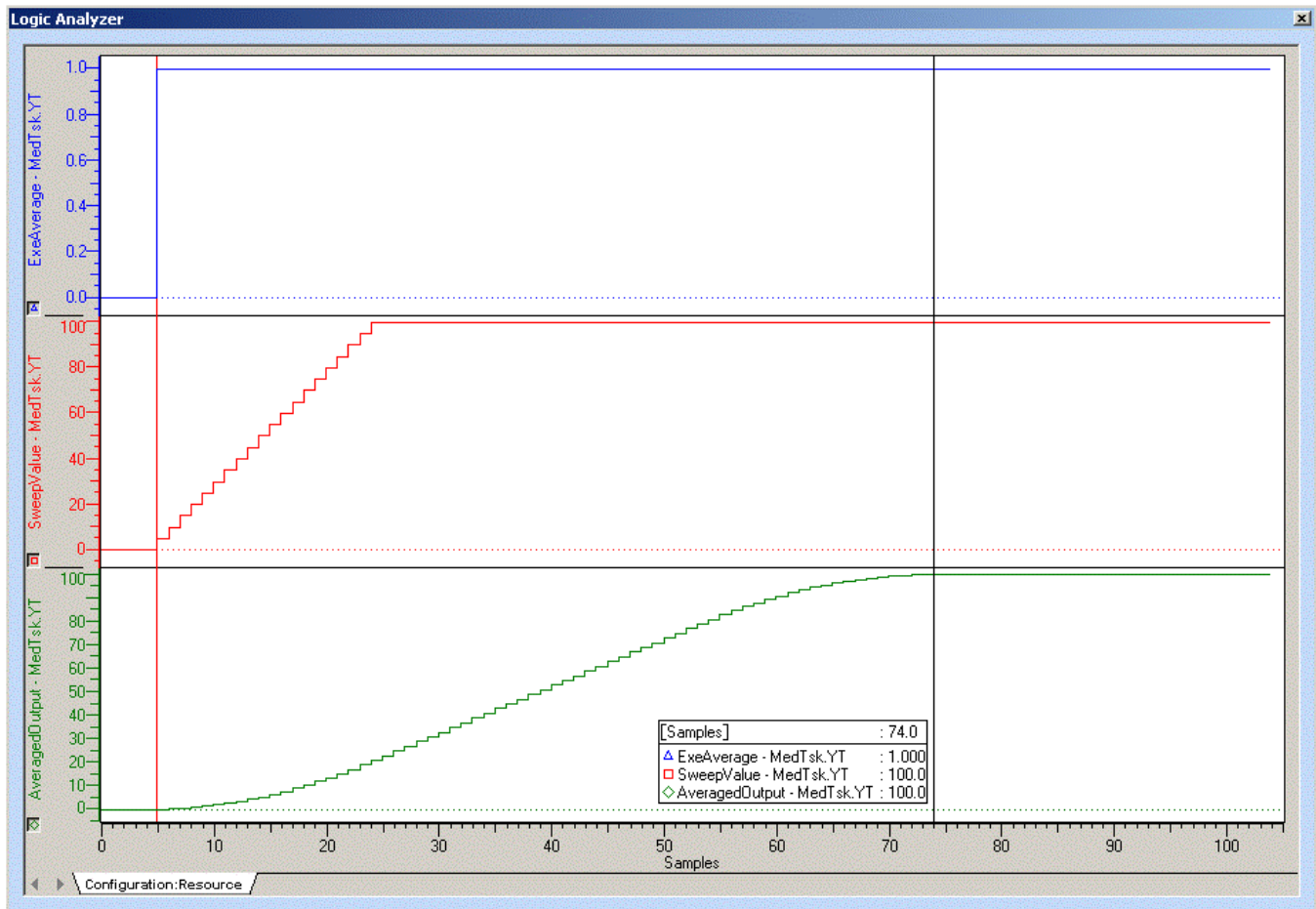
| ErrorID | Meaning |
|---------|-------------------------------------|
| 0 | No error. |
| 10024 | DataSize must be greater than zero. |

Example

The MovingAverage function acts as a smoothing filter. In this example, the Sweep function will increment by 5 each cycle. The Sweep function will continue to increment the OutputValue until it has reached 100.

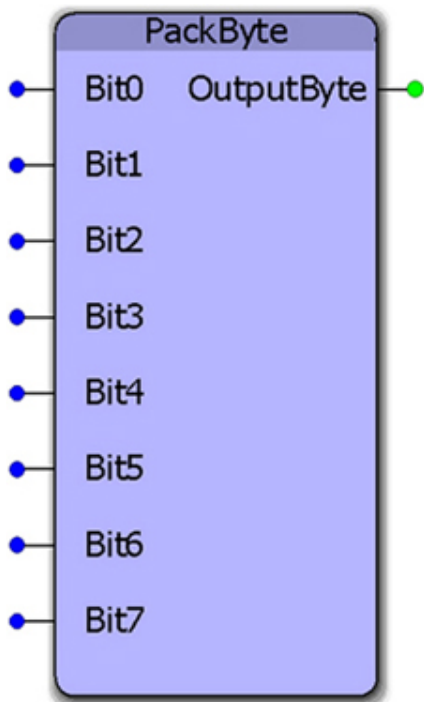


The Moving average function has a sample size of 50 which means that if Sweep reaches its maximum value after 19 cycles, MovingAverage will output the maximum value after 69 cycles. By looking at the Logic Analyzer plot below, notice there is a 5 cycle pre-record that must be taken in to account: $74 - 5 = 69$ cycles.





PackByte



This function block converts 8 BOOL inputs to a single BYTE output.

Library

Yaskawa Toolbox

Parameters

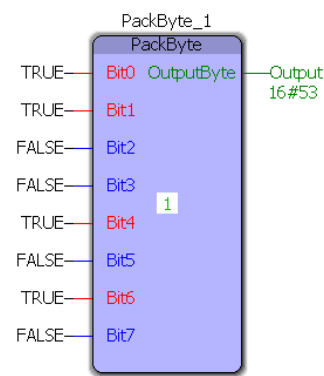
| * | Parameter | Data Type | Description | |
|-----------|-----------|-----------|--------------------------------|---------|
| VAR_INPUT | | | | Default |
| V | Bit0 | BOOL | Bit 0 of the BYTE to be output | FALSE |
| V | Bit1 | BOOL | Bit 1 of the BYTE to be output | FALSE |
| V | Bit2 | BOOL | Bit 2 of the BYTE to be output | FALSE |
| V | Bit3 | BOOL | Bit 3 of the BYTE to be output | FALSE |
| V | Bit4 | BOOL | Bit 4 of the BYTE to be output | FALSE |
| V | Bit5 | BOOL | Bit 5 of the BYTE to be output | FALSE |
| V | Bit6 | BOOL | Bit 6 of the BYTE to be output | FALSE |

| | | | | |
|-------------------|------------|------|----------------------------------|-------|
| V | Bit7 | BOOL | Bit 7 of the BYTE to be output | FALSE |
| VAR_OUTPUT | | | | |
| V | OutputByte | BYTE | Resulting byte of the input bits | |

Error Description

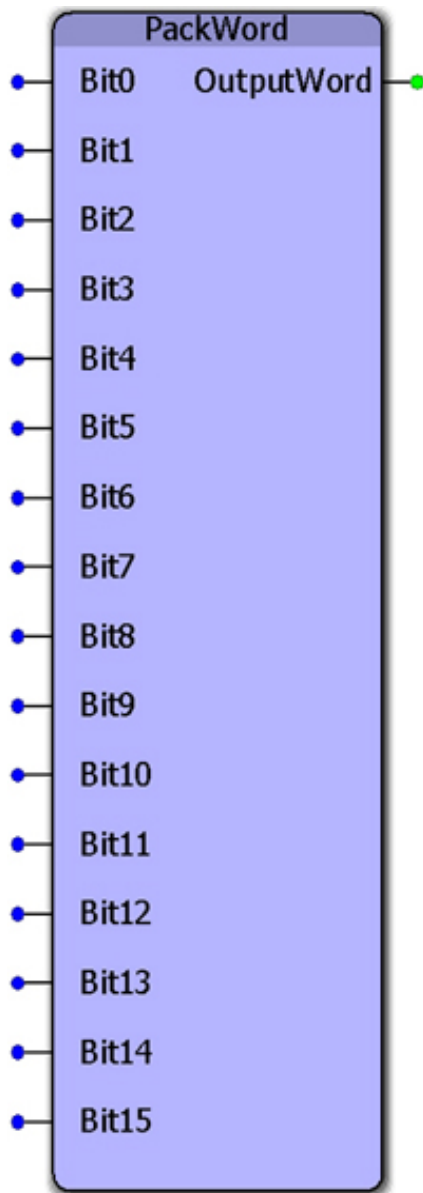
No errors will be generated

Example





PackWord



This function block converts 16 Boolean inputs to a single WORD output.

Library

Yaskawa Toolbox

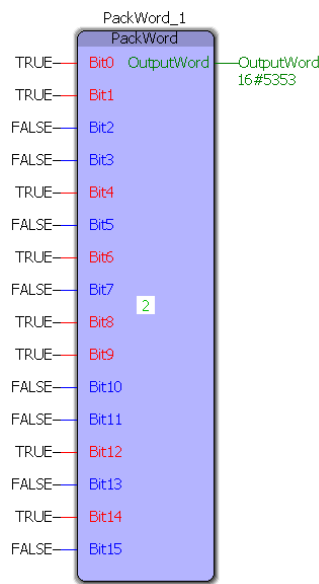
Parameters

| * | Parameter | Data Type | Description | |
|------------|------------|-----------|--------------------------------------|---------|
| VAR_INPUT | | | | Default |
| V | Bit0 | BOOL | Bit 0 of the WORD to be output | |
| V | Bit1 | BOOL | Bit 1 of the WORD to be output | |
| V | Bit2 | BOOL | Bit 2 of the WORD to be output | |
| V | Bit3 | BOOL | Bit 3 of the WORD to be output | |
| V | Bit4 | BOOL | Bit 4 of the WORD to be output | |
| V | Bit5 | BOOL | Bit 5 of the WORD to be output | |
| V | Bit6 | BOOL | Bit 6 of the WORD to be output | |
| V | Bit7 | BOOL | Bit 7 of the WORD to be output | |
| V | Bit8 | BOOL | Bit 8 of the WORD to be output | |
| V | Bit9 | BOOL | Bit 9 of the WORD to be output | |
| V | Bit10 | BOOL | Bit A of the WORD to be output | |
| V | Bit11 | BOOL | Bit B of the WORD to be output | |
| V | Bit12 | BOOL | Bit C of the WORD to be output | |
| V | Bit13 | BOOL | Bit D of the WORD to be output | |
| V | Bit14 | BOOL | Bit E of the WORD to be output | |
| V | Bit15 | BOOL | Bit F of the WORD to be output | |
| VAR_OUTPUT | | | | |
| V | OutputWord | WORD | The resulting WORD of the input bits | |

Error Description

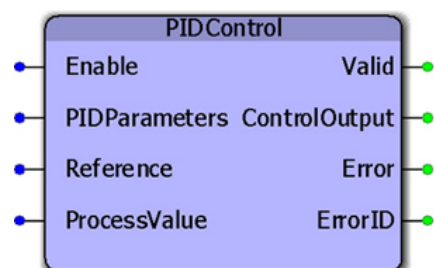
No errors will be generated

Example





PIDControl



This function block can be used as a generic control loop feedback mechanism. A PID controller calculates an "error" value as the difference between a measured process variable and a desired set point, or reference. PIDParameters must be adjusted to allow the process to provide the proper ControlOutput for a given error situation.

Library

Yaskawa Toolbox

Parameters

| * | Parameter | Data Type | Description | |
|-------------------|---------------|---------------------------|--|----------------|
| VAR_INPUT | | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. | FALSE |
| V | PIDParameters | PIDStruct | Structure containing all the information for PID control block to operate | N/A |
| V | Reference | LREAL | Setpoint for the PID control loop. | LREAL#0.0 |
| V | ProcessValue | LREAL | Real world value to be compared with the Reference in the control loop | LREAL#0.0 |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| V | ControlOutput | LREAL | Output value from the PID control block. The range of values will be governed by the PID parameters, especially the upper and lower limit. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Notes

- All time parameters in the PIDStruct (Ts, Td1, and Td2) must be in the same units, i.e seconds or ms.
- See Yaskawa's Youtube webinar - [MPiec Web Tension Control Applications](#) for more info on using this function block.

Example

Initialization of the PIDStruct:

```
PIDPrm.Ts      := LREAL#0.004; (* Set to the same value as the cyclic application task *)
PIDPrm.Kp      := LREAL#40.0;  (* Proportional gain *)
PIDPrm.Ki      := LREAL#0.0;   (* Integral gain *)
PIDPrm.Kd      := LREAL#0.0;   (* Derivative gain *)
PidPrm.Td1     := LREAL#4.0;   (* Divergence differentiation time *)
PidPrm.Td2     := LREAL#4.0;   (* Convergence differentiation time *)
PIDPrm.Ti      := LREAL#4.0;   (* Integration time *)
PIDPrm.ILL     := LREAL#-10.0; (* The smallest integration value *)
PIDPrm.IUL     := LREAL#10.0;  (* The largest integration value *)
PIDPrm.LowerLimit := LREAL#-2000.0; (* The smallest ControlOutput that will be output *)
PIDPrm.UpperLimit := LREAL#2000.0; (* The largest ControlOutput that will be output *)
PIDPrm.DeadBand  := LREAL#0.00001; (* Maximum absolute error value that will result in a
ControlOutput of zero *)
```

| Symbol | Specification |
|------------|--|
| Ts | Scan time set value |
| Kp | Proportional gain |
| Ki | Integral gain |
| Kd | Derivative gain |
| Td1 | Divergence differentiation time |
| Td2 | Convergence differentiation time |
| Ti | Integration time |
| IUL | Upper integration limit |
| ILL | Lower integration limit |
| LowerLimit | Lower PID Limit |
| UpperLimit | Upper PID limit |
| Deadband | Width of the deadband for the P+I+D correction value |

Here, the PID operation is expressed as follows:

$$\frac{Y}{X} \cdot Kp + \frac{Ki}{Ti \cdot S} = Kd \cdot Td \cdot S$$

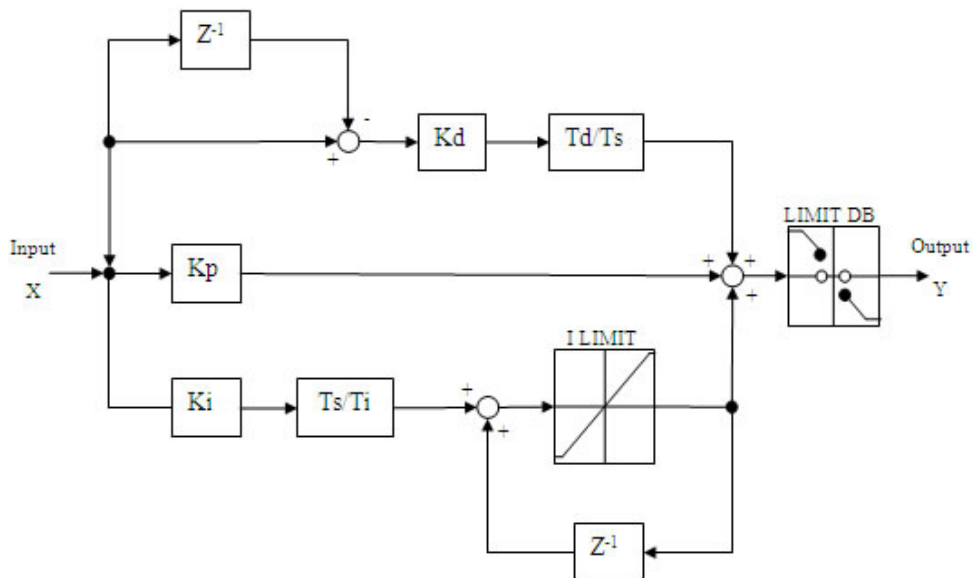
$$\frac{Y}{X} = Kp + Kd \cdot Td \cdot S$$

X: deviation input value; Y: output value

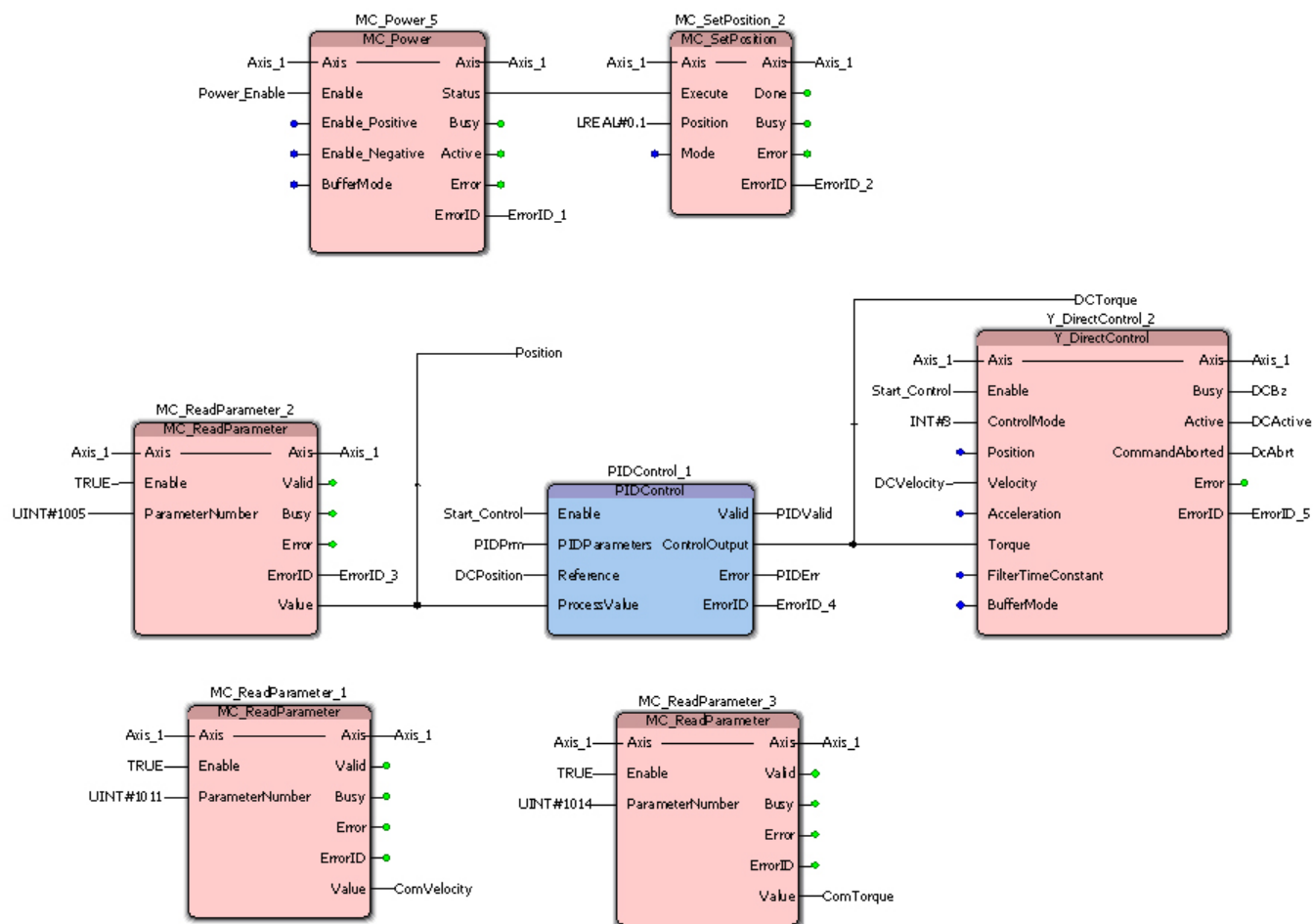
The following operation is performed within the PID instruction:

$$Y = Kp.X + \left\{ \frac{Ki.X + IREM}{\frac{Ti}{Ts}} + Yi' \right\} + Kd.(X - X'). \frac{Td}{Ts}$$

X': previous input value; Yi': previous I output value; Ts: scan time set value

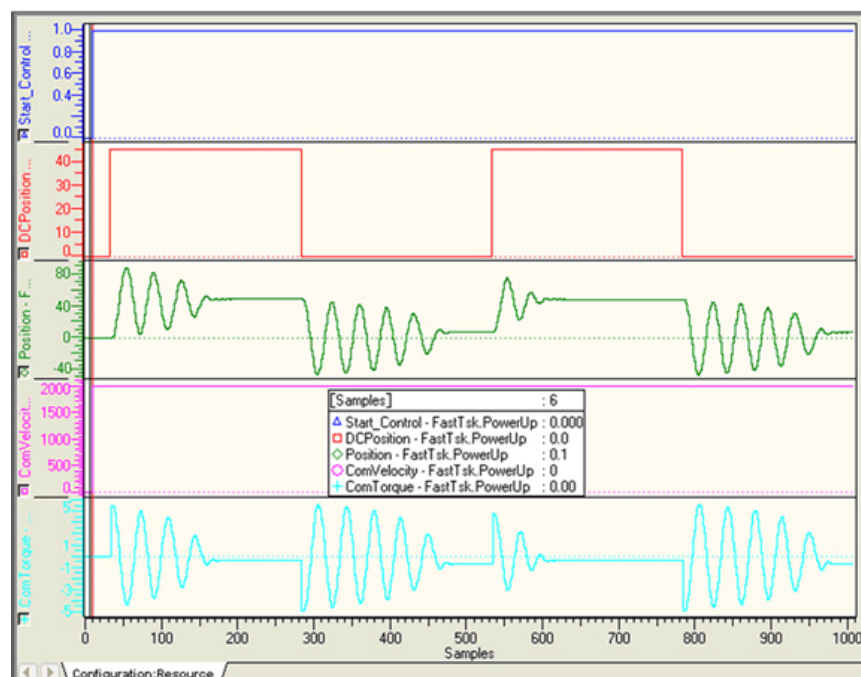


1. An example controlling a servo in torque mode:



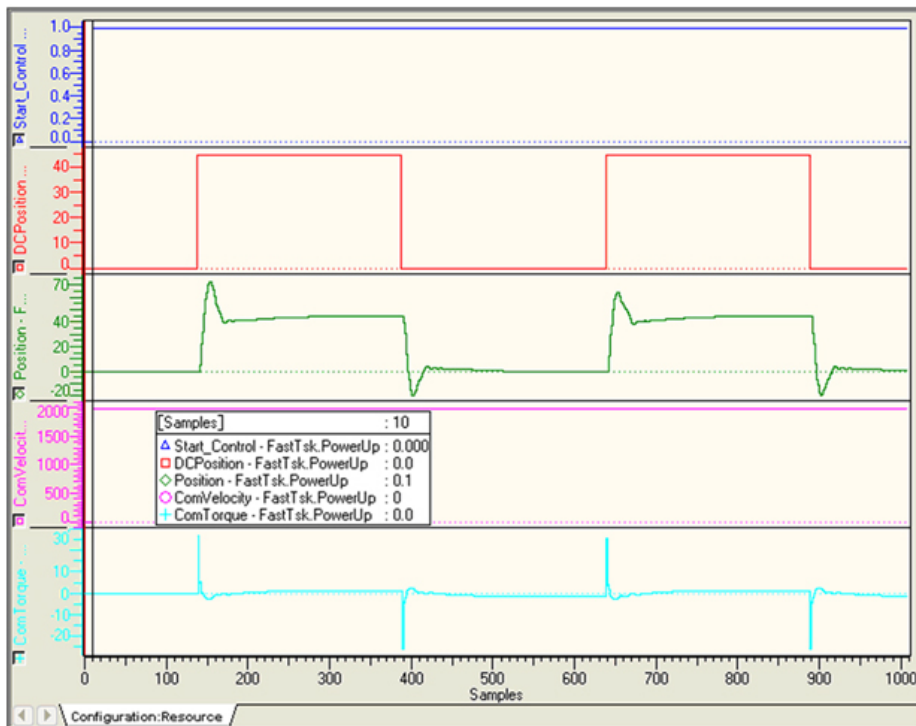
The following series of graphs show changes made to the PID gains to minimize error:

a. Proportional Control Only. Severe oscillation:



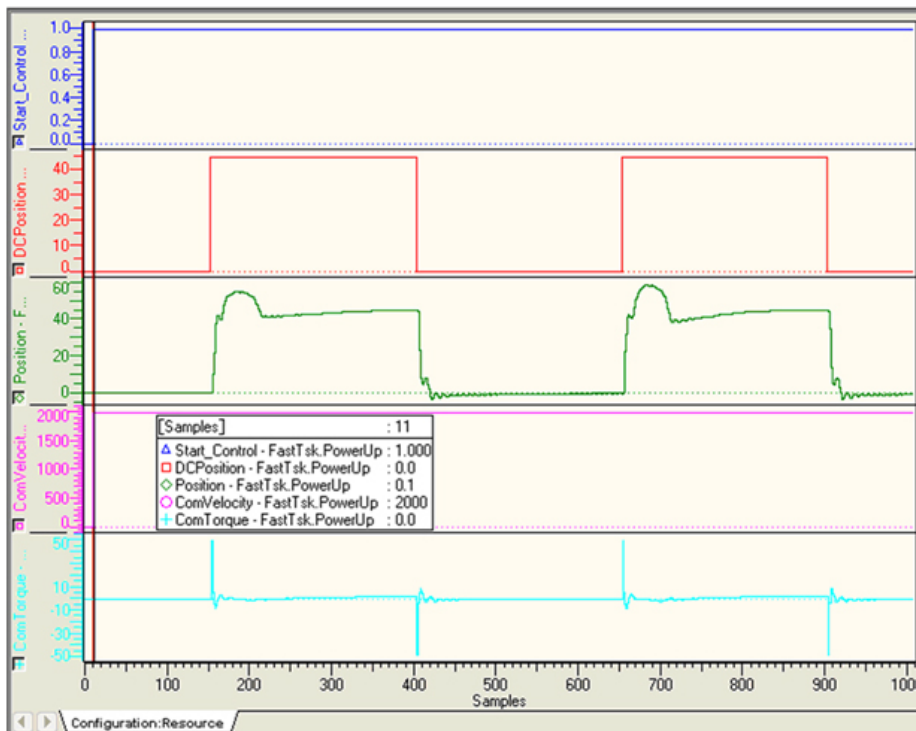
| Variable | Value |
|------------|-----------------|
| PwrEnable | ??? |
| MvDCExe | ??? |
| PIDPrm | |
| Kp | 1.0000000E-001 |
| Ki | 0.0000000E+000 |
| Kd | 0.0000000E+000 |
| Ti | 4.0000000E-003 |
| Td1 | 4.0000000E-003 |
| Td2 | 4.0000000E-003 |
| IUL | 1.0000000E+001 |
| ILL | -1.0000000E+001 |
| UpperLimit | 1.0000000E+002 |
| LowerLimit | -1.0000000E+002 |
| DeadBand | 0.0000000E+000 |
| Ts | 4.0000000E-003 |

b. PID Control. Derivative helps to control oscillation:



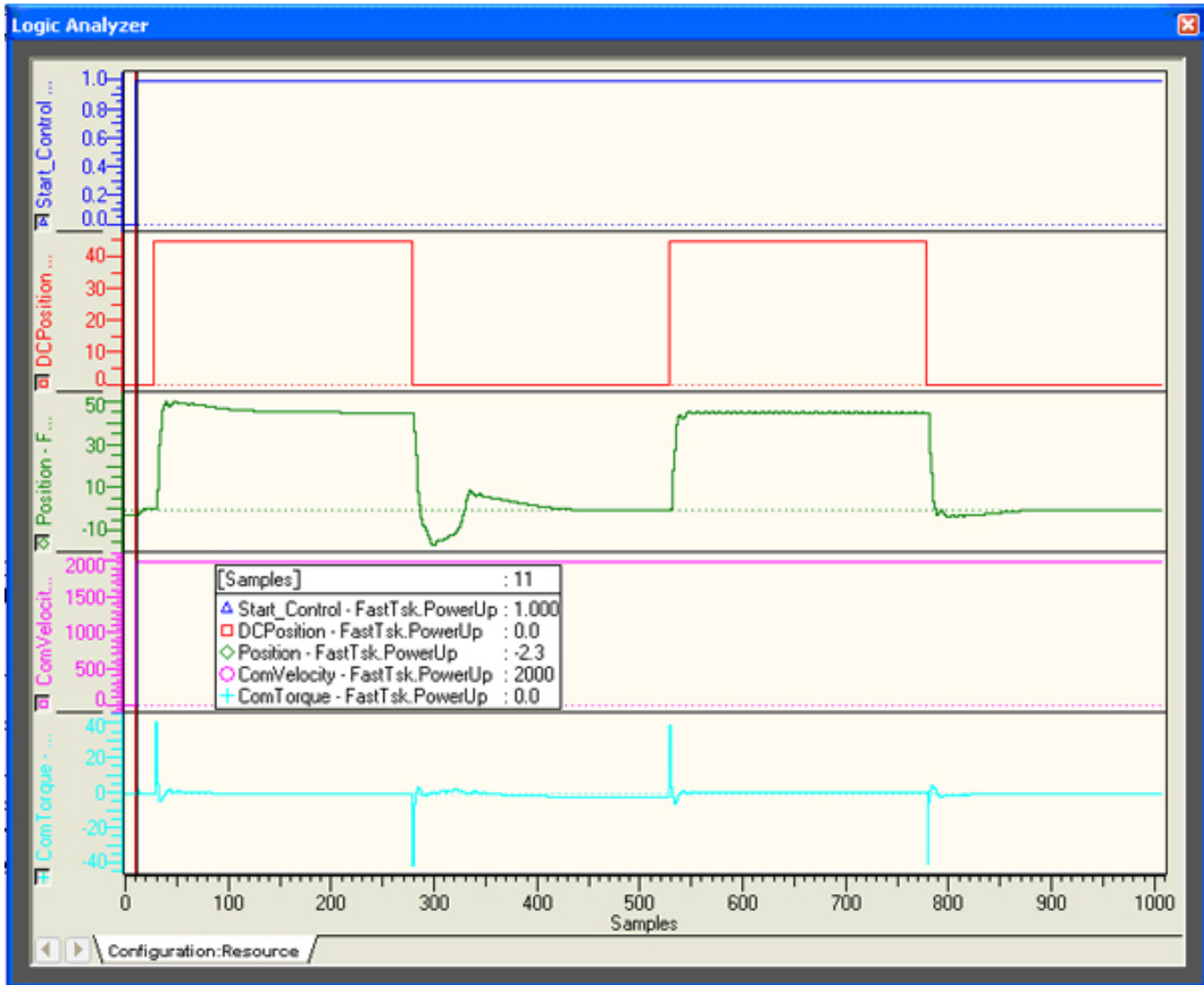
| Variable | Value |
|------------|----------------|
| PwrEnable | ??? |
| MvDCExe | ??? |
| PIDPrm | |
| Kp | 1.000000E-001 |
| Ki | 1.000000E-002 |
| Kd | 5.000000E-001 |
| Ti | 4.000000E-003 |
| Td1 | 4.000000E-003 |
| Td2 | 4.000000E-003 |
| IUL | 1.000000E+001 |
| ILL | -1.000000E+001 |
| UpperLimit | 1.000000E+002 |
| LowerLimit | -1.000000E+002 |
| DeadBand | 0.000000E+000 |
| Ts | 4.000000E-003 |

c. PID Control – Increasing the derivative gain:



| Variable | Value |
|------------|----------------|
| PwrEnable | ??? |
| MvDCExe | ??? |
| PIDPrm | |
| Kp | 1.000000E-001 |
| Ki | 1.000000E-002 |
| Kd | 1.000000E+000 |
| Ti | 4.000000E-003 |
| Td1 | 4.000000E-003 |
| Td2 | 4.000000E-003 |
| IUL | 1.000000E+001 |
| ILL | -1.000000E+001 |
| UpperLimit | 1.000000E+002 |
| LowerLimit | -1.000000E+002 |
| DeadBand | 0.000000E+000 |
| Ts | 4.000000E-003 |

d. Further increase in the derivative gain:

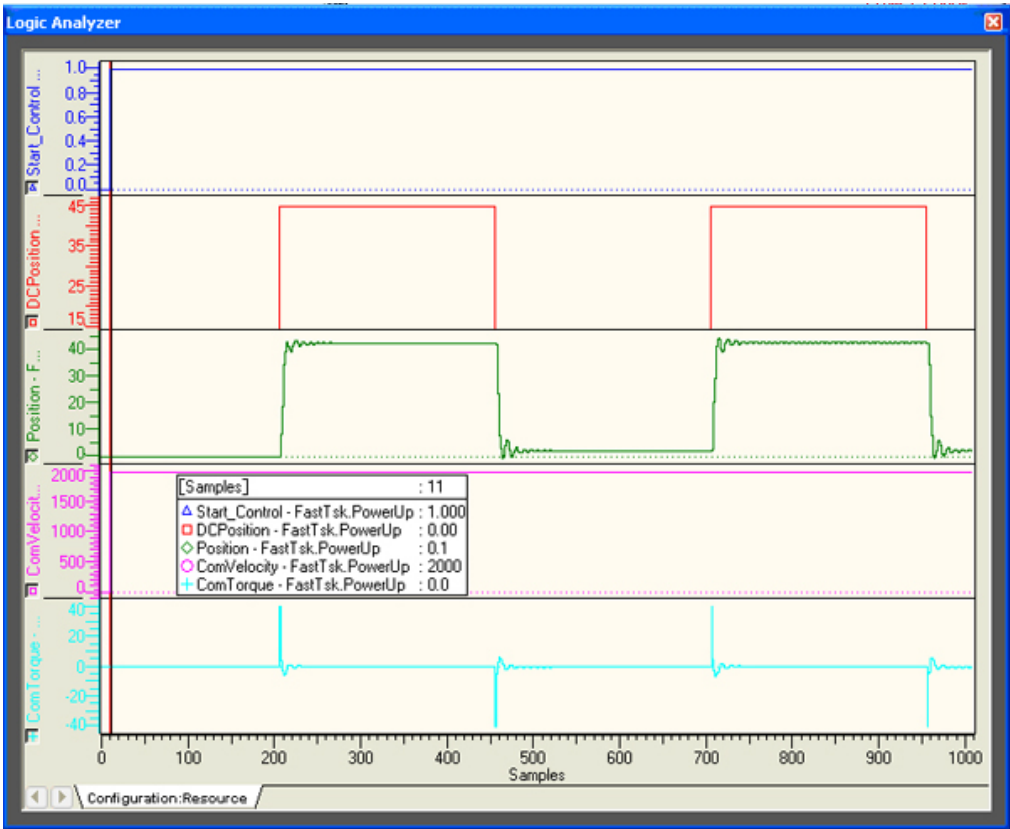


Watch Window

| Variable | Value | Default value | Type |
|------------|-----------------|---------------|-----------|
| PwEnable | ??? | | |
| MvDCExe | ??? | | |
| PIDPrm | | | PIDStruct |
| Kp | 1.0000000E-001 | | LREAL |
| Ki | 1.0000000E-002 | | LREAL |
| Kd | 8.0000000E-001 | | LREAL |
| Ti | 4.0000000E-003 | | LREAL |
| Td1 | 4.0000000E-003 | | LREAL |
| Td2 | 4.0000000E-003 | | LREAL |
| IUL | 1.0000000E+001 | | LREAL |
| ILL | -1.0000000E+001 | | LREAL |
| UpperLimit | 1.0000000E+002 | | LREAL |
| LowerLimit | -1.0000000E+002 | | LREAL |
| DeadBand | 0.0000000E+000 | | LREAL |
| Ts | 4.0000000E-003 | | LREAL |

Watch 1 Watch 2 Watch 3 Watch 4 Watch 5 Watch 6 Watch 7 Watch 8 Watch 9

e. PD Control – Integral gain is set to zero, which is best suited for this example.



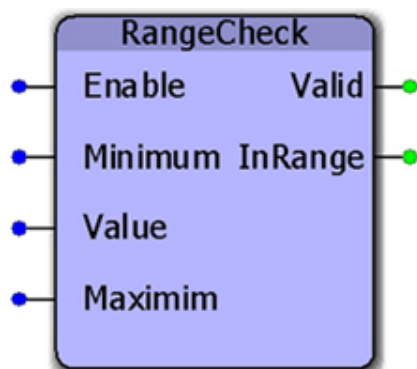
Watch Window

| Variable | Value | Default value | Type |
|------------------|-----------------|---------------|-----------|
| PwrEnable | ??? | | |
| MvDCExe | ??? | | |
| PIDPrm | | | PIDStruct |
| Kp | 1.0000000E-001 | | LREAL |
| Ki | 0.0000000E+000 | | LREAL |
| Kd | 8.0000000E-001 | | LREAL |
| Ti | 4.0000000E-003 | | LREAL |
| Td1 | 4.0000000E-003 | | LREAL |
| Td2 | 4.0000000E-003 | | LREAL |
| IUL | 1.0000000E+001 | | LREAL |
| ILL | -1.0000000E+001 | | LREAL |
| UpperLimit | 1.0000000E+002 | | LREAL |
| LowerLimit | -1.0000000E+002 | | LREAL |
| DeadBand | 0.0000000E+000 | | LREAL |
| Ts | 4.0000000E-003 | | LREAL |

Watch 1 Watch 2 Watch 3 Watch 4 Watch 5 Watch 6 Watch 7 Watch 8 Watch 9



RangeCheck



This function block will set the output 'InRange' if the Value input is between the Minimum and Maximum. The check is inclusive, meaning that if Value=Minimum or Value=Maximum, then the InRange output will be on.

Library

Yaskawa Toolbox

Parameters

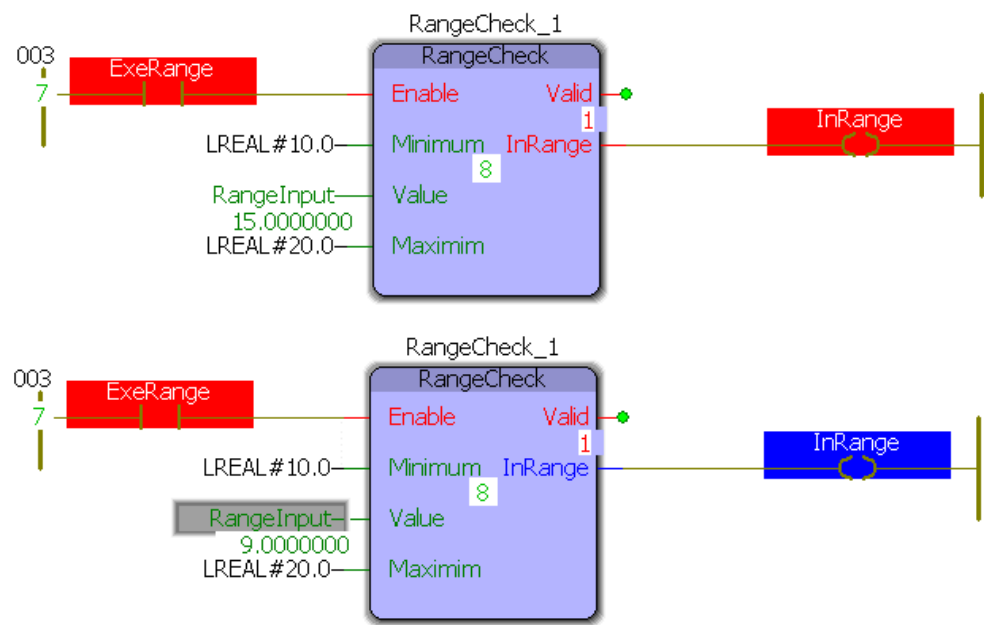
| * | Parameter | Data Type | Description | |
|-------------------|-----------|-----------|---|----------------|
| VAR_INPUT | | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. | FALSE |
| V | Minimum | LREAL | The smallest 'Value' that will set the InRange output high. | LREAL#0.0 |
| V | Value | LREAL | The data to be tested against the Minimum and Maximum. | LREAL#0.0 |
| V | Maximum | LREAL | The largest 'Value' that will set the InRange output high. | LREAL#0.0 |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| V | InRange | BOOL | Indicates if the Value is between the Minimum and Maximum. (Inclusive) | |

Error Description

No errors will be generated.

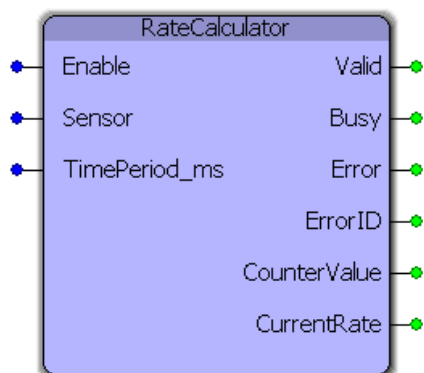
Example

ExeRange does not need to be toggled if Value is changed, as demonstrated below:





RateCalculator



This function block determines the frequency and number of occurrences of an event, such as determining the part output rate of a machine. RateCalculator counts the number of times an input 'Sensor' signal produces a rising edge and determines the frequency of that signal with respect to a chosen time period. It can account for real-time changes to the time period.

Library

Yaskawa Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|---------------|-----------|--|
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | Sensor | BOOL | Periodic signal to be measured. Commonly a "part-complete" sensor. |
| V | TimePeriod_ms | DINT | Sensor is measured with respect to this time window (milliseconds) to determine the current real-time rate. |
| VAR_OUTPUT | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| B | Busy | BOOL | Set high upon the rising edge of the Execute input, and reset when Done, CommandAborted, or Error is true. In the case of a function block with an Enable input, a Busy output indicates the function is operating, but not ready to provide Valid information. (No Error) |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

| | | | |
|---|--------------|-------|--|
| V | CounterValue | LREAL | Number of times 'Sensor' has measured a rising edge since the function block has been enabled. |
| V | CurrentRate | LREAL | The current frequency of the 'Sensor' input with respect to the chosen time period. |

Notes

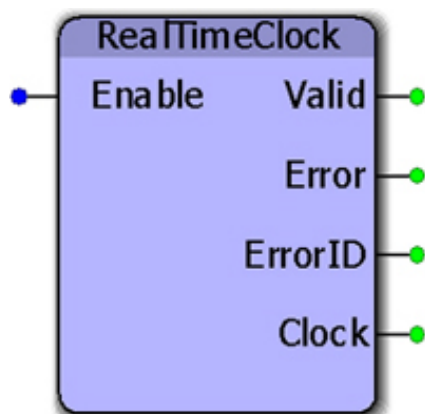
- Upon enabling or a change of the time period, the 'Busy' signal remains active until the specified time period elapses, whereupon 'Busy' will go low and 'Valid' will go high. This is to receive a complete initial measurement of the rate 'Sensor' / 'TimePeriod_ms'.

Error Description

No errors will be generated.



RealTimeClock



This function block provides the controllers real time clock as an RTCStruct containing year, month, day, hour, minute, second, and millisecond. This function uses the RTC_S function, provided in the ProConOS firmware library, which returns the real time clock as a string.

Library

Yaskawa Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|---------------------------|---|
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. FALSE |
| VAR_OUTPUT | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |
| V | Clock | RTCStruct | Structure containing year, month, day, hour, minute, second, and millisecond. |

Notes

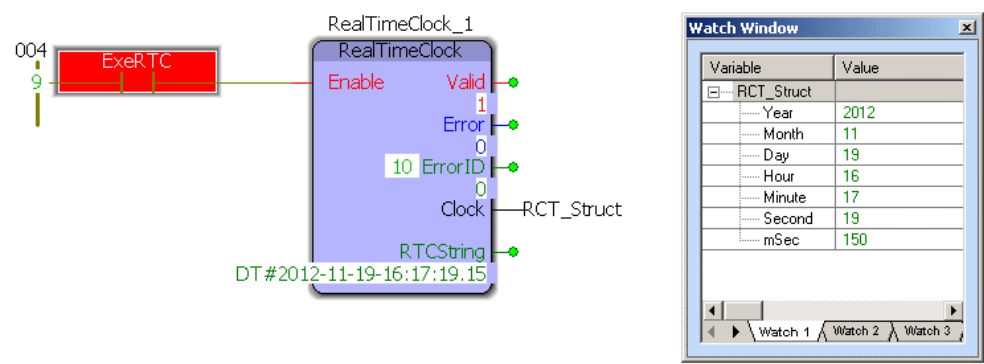
The controllers clock can be set from the web server, or by using the Y_SetRTC function block from the YMotion firmware library, which requires firmware version 2.0.0 or greater.

Error Description

No errors will be generated.

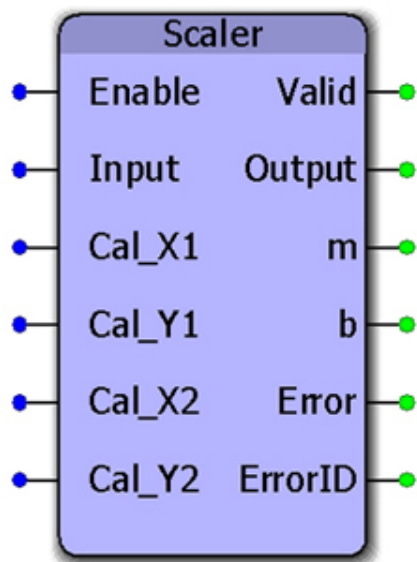
Example

The output of this block is continually updated as long as Enable is TRUE.





Scaler



This function block performs the calculation $y := mx + b$.

Library

Yaskawa Toolbox

Parameters

| * | Parameter | Data Type | Description | |
|-----------|-----------|-----------|---|-----------|
| VAR_INPUT | | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. | FALSE |
| V | Input | LREAL | The x variable of $y := mx + b$. | LREAL#0.0 |
| V | CalX1 | LREAL | Datapoint specifying a line along which data is to be scaled. | LREAL#0.0 |
| V | CalY1 | LREAL | Datapoint specifying a line along which data is to be scaled. | LREAL#0.0 |
| V | CalX2 | LREAL | Datapoint specifying a line along which data is to be scaled. | LREAL#0.0 |
| V | CalY2 | LREAL | Datapoint specifying a line along which data is to be scaled. | LREAL#0.0 |

| VAR_OUTPUT | | | |
|------------|---------|-------|---|
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| V | Output | LREAL | The result of the calculation $y := mx + b$. |
| V | m | LREAL | The calculated slope of the line. |
| V | b | LREAL | The calculated intercept of the line. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

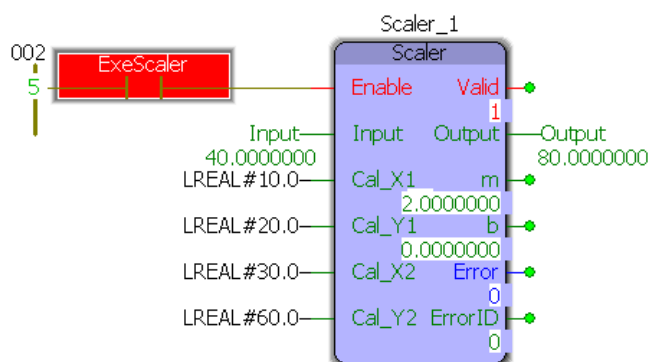
Notes

- This function can be used with temperature sensors or any analog value that must be adjusted before further processing takes place.
- m is determined by the slope of a line specified by Cal_X1, Cal_Y1, Cal_X2, Cal_Y2.
- x is the 'Input'
- b is determined by calculating the Y intercept of the line.

Error Description

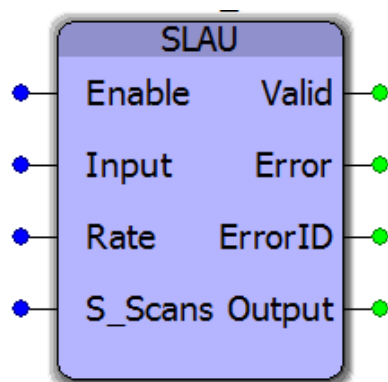
| ErrorID | Meaning |
|---------|--|
| 0 | No error. |
| 10075 | Calibration Error: Cal_X2 must be greater than Cal_X1. |

Example





SLAU



This function block generates an S-curve profile to the input value based on a moving average calculation. First, a slope is calculated based on the ramp input. Second, a moving average is applied to the ramp profile. The input value can be changed continuously on the fly.

Library

Yaskawa Toolbox

Parameters

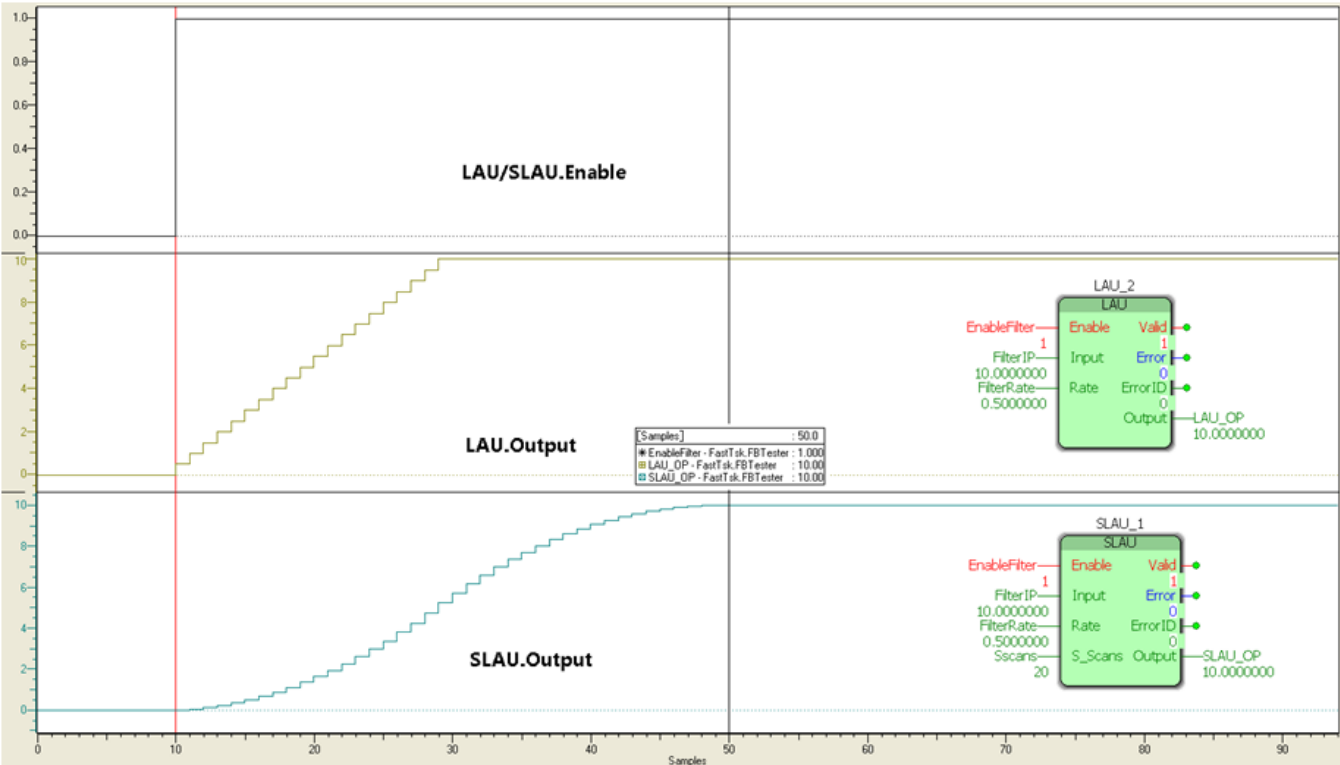
| * | Parameter | Data Type | Description | |
|-------------------|-----------|-----------|--|----------------|
| VAR_INPUT | | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. | FALSE |
| V | Input | LREAL | Target Value. | LREAL#0.0 |
| V | Rate | LREAL | Acceleration/Deceleration per scan. The time required for the Output to become the Input value profile depends on the Rate and S_Scans Inputs and the interval (Application task rate) at which the LAU function block is being run. | LREAL#0.0 |
| V | S_Scans | UINT | Number of scans for the moving average calculation (S-Curve). | UINT#0 |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |
| V | Output | LREAL | Output value. | |

Error Description

| ErrorID | Meaning |
|---------|--|
| 10093 | Rate cannot be less than or equal to 0. |
| 10094 | S_Scans cannot be less than 2 or greater than 30000. |

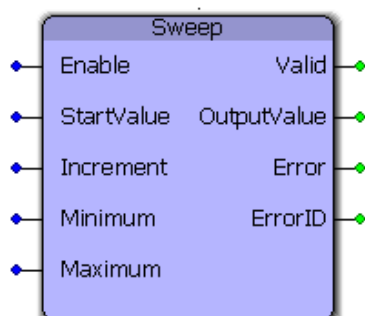
Example 1

An example of a step input converted to a smooth s-curve by the SLAU function block is shown below. The 0 to 10 unit step change is converted to a smooth s-curve profile with a 20 scan ramp and an additional 20 scan s-curve (moving average). Output of the LAU function block with a similar rate input is also shown.





Sweep



This function block generates an output that rises and falls between the minimum and maximum outputs specified by the inputs. The OutputValue is the changed by the Increment input. This function block is useful for testing purposes by forcing other portions of application code to be tested with a full range of expected values.

Library

Yaskawa Toolbox

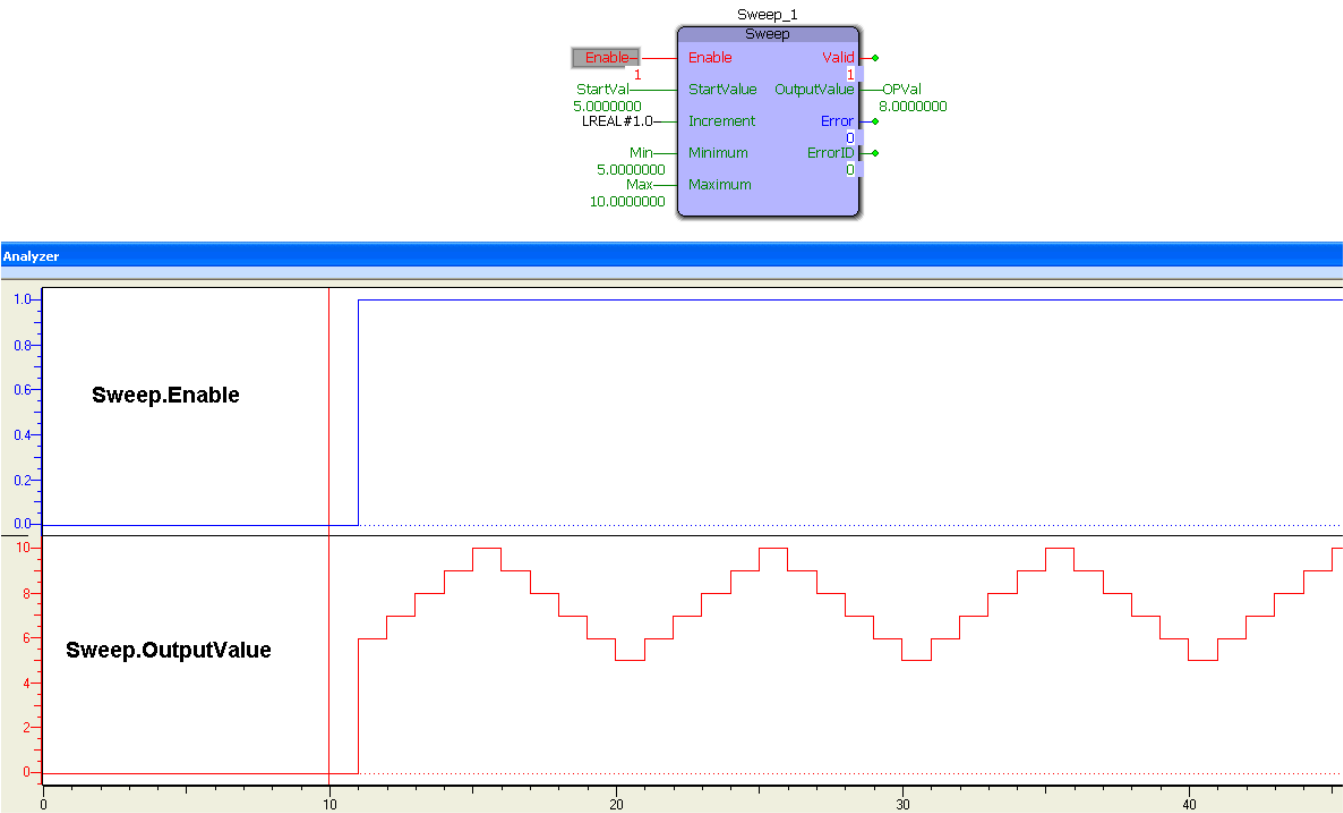
Parameters

| * | Parameter | Data Type | Description | |
|-------------------|-------------|-----------|---|----------------|
| VAR_INPUT | | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. | FALSE |
| V | StartValue | LREAL | The OutputValue will start from this value. | LREAL#0.0 |
| V | Increment | LREAL | The amount by which the Outputvalue is changed each scan. | LREAL#0.0 |
| V | Minimum | LREAL | The minimum value output. | LREAL#0.0 |
| V | Maximum | LREAL | The maximum value output. | LREAL#0.0 |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| V | OutputValue | LREAL | The output of the function. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| E | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Error Description

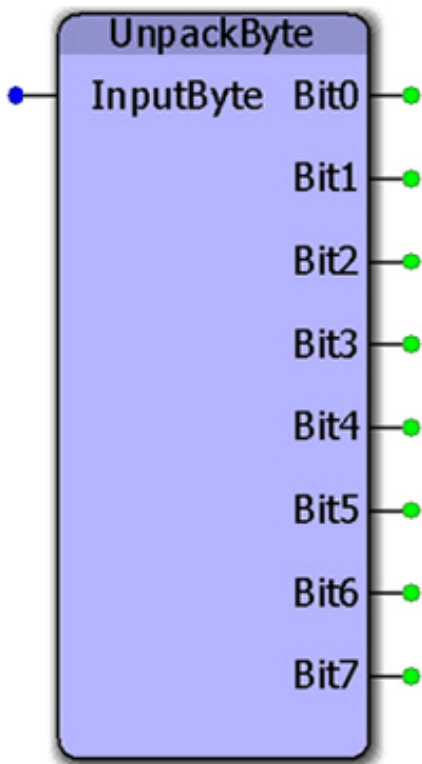
No errors will be generated.

Example:





UnpackByte



This function block converts a byte into discrete bits.

Library

Yaskawa Toolbox

Parameters

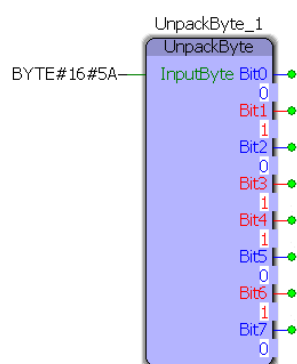
| * | Parameter | Data Type | Description | |
|------------|-----------|-----------|---|---------|
| VAR_INPUT | | | | Default |
| B | InputByte | BYTE | The input data to be separated into bits. | BYTE#0 |
| VAR_OUTPUT | | | | |
| V | Bit0 | BOOL | Bit 0 of the InputByte | |
| V | Bit1 | BOOL | Bit 1 of the InputByte | |
| V | Bit2 | BOOL | Bit 2 of the InputByte | |

| | | | |
|---|------|------|------------------------|
| V | Bit3 | BOOL | Bit 3 of the InputByte |
| V | Bit4 | BOOL | Bit 4 of the InputByte |
| V | Bit5 | BOOL | Bit 5 of the InputByte |
| V | Bit6 | BOOL | Bit 6 of the InputByte |
| V | Bit7 | BOOL | Bit 7 of the InputByte |

Error Description

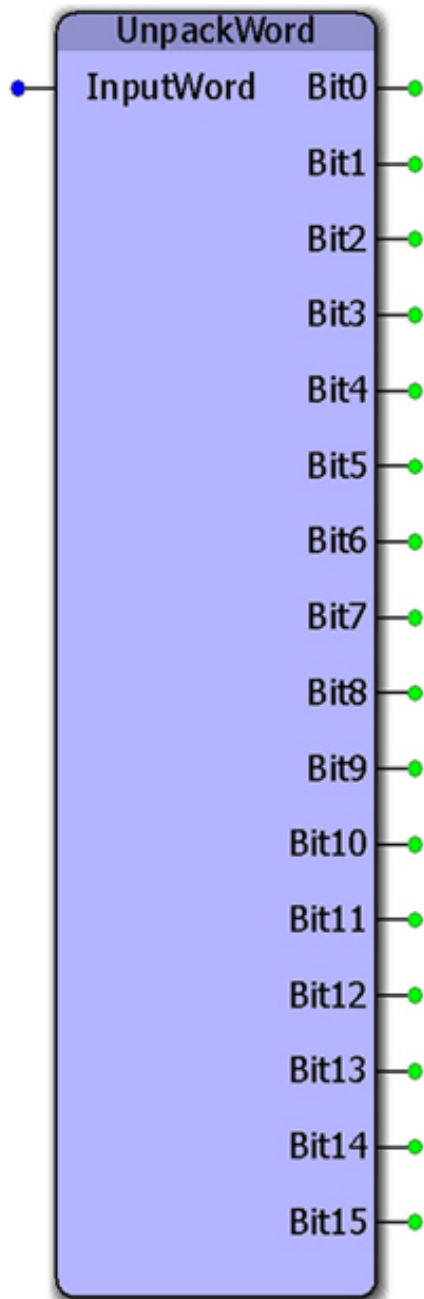
No errors will be generated.

Example





UnpackWord



This function block separates a word into individual bits.

Library

Yaskawa Toolbox

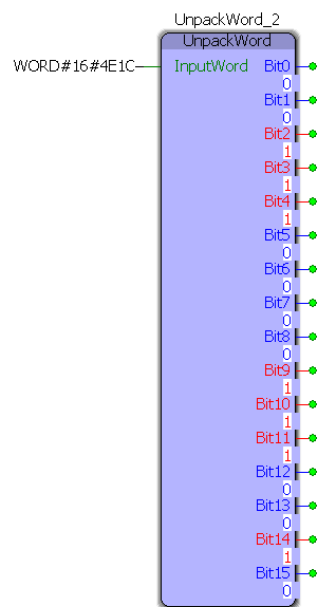
Parameters

| * | Parameter | Data Type | Description | |
|-------------------|-----------|-----------|---|----------------|
| VAR_INPUT | | | | Default |
| B | InputWord | WORD | The input data to be separated into bits. | WORD#0 |
| VAR_OUTPUT | | | | |
| V | Bit0 | BOOL | Bit 0 of the InputWord | |
| V | Bit1 | BOOL | Bit 1 of the InputWord | |
| V | Bit2 | BOOL | Bit 2 of the InputWord | |
| V | Bit3 | BOOL | Bit 3 of the InputWord | |
| V | Bit4 | BOOL | Bit 4 of the InputWord | |
| V | Bit5 | BOOL | Bit 5 of the InputWord | |
| V | Bit6 | BOOL | Bit 6 of the InputWord | |
| V | Bit7 | BOOL | Bit 7 of the InputWord | |
| V | Bit8 | BOOL | Bit 8 of the InputWord | |
| V | Bit9 | BOOL | Bit 9 of the InputWord | |
| V | Bit10 | BOOL | Bit 10 of the InputWord | |
| V | Bit11 | BOOL | Bit 11 of the InputWord | |
| V | Bit12 | BOOL | Bit 12 of the InputWord | |
| V | Bit13 | BOOL | Bit 13 of the InputWord | |
| V | Bit14 | BOOL | Bit 14 of the InputWord | |
| V | Bit15 | BOOL | Bit 15 of the InputWord | |

Error Description

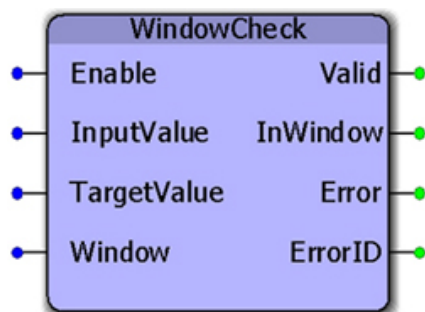
No errors will be generated.

Example





WindowCheck



This function block sets the InWindow output high if the InputValue is within $\pm (\text{Window}/2)$ of the TargetValue. This function is useful when making a comparison that only relies on the InputValue to be close to the Target, but an exact match is not required.

Library

Yaskawa Toolbox

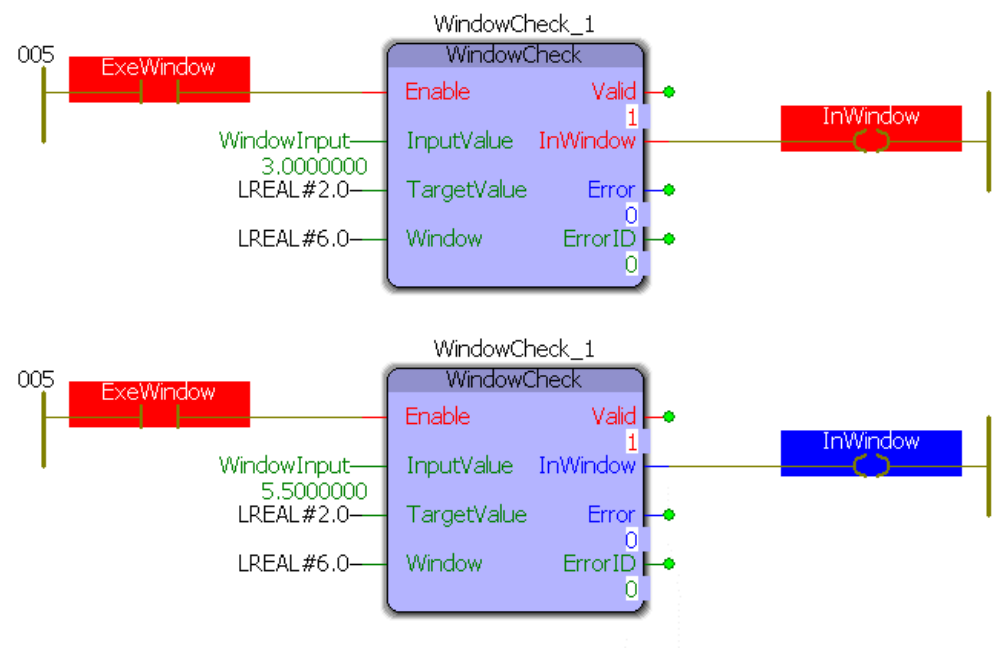
Parameters

| * | Parameter | Data Type | Description | |
|-------------------|-------------|-----------|---|----------------|
| VAR_INPUT | | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. | FALSE |
| V | InputValue | LREAL | The data to be tested against the TargetValue | LREAL#0.0 |
| V | TargetValue | LREAL | The desired data to be compared against. | LREAL#0.0 |
| V | Window | LREAL | This amount will be divided in two. The InputValue must fall within half the window distance of the TargetValue for the InWindow output to go high. Window must be greater than zero. | LREAL#0.0 |
| VAR_OUTPUT | | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. | |
| V | InWindow | BOOL | Indicates that the InputValue is within the TargetValue $\pm (\text{Window}/2)$ inclusive. | |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. | |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. | |

Error Description

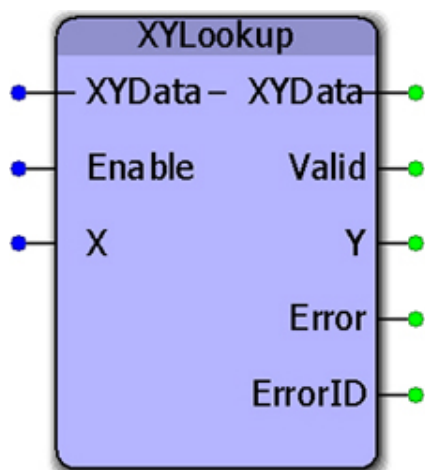
| ErrorID | Meaning |
|-----------------------|---------------------------------------|
| 0 | No error. |
| 10076 | WindowSize must be greater than zero. |

Example





XYLookup



This function block will do a binary search on the XYdata to find the X value, then output the corresponding Y value. This function will perform linear interpolation if the X value is between two data points in the XYData and calculate the appropriate Y value.

Library

Yaskawa Toolbox

Parameters

| * | Parameter | Data Type | Description |
|-------------------|-----------|--------------|---|
| VAR_IN_OUT | | | |
| V | XYData | XYDataStruct | An array of X & Y data pairs |
| VAR_INPUT | | | Default |
| B | Enable | BOOL | The function will continue to execute every scan while Enable is held high and there are no errors. |
| V | X | LREAL | The input reference |
| VAR_OUTPUT | | | |
| B | Valid | BOOL | Indicates that the function is operating normally and the outputs of the function are valid. |
| V | Y | LREAL | The resulting output that relates the input. |
| B | Error | BOOL | Set high if an error has occurred during the execution of the function block. This output is cleared when 'Execute' or 'Enable' goes low. |
| B | ErrorID | UINT | If Error is true, this output provides the Error ID. This output is reset when 'Execute' or 'Enable' goes low. |

Notes

- Works for sets where the X value is always increasing or always decreasing, but to use decreasing values of X requires v205 or higher.

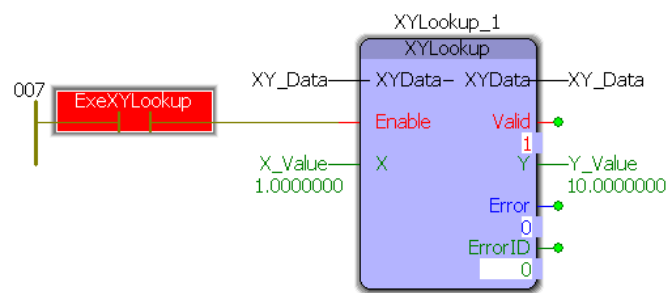
Error Description

| ErrorID | Meaning |
|---------|--|
| 0 | No error. |
| 10038 | CamData.LastSegment must be greater than 0 and less than 400, or whatever value has been declared as the ARRAY size in the CTB_Types file. |

Example

The XY_Data structure was initialized as:

```
1      1.0000000 XY_Data.Pair[0].X := LREAL#1.0;
2      10.0000000 XY_Data.Pair[0].Y := LREAL#10.0;
3      2.0000000 XY_Data.Pair[1].X := LREAL#2.0;
4      20.0000000 XY_Data.Pair[1].Y := LREAL#20.0;
5      3.0000000 XY_Data.Pair[2].X := LREAL#3.0;
6      30.0000000 XY_Data.Pair[2].Y := LREAL#30.0;
7      2 XY_Data.LastPair := INT#2;
```



Yaskawa DataTypes

Data Type: MovingAverageArray

Data Type: PIDStruct

Data Type: RTCStruct

Data Type: XYData

Data Type: XYDataStruct

Toolbox Help Documentation

Help version created 1/31/2018

YASKAWA



Enumerated Types for Yaskawa Toolbox

Some blocks accept an enumerated type (ENUM), which is a keyword (or constant) representing a value which will configure the operation of the function block. Enumerated types are equivalent to zero-based integers (INT). Therefore, the first value equates to zero, the second to 1, etc. The format for enumerated types is as follows: ENUM:(0, 1, 2...) as displayed in the example below (MC_BufferMode#Aborting).

| Enumerated Type | #INT Value | Enum Value | Description |
|-----------------|-------------------------|--------------------------|---|
| Analog_Inputs | <ENUM Type Description> | | |
| | 0 | <Enumeration_Text_Value> | <Enumeration_functionality_description> |
| | 1 | | |
| | 2 | | |
| FBErrorDetails | <ENUM Type Description> | | |
| | 0 | | |
| | 1 | | |
| | 2 | | |
| FBErrorHistory | <ENUM Type Description> | | |
| | 0 | | |
| | 1 | | |
| | 2 | | |
| FBErrorStruct | <ENUM Type Description> | | |
| | 0 | | |
| | 1 | | |
| | 2 | | |

ExplicitMessage Types

Toolbox Help Documentation

Help version created 1/31/2018

YASKAWA



DataType: ExplicitData

For use with the [Explicit_Message](#) function block.

Data Type Declaration

TYPE

ExplicitData : ARRAY[0..503] OF BYTE;

END_TYPE



RegSessionRequestStruct

For use with the [Explicit_Message](#) function block.

Refer to 2-5.4.2 in Vol 2, Chapter 2 EtherNet/IP Adaptation of CIP

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|----------------------------------|--------------------------------|-------------|--|
| | MyRegSessionRequestStruct | RegSessionRequestStruct | | |
| U | RSR_Command1 | BYTE | | MyRegSessionRequestStruct.RSR_Command1 |
| U | RSR_Command2 | BYTE | | MyRegSessionRequestStruct.RSR_Command2 |
| U | RSR_Length1 | BYTE | | MyRegSessionRequestStruct.RSR_Length1 |
| U | RSR_Length2 | BYTE | | MyRegSessionRequestStruct.RSR_Length2 |
| U | RSR_SessionHandle1 | BYTE | | MyRegSessionRequestStruct.RSR_SessionHandle1 |
| U | RSR_SessionHandle2 | BYTE | | MyRegSessionRequestStruct.RSR_SessionHandle2 |
| U | RSR_SessionHandle3 | BYTE | | MyRegSessionRequestStruct.RSR_SessionHandle3 |
| U | RSR_SessionHandle4 | BYTE | | MyRegSessionRequestStruct.RSR_SessionHandle4 |
| U | RSR_Status1 | BYTE | | MyRegSessionRequestStruct.RSR_Status1 |
| U | RSR_Status2 | BYTE | | MyRegSessionRequestStruct.RSR_Status2 |
| U | RSR_Status3 | BYTE | | MyRegSessionRequestStruct.RSR_Status3 |
| U | RSR_Status4 | BYTE | | MyRegSessionRequestStruct.RSR_Status4 |
| U | RSR_SenderContext | SenderContext | | MyRegSessionRequestStruct.RSR_SenderContext[0] |
| U | RSR_Options1 | BYTE | | MyRegSessionRequestStruct.RSR_Options1 |
| U | RSR_Options2 | BYTE | | MyRegSessionRequestStruct.RSR_Options2 |
| U | RSR_Options3 | BYTE | | MyRegSessionRequestStruct.RSR_Options3 |
| U | RSR_Options4 | BYTE | | MyRegSessionRequestStruct.RSR_Options4 |
| U | RSR_ProtocolVersion1 | BYTE | | MyRegSessionRequestStruct.RSR_ProtocolVersion1 |
| U | RSR_ProtocolVersion2 | BYTE | | MyRegSessionRequestStruct.RSR_ProtocolVersion2 |
| U | RSR_OptionFlags1 | BYTE | | MyRegSessionRequestStruct.RSR_OptionFlags1 |
| U | RSR_OptionFlags2 | BYTE | | MyRegSessionRequestStruct.RSR_OptionFlags2 |

ExplicitReceiveDataStruct



For use with the [Explicit_Message](#) function block.
Refer to 2-5.7.2 in Vol 2, Chapter 2 EtherNet/IP Adaptation of CIP.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|---------|-----------|-------------|-------|
|---|---------|-----------|-------------|-------|

| | MyExplicitReceiveDataStruct | ExplicitReceiveDataStruct | | |
|---|-----------------------------|-------------------------------|--|---|
| U | ED_Command1 | BYTE | | MyExplicitReceiveDataStruct.ED_Command1 |
| U | ED_Command2 | BYTE | | MyExplicitReceiveDataStruct.ED_Command2 |
| U | ED_Length1 | BYTE | | MyExplicitReceiveDataStruct.ED_Length1 |
| U | ED_Length2 | BYTE | | MyExplicitReceiveDataStruct.ED_Length2 |
| U | ED_SessionHandle1 | BYTE | | MyExplicitReceiveDataStruct.ED_SessionHandle1 |
| U | ED_SessionHandle2 | BYTE | | MyExplicitReceiveDataStruct.ED_SessionHandle2 |
| U | ED_SessionHandle3 | BYTE | | MyExplicitReceiveDataStruct.ED_SessionHandle3 |
| U | ED_SessionHandle4 | BYTE | | MyExplicitReceiveDataStruct.ED_SessionHandle4 |
| U | ED_Status1 | BYTE | | MyExplicitReceiveDataStruct.ED_Status1 |
| U | ED_Status2 | BYTE | | MyExplicitReceiveDataStruct.ED_Status2 |
| U | ED_Status3 | BYTE | | MyExplicitReceiveDataStruct.ED_Status3 |
| U | ED_Status4 | BYTE | | MyExplicitReceiveDataStruct.ED_Status4 |
| U | ED_SenderContext | SenderContext | | MyExplicitReceiveDataStruct.ED_SenderContext[0] |
| U | ED_Options1 | BYTE | | MyExplicitReceiveDataStruct.ED_Options1 |
| U | ED_Options2 | BYTE | | MyExplicitReceiveDataStruct.ED_Options2 |
| U | ED_Options3 | BYTE | | MyExplicitReceiveDataStruct.ED_Options3 |
| U | ED_Options4 | BYTE | | MyExplicitReceiveDataStruct.ED_Options4 |
| U | ED_InterfaceHandle1 | BYTE | | MyExplicitReceiveDataStruct.ED_InterfaceHandle1 |
| U | ED_InterfaceHandle2 | BYTE | | MyExplicitReceiveDataStruct.ED_InterfaceHandle2 |
| U | ED_InterfaceHandle3 | BYTE | | MyExplicitReceiveDataStruct.ED_InterfaceHandle3 |
| U | ED_InterfaceHandle4 | BYTE | | MyExplicitReceiveDataStruct.ED_InterfaceHandle4 |
| U | ED_TimeOut1 | BYTE | | MyExplicitReceiveDataStruct.ED_TimeOut1 |
| U | ED_TimeOut2 | BYTE | | MyExplicitReceiveDataStruct.ED_TimeOut2 |
| U | ED_ItemCount1 | BYTE | | MyExplicitReceiveDataStruct.ED_ItemCount1 |
| U | ED_ItemCount2 | BYTE | | MyExplicitReceiveDataStruct.ED_ItemCount2 |
| U | ED_AddressItemID1 | BYTE | | MyExplicitReceiveDataStruct.ED_AddressItemID1 |
| U | ED_AddressItemID2 | BYTE | | MyExplicitReceiveDataStruct.ED_AddressItemID2 |
| U | ED_AddressItemLength1 | BYTE | | MyExplicitReceiveDataStruct.ED_AddressItemLength1 |
| U | ED_AddressItemLength2 | BYTE | | MyExplicitReceiveDataStruct.ED_AddressItemLength2 |
| U | ED_DataItemID1 | BYTE | | MyExplicitReceiveDataStruct.ED_DataItemID1 |
| U | ED_DataItemID2 | BYTE | | MyExplicitReceiveDataStruct.ED_DataItemID2 |
| U | ED_DataItemLength1 | BYTE | | MyExplicitReceiveDataStruct.ED_DataItemLength1 |
| U | ED_DataItemLength2 | BYTE | | MyExplicitReceiveDataStruct.ED_DataItemLength2 |
| U | ED_Response1 | BYTE | | MyExplicitReceiveDataStruct.ED_Response1 |
| U | ED_Response2 | BYTE | | MyExplicitReceiveDataStruct.ED_Response2 |
| U | ED_ResponseStatus1 | BYTE | | MyExplicitReceiveDataStruct.ED_ResponseStatus1 |
| U | ED_ResponseStatus2 | BYTE | | MyExplicitReceiveDataStruct.ED_ResponseStatus2 |
| U | ED_Data | ExplicitData | | MyExplicitReceiveDataStruct.ED_Data[0] |



Service

For use with the [Explicit_Message](#) function block.

Data Type Declaration

TYPE

Service : ARRAY[0..7] OF BYTE;

END_TYPE



ExplicitSendDataStruct

For use with the [Explicit_Message](#) function block.

Refer to 2-5.7.2 in Vol 2, Chapter 2 EtherNet/IP Adaptation of CIP.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|---------------------------------|-------------------------------|-------------|--|
| | MyExplicitSendDataStruct | ExplicitSendDataStruct | | |
| U | ED_Command1 | BYTE | | MyExplicitSendDataStruct.ED_Command1 |
| U | ED_Command2 | BYTE | | MyExplicitSendDataStruct.ED_Command2 |
| U | ED_Length1 | BYTE | | MyExplicitSendDataStruct.ED_Length1 |
| U | ED_Length2 | BYTE | | MyExplicitSendDataStruct.ED_Length2 |
| U | ED_SessionHandle1 | BYTE | | MyExplicitSendDataStruct.ED_SessionHandle1 |
| U | ED_SessionHandle2 | BYTE | | MyExplicitSendDataStruct.ED_SessionHandle2 |
| U | ED_SessionHandle3 | BYTE | | MyExplicitSendDataStruct.ED_SessionHandle3 |
| U | ED_SessionHandle4 | BYTE | | MyExplicitSendDataStruct.ED_SessionHandle4 |
| U | ED_Status1 | BYTE | | MyExplicitSendDataStruct.ED_Status1 |
| U | ED_Status2 | BYTE | | MyExplicitSendDataStruct.ED_Status2 |
| U | ED_Status3 | BYTE | | MyExplicitSendDataStruct.ED_Status3 |
| U | ED_Status4 | BYTE | | MyExplicitSendDataStruct.ED_Status4 |
| U | ED_SenderContext | BYTE | | MyExplicitSendDataStruct.ED_SenderContext[0] |
| U | ED_Options1 | BYTE | | MyExplicitSendDataStruct.ED_Options1 |
| U | ED_Options2 | BYTE | | MyExplicitSendDataStruct.ED_Options2 |
| U | ED_Options3 | BYTE | | MyExplicitSendDataStruct.ED_Options3 |
| U | ED_Options4 | BYTE | | MyExplicitSendDataStruct.ED_Options4 |
| U | ED_InterfaceHandle1 | BYTE | | MyExplicitSendDataStruct.ED_InterfaceHandle1 |
| U | ED_InterfaceHandle2 | BYTE | | MyExplicitSendDataStruct.ED_InterfaceHandle2 |
| U | ED_InterfaceHandle3 | BYTE | | MyExplicitSendDataStruct.ED_InterfaceHandle3 |
| U | ED_InterfaceHandle4 | BYTE | | MyExplicitSendDataStruct.ED_InterfaceHandle4 |
| U | ED_TimeOut1 | BYTE | | MyExplicitSendDataStruct.ED_TimeOut1 |
| U | ED_TimeOut2 | BYTE | | MyExplicitSendDataStruct.ED_TimeOut2 |
| U | ED_ItemCount1 | BYTE | | MyExplicitSendDataStruct.ED_ItemCount1 |
| U | ED_ItemCount2 | BYTE | | MyExplicitSendDataStruct.ED_ItemCount2 |
| U | ED_AddressItemID1 | BYTE | | MyExplicitSendDataStruct.ED_AddressItemID1 |
| U | ED_AddressItemID2 | BYTE | | MyExplicitSendDataStruct.ED_AddressItemID2 |
| U | ED_AddressItemLength1 | BYTE | | MyExplicitSendDataStruct.ED_AddressItemLength1 |
| U | ED_AddressItemLength2 | BYTE | | MyExplicitSendDataStruct.ED_AddressItemLength2 |
| U | ED_DataItemID1 | BYTE | | MyExplicitSendDataStruct.ED_DataItemID1 |
| U | ED_DataItemID2 | BYTE | | MyExplicitSendDataStruct.ED_DataItemID2 |
| U | ED_DataItemLength1 | BYTE | | MyExplicitSendDataStruct.ED_DataItemLength1 |
| U | ED_DataItemLength2 | BYTE | | MyExplicitSendDataStruct.ED_DataItemLength2 |
| U | ED_DataService | Service | | MyExplicitSendDataStruct.ED_DataService[0] |
| U | ED_Data | ExplicitData | | MyExplicitSendDataStruct.ED_Data[0] |



SenderContext

For use with the [Explicit_Message](#) function block.

Data Type Declaration

TYPE

SenderContext : ARRAY[0..7] OF BYTE;

END_TYPE



UnRegSessionRequestStruct

For use with the [Explicit_Message](#) function block.

Refer to 2-5.4.3 in Vol 2, Chapter 2 EtherNet/IP Adaptation of CIP.

Data Type Declaration

| * | Element | Data Type | Description | Usage |
|---|------------------------------------|----------------------------------|-------------|--|
| | MyUnRegSessionRequestStruct | UnRegSessionRequestStruct | | |
| U | USR_Command1 | BYTE | | MyUnRegSessionRequestStruct.USR_Commands1 |
| U | USR_Command2 | BYTE | | MyUnRegSessionRequestStruct.USR_Commands2 |
| U | USR_Length1 | BYTE | | MyUnRegSessionRequestStruct.USR_Length1 |
| U | USR_Length2 | BYTE | | MyUnRegSessionRequestStruct.USR_Length2 |
| U | USR_SessionHandle1 | BYTE | | MyUnRegSessionRequestStruct.USR_SessionHandle1 |
| U | USR_SessionHandle2 | BYTE | | MyUnRegSessionRequestStruct.USR_SessionHandle2 |
| U | USR_SessionHandle3 | BYTE | | MyUnRegSessionRequestStruct.USR_SessionHandle3 |
| U | USR_SessionHandle4 | BYTE | | MyUnRegSessionRequestStruct.USR_SessionHandle4 |
| U | USR_Status1 | BYTE | | MyUnRegSessionRequestStruct.USR_Status1 |
| U | USR_Status2 | BYTE | | MyUnRegSessionRequestStruct.USR_Status2 |
| U | USR_Status3 | BYTE | | MyUnRegSessionRequestStruct.USR_Status3 |
| U | USR_Status4 | BYTE | | MyUnRegSessionRequestStruct.USR_Status4 |
| U | USR_SenderContext | SenderContext | | MyUnRegSessionRequestStruct.USR_SenderContext[0] |
| U | USR_Options1 | BYTE | | MyUnRegSessionRequestStruct.USR_Options1 |
| U | USR_Options2 | BYTE | | MyUnRegSessionRequestStruct.USR_Options2 |
| U | USR_Options3 | BYTE | | MyUnRegSessionRequestStruct.USR_Options3 |
| U | USR_Options4 | BYTE | | MyUnRegSessionRequestStruct.USR_Options4 |

Function Block ErrorID List

Toolbox Help Documentation

Help version created 1/31/2018

YASKAWA



Function Block ErrorID List

| ErrorID | Description |
|---------------------------|--|
| 0 | No error. |
| 1 | Time limit exceeded. |
| 2 | Distance limit exceeded. |
| 3 | Torque limit exceeded. |
| Motion State Error | |
| 4369 | The move could not be buffered because the motion queue is full. The default queue size for single axis moves is 16. For Mechatrolink groups, the queue size can be set in the Hardware Configuration, Yaskawa recommends setting the IO Task Assignment to the cyclic task with the fastest update interval. For MLX hosted robots, the queue size is 25. |
| 4370 | The move could not be started because motion is prohibited. Possible causes: 1) The axis may not be enabled. Check MC_Power.Status output. 2) An MC_Stop.Execute might be held high - no other block can override the Stopping state. 3) Verify that the limit switches are not active - check the Global Variables for the Axis. 4) A motion block may be attempting to abort an MC_TorqueControl move. 5) If this axis is included in a set of Grouped axes, this Error may occur when executing a single axis function block while the axis is part of an Enabled Group. Use MC_GroupDisable first. 6) If the axis is a cam slave AND configured as a rotary axis, verify that the slave positions in the Y_MS_CAM_STRUCT are within 0.0 to MachineCycle. |
| 4371 | The servo drive failed to enable or disable. Check the amplifier wiring for L1 / L2 / L3. The amplifier could be e-stopped or has an alarm. |
| 4375 | CamOut called while not camming. |
| 4376 | The master slave relationship can not be modified because the master axis has not been set yet. |
| 4377 | File reading already in progress. |
| 4378 | The function block is not applicable for the external axis specified. |
| 4379 | A homing sequence is already in progress. |
| 4380 | MC_SetPosition cannot be executed while the axis is already moving. |
| 4381 | Motion aborted due to axis alarm. It is also possible that a software limit has been exceeded. |
| 4382 | When an axis is configured for rotary mode, and the MC_SetPosition tries to set a position that is equal to or greater than the MachineCycle, this error is generated, and the position is not set. |
| 4383 | Axis must be commanded at standstill when homing is attempted. Refer to the Motion State Diagram and MC_ReadStatus. Maybe the axis is not enabled using MC_Power? |
| 4390 | Position cannot be defined while the axis is in a master / slave relationship. To redefine the position, use the MC_Stop function block for slave axis, then execute MC_SetPosition. If attempting to redefine a master position, execute MC_Stop for all slaves first. |
| 4391 | The function block cannot be used with a virtual axis. |
| 4394 | More than 10 Y_CamIn, Y_CamOut, or MC_GearInPos function blocks for a given axis are active at the same time. Most likely the application program is not coded correctly, and the Execute input is being fired too frequently. |
| 4395 | Window parameters are outside of the master axis' machine cycle. (0 to Prm 1502, the last master position in the active cam table.) |

| ErrorID | Description |
|--------------------------------|--|
| 4396 | Axis latch function already in use. |
| 4397 | Over travel is limit still ON after attempting to move away from it. |
| 4398 | The cam shift is not possible with EndPosition and current master position. This error occurs if the shift is greater than the distance to the end of the window. For example: shift = 90, window [180,360], and the master position = 300 when Y_CamShift.Execute=TRUE. (There is only 60 degrees of distance remaining.) To remedy this situation, execute Y_CamShift sooner. The function itself will monitor for the StartPosition and wait if necessary to actually start the correction. It is not necessary to monitor for the right position in the IEC application task before executing this function. |
| 4399 | The L1 / L2 / L3 power inputs on the drive may not be supplied with power, possibly due to an E-Stop condition. |
| 4400 | The safety input (HBB on the CN8 connector) is preventing the drive from enabling. |
| 4401 | The controller cannot communicate with the drive. It may be disconnected from the MECHATROLINK network. |
| 4402 | The scan compensation delay parameter 1305 is only valid for external encoders. |
| 4403 | The High Speed Output functionality is only available on external encoders. |
| 4404 | Cannot execute MC_GearOut because the axis is not in gear. |
| 4405 | Y_CamOut was aborted. |
| 4406 | Continuous Latch Mode is not supported on Sigma II, Sigma III, or external encoders. |
| 4407 | Internal buffer overflow. |
| 4408 | PatternSize is out of range (1-8) or PatternCount is out of range (0-255). |
| 4409 | Parameter write is already in progress. |
| 4410 | Parameter is read-only. |
| 4411 | The function block cannot be re-executed while it already is in progress. |
| 4412 | Parameter not supported for the specified axis or group. |
| 4413 | The stepper axis does not support the mode of motion commanded. |
| 4414 | MECHATROLINK communications to the drive was disrupted. Execute MC_Reset to restore the connection. |
| 4415 | Reboot is already in progress. |
| 4416 | Add IP Address already in progress |
| 4417 | Remove IP Address already in progress |
| 4418 | Debug Print already in progress |
| 4419 | Motion queue resize failed. Motion queue is not empty. |
| 4420 | Brake release function failed to execute. Brake release is prohibited while servo on, or the axis may not support brake release |
| 4421 | Servo ON is prohibited while the brake is manually released with Y_BrakeRelease |
| 4422 | Position offset update failed. This can happen if MC_SetPosition is called too often with absolute encoder axis on Sigma-7Siec (can't write the offset to flash fast enough). |
| 4423 | The function block can not be used with an active slave axis. |
| 4424 | Velocity override value is outside the allowable range of 0.0 to 1.0 inclusive. |
| Invalid Structure Value | |
| 4624 | RESERVED - General structure value error. |
| 4625 | AXIS_REF.AxisNum does not correspond to an axis configured on the system. Verify the value of AxisNum matches a logical axis number in the configuration. Tip: Make sure a variable of type AXIS_REF is properly declared as a VAR or VAR_GLOBAL in all relevant POU's. |
| 4626 | The master / slave relationship is already defined. If a slave must follow a different master, use the MC_Stop block on the slave before executing the next Y_CamIn. If cascading master slaves, a maximum of two levels of cascaded master / slave relationships can be configured. |
| 4630 | Trigger reference is not valid. |
| 4633 | Table size results in misaligned data. Refer to the help section "Internally Created Cam Data." A cam table will have a multiple of 16 bytes if created correctly. |
| 4634 | Buffer size results in misaligned data. |

| ErrorID | Description |
|---------------------------------|--|
| 4635 | Table type is not supported. |
| 4636 | Invalid start index. |
| 4637 | Invalid end index. |
| 4638 | Buffer Overrun. User Buffer is full. |
| Invalid Enumeration Type | |
| 4641 | Buffer mode does not correspond to a valid enumeration value. |
| 4642 | Direction does not correspond to a valid enumeration value. |
| 4643 | Start mode does not correspond to a valid enumeration value. |
| 4644 | Invalid shift mode. |
| 4645 | Offset mode does not correspond to a valid enumeration value. |
| 4646 | Mode does not correspond to a valid enumeration value or the enumeration is not supported. |
| 4647 | The synch mode does not correspond to a valid enumeration value. |
| 4648 | The parameter number does not exist for the specified axis - OR The parameter number requires the other function block (e.g. MC_WriteParameter vs MC_WriteBoolParameter) |
| 4649 | Invalid adjust mode. |
| 4650 | RampIn does not correspond to a valid enumeration value. |
| 4651 | ControlMode does not correspond to a valid enumeration value. |
| 4652 | EndMode does not correspond to a valid enumeration value. Y_CamOut only supports 'AtPosition' mode. |
| 4653 | ExecutionMode does not correspond to a valid enumeration value or the selected behavior is unsupported. |
| 4654 | Invalid Speed Unit setting in Y_MoveOptions.ProfileUnit. Select 0 for Absolute units, or 1 for % of maximum. |
| Range Error | |
| 4657 | Distance parameter is less than or equal to zero. |
| 4658 | Velocity parameter is less than or equal to zero. |
| 4659 | Acceleration is less than or equal to zero. |
| 4660 | Deceleration is less than or equal to zero. |
| 4661 | Torque is less than or equal to zero. |
| 4662 | Time is less than or equal to zero. |
| 4663 | Specified time was less than zero. |
| 4664 | Specified scale was less than or equal to zero. |
| 4665 | Velocity parameter is negative. (Conveyor moving in wrong direction.) |
| 4666 | Denominator is zero. |
| 4667 | Jerk is less than or equal to zero. For remote hosted groups such as MLX200, the Jerk units are in percentage, and the range is 20 to 100%. |
| 4668 | Torque Ramp is less than or equal to zero. |
| 4669 | Engage position is outside the cam table domain. |
| 4670 | Engage window is less than zero. |
| 4671 | Disengage position is outside the cam table domain. |
| 4672 | Negative Disengage Window. |
| 4673 | StartPosition is outside of master's range. |
| 4674 | EndPosition is outside of master's range. |
| 4675 | Axis filter time constant out of range, or an attempt to change the value was made while the axis was enabled. (The axis must be disabled to change the moving average time constant.) |
| 4676 | The time value must be within 0 to 10 MECHATROLINK cycles. |
| 4677 | Array size too large. |
| 4678 | Buffer array index out of range. |
| 4679 | Invalid date or time values entered. |
| 4680 | Invalid acceleration filter type entered. |
| 4681 | Position value exceeded configured limits. |

| ErrorID | Description |
|------------------------------|--|
| 4682 | Velocity value exceeded configured limits. |
| 4683 | Acceleration value exceeded configured limits. |
| 4684 | IdentInGroup not found. Verify that the string name of the joint exactly matches the definition in the Hardware Configuration. OR - Invalid JointIndex. The value provided does not map to a valid AXIS_REF on the system. |
| Invalid Input Data | |
| 4881 | The specified Pn does not exist. |
| 4882 | The mask does not correspond to valid tracks. |
| 4883 | The profile must start with relative time equal to zero, and the time must be increasing. |
| 4884 | The specified cam file does not exist. |
| 4885 | Invalid header for the cam file (missing # of rows, #of columns, or feed-forward velocity flag). You must first populate the TableType and DataSize in the Y_MS_CAM_STRUCT before executing the function. |
| 4886 | The first (master) column must be either increasing or decreasing. If the master data is incremental, even the very first point cannot be zero. |
| 4887 | CamTableID does not refer to a valid cam table. |
| 4888 | The engage phase exceeded the time limit. Slave axis could not attain the target position and velocity within the user specified time limit. |
| 4889 | The engage phase exceeded the distance limit. Slave axis could not attain the target position and velocity within the user specified master distance. |
| 4890 | Invalid width input. Width is an enumeration type with the following allowable values 'WIDTH_8'=0, 'WIDTH_16'=1, and 'WIDTH_32'=2. |
| 4891 | The slave axis can not be the same as the master axis. |
| 4892 | Default drive parameter info is not available for this parameter. Use the DataType Override input to specify the parameter size. |
| 4893 | The specified external axis may not be used. A physical axis is required. |
| 4894 | The specified virtual axis may not be used with this function block. |
| 4895 | Missing or unrecognized file extension. |
| 4896 | Could not find the axis parameter file. |
| 4897 | The drive's model number or type does not match the parameter file. |
| 4898 | The S Curve filter parameter must first be enabled in the Hardware Configuration before it is possible to enable/disable it using MC_WriteParameter. |
| 4899 | Axis position compensation file not found. |
| 4900 | Invalid axis position compensation file format. |
| 4901 | Cannot enable/disable axis position compensation while servo on. |
| 4902 | Invalid compensation table wrap range. |
| 4903 | Data Type value does not match the data type of the Value input. |
| 4904 | Data Type is out of range. |
| Y_DeviceComm ErrorIDs | |
| 8705 | The maximum number of concurrently open user sockets/IO device handles has been reached or exceeded. |
| 8706 | The socket/IO device handle was invalid. Invalid IP address. |
| 8707 | The IP address string was not in a valid format. |
| 8708 | The socket/IO device handle could not be created. |
| 8709 | The specified address or port is already in use on the local network. |
| 8710 | The specified address or port is not available for use. (Maybe the IP address specified is not assigned to one of the networks available on this MPiec?) |
| 8711 | Unable to accept new socket/IO device handle connection. |
| 8712 | Unable to bind to the specified address. |
| 8713 | The socket/IO device handle type argument was invalid. |
| 8714 | The local address or port was not valid. |
| 8715 | Connecting to the socket/IO device handle failed. |

| ErrorID | Description |
|-----------------------|---|
| 8716 | The remote IP address is unreachable. Check the default gateway. |
| 8717 | The socket/IO device handle is already connected to another endpoint. |
| 8718 | The socket/IO device handle connection attempt was actively refused by the remote device. |
| 8719 | The socket/IO device handle was not connected to a remote endpoint. Call Y_ConnectSocket prior to Y_ReadDevice or Y_WriteDevice. |
| 8720 | An error occurred trying to get or set the device option. |
| 8721 | The communication device could not be read. |
| 8722 | The communication device could not be written. |
| 8723 | A valid buffer argument to WriteDevice and ReadDevice is required. |
| 8724 | Invalid Device Option ID. |
| 8725 | The device option value was not the right size or the data was out of range. |
| 8726 | The serial port ID was not a valid serial port. |
| 8727 | The serial port specified could not be opened. |
| Group ErrorIDs | |
| 8960 | Invalid axes group. Confirm that the AxesGroup variable has the correct %M address as automatically assigned by the Hardware Configuration. Be sure the AxesGroup variable is global, and that if the group has been recently defined, the controller was rebooted. |
| 8961 | An axis is already owned by another group. |
| 8962 | Group activation is blocked. Ownership can not be changed while Mechatrolink reset is in progress. |
| 8963 | Specified Coordinate System is not supported. Possible causes: If a custom group is specified, only the ACS Coordinate System is applicable. |
| 8964 | Move prohibited because group has an alarm. |
| 8965 | Group activation prohibited, invalid axis/joint config. |
| 8966 | Group activation prohibited, mismatched axis command position for split axis. Example: X and X Prime sharing the same load. |
| 8967 | The group reports one or more of its axes has an error. |
| 8968 | Axis group reset is already in progress. |
| 8969 | Invalid circular path method. |
| 8970 | Invalid PathChoice. MC_MoveCircularAbsolute.PathChoice cannot be set to Clockwise or Counter Clockwise if the Group can move in three dimensions. |
| 8971 | Invalid circle geometry. Check the PathChoice input, only Longest and Shortest are allowed if the group has more than two dimensions. Be sure that the starting point (which is the position of the group before executing MC_MoveCircularAbsolute,) the AuxPoints, and the EndPoint define the intended arc. If using MC_CircleMode#Center, the calculated radius of the start position to the center and the end position to the center must be within 0.1%. It may be necessary to increase the resolution of the values provided. |
| 8972 | A grouped axis is disabled. If using MC_GroupEnable, all axes must be powered up using Y_GroupPower first. |
| 8973 | Invalid transition mode. |
| 8974 | Invalid transition parameter. |
| 8975 | Invalid transition geometry. The values for the acceleration, deceleration, and/or velocity of the transition yield an invalid geometry. Given the limits of accel/decel, velocity, and length of the segment, can't create the corner geometry to meet the specification. |
| 8976 | Invalid axes group state transition. Axes groups cannot transition directly between certain states, such as direct transition to disabled state from moving or error states. Use the appropriate function block to transition to the correct intermediate state. |
| 8977 | Invalid axes group motion coordinate type. The optional limit coordinate type specifier (a.k.a. VelocityUnit) parameter for the motion was outside the allowed range. |
| 8978 | Infinite velocity constraint. The resolved velocity limit for the move was infinite. If there is no Cartesian motion, and a rotational change only, use the MoveOptions input to specify the VelocityUnits as "UseRotationalScalers." Or - There is a non zero value in the position VECTOR for a degree of freedom that the AxesGroup does not support. |

| ErrorID | Description |
|------------------------|---|
| 8979 | Infinite acceleration constraint. The resolved acceleration limit for the move was infinite. |
| 8980 | Infinite deceleration constraint. The resolved acceleration limit for the move was infinite. |
| 8981 | Insufficient Coordinate Frame size. |
| 8982 | Invalid Tangent Plane. |
| 8983 | Invalid Colinearity Angle. The range is 0.0 to 10.0. |
| 8984 | The points specified to describe the circle are invalid due to a mismatch in dimensions, or the rotations do not match. |
| 8985 | Acceleration constraints violation. Computed motion violates acceleration constraints. |
| 8992 | Computed motion violates velocity constraints. |
| 8993 | Group must not be enabled for this action. |
| 8994 | Group filter not supported. |
| 8995 | Axis group filter time constant too large. |
| 8996 | Group filter time constant must be set to non-zero value prior to enabling |
| 8997 | The specified action was not supported for the specified coordinate frame combination. |
| 8998 | A zero-length vector was supplied for the direction |
| 8999 | The specified coordinate frame was actively involved in commanded motion and could not be modified. PCS frame already in motion with ExecutionMode#immediate (use queued mode instead.) |
| 9000 | The specified blending transition is not possible based on the two moves in the buffer to be blended. For example, Move 1 is a line and Move 2 is an arc, and they are not in the same plane. |
| 9001 | The specified blending transition required exact corner distance or deviation, but insufficient distance remained in the segment to satisfy the transition geometry. |
| 9002 | The position was unreachable due to inverse kinematics limitations . Try a direct move instead of a linear move. |
| 9003 | Specified blending transition for the function block could not be realized due to blending parameter restrictions. Typically due to accel limit too low or segment length too short, relative to transition velocity. |
| 9005 | Invalid or unsupported TrackProfile |
| 9006 | Invalid TrackProfile parameter, possibly the SyncIn and SyncOut master distance sum is greater than (EndDistance - StartDistance) |
| 9007 | The execution of the function with ExecutionMode = Queued or Delayed failed. The conditions for applying the function were validated when it was executed, but when the deferred execution occurred the conditions were no longer valid. Check the sequencing of the program. |
| 9008 | Invalid servopack memory address. The specified memory address is out of range. |
| 9009 | Unsupported servopack memory operation. Memory operations are not supported on this servopack model. |
| 9010 | Invalid servopack memory access mode . Attempted non volatile write to volatile only address. |
| 9011 | The tracking position was already past the allowable sync range before the conditions for sync-in were met. |
| 9012 | Conveyor tracking cannot be re executed while TrackState is non zero. (Tracking is currently in operation.) |
| 9013 | The target coordinate frame is invalid or not defined. Tip: Use Y_GroupSetFrameOffset or MC_TrackConveyorBelt before executing a move in PCS. |
| 9014 | The Conveyor reversed direction and re entered a previously completed TrackState region. |
| 9015 | The tracking position traveled past TrackOptions.StartDistance + DelayLimit with ExecutionMode#Queued or #Delayed without the ExecutionMode being satisfied. |
| 9016 | Group not paused/interrupted |
| MLX200 ErrorIDs | |
| 9216 | Invalid Host_ID. Supported Host_IDs are (0 = MECHATROLINK group, 1 = MLX hosted group) |
| 9217 | Invalid Interface_ID. Supported Interface_IDs are (0..7) |
| 9218 | Invalid Device_ID. Device_ID must be 0. |

| ErrorID | Description |
|---------|---|
| 9219 | The groups motion engine generated an error. Use the MC_GroupReadError function block to obtain the GroupErrorID. |
| 9220 | Group is not enabled. Enable the group using MC_GroupEnable. |
| 9221 | EtherNet/IP communication between the MPiec and the MLX robot interface was lost. |
| 9222 | State Transition Error. Refer to MC_GroupReadError for further details. |
| 9223 | Trajectory Shape Error. The value passed to MoveOptions.TrajectoryShape is invalid Valid trajectory types are 0 = Trapezoid and 1 = S-Curve. |
| 9224 | Profile Unit Error. The value passed to MoveOptions.ProfileUnit is invalid. Valid values are 0 (% of maximum) or 1 (Absolute units). |
| 9225 | Invalid Control Mode. The group is set for Jogging or Manual mode, and an MC_MoveLinear or similar function block was executed, or Y_GroupJog or similar function block was called while the group was set for Automatic mode. |
| 9226 | IdentInGroup not found in AxesGroup.Axis.Label[] |
| 9227 | The Conveyor Position is already greater than RecordedPosition + Track-Options.SyncIn.EndDistance before MC_TrackConveyorBelt became Active. |
| 9228 | An unsupported value of Y_VelocityUnit was used as the VelocityUnit input for the function block. Valid values are 0, 1 and 2. |
| 9229 | The AxisRef passed into the function block does not match any AxisNums in AxesGroup.AxisRef [].AxisNum |
| 9230 | MLX_Driver startup error. Possible causes: 1) Verify that the correct IP address for the remote hosted controller is configured. 2) Possibly the EIP_Output structure is not mapped to the correct hardware address. 3) Try slowing the cyclic task interval of the MLX_Driver FB to 8 mSec. |
| 9231 | MLX_Driver startup error. Possibly the EIP_Input structure is not mapped to the correct hardware address. The Ethernet/IP status word has a value of zero, which should never occur. Open the Hardware Configuration and save again. The Hardware Configuration configures the necessary variables and maps them to the appropriate hardware address. |
| 9232 | Trajectory Type Error. An invalid trajectory type input was used for the function block. Valid trajectory types are 0 = Axis and 1 = Tool Center Point (TCP) |
| 9233 | An invalid value was passed to the TCPCoordinate input. Valid value are (0, 1, 2, 3, 4, 5) which correspond to (X, Y, Z, Rx, Ry, Rz) |
| 9234 | A watchdog error for data passing between the MPiec and an MLX Ethernet/IP interface has occurred |
| 9235 | Module Info Read Error. There was an internal error in the function which reads the MLX module information. |
| 9236 | Ethernet/IP communication Error. The status variable for the MLX interface does not indicate healthy communication. (It is not 1000 Hex.) |
| 9237 | When there is more than one robot configured on an MLX interface, there must be one MLX_Driver for each robot. The first function block to run is designated as the primary. A secondary MLX_Driver will indicate this error if the primary MLX_Driver function block is no longer 'Valid'. |
| 9238 | Invalid [Origin, XX, XY] points. Origin coincides with XX, or Origin coincides with XY, or XX coincides with XY or Origin to XX is parallel to XX-XY. |
| 9239 | Invalid input or output frame. This function supports WCS, MCS, and PCS. |
| 9240 | Calculation leads to a singularity. Calculated output coordinates is in a singular or gimbal lock configuration. |
| 9241 | The AxesGroup BaseOffset, ToolOffset, or PartFrameOffset was changed while this function block was enabled. |
| 9242 | The MLX interface has a firmware version that is not compatible with the MLX200_**** user library in the project. Check the MLX hardware to verify the firmware version. Either change to the appropriate user library or send the MLX200 unit to Yaskawa for a firmware upgrade. |
| 9243 | The MLX reports Error 17. Possible causes include: HardwareMode was selected, but the MLX could not connect to the ServoPacks via EtherCat. |

| ErrorID | Description |
|-------------------------|---|
| 9244 | The HardwareMode selected does not match the MLX operation mode. Possible causes are: 1) The HardwareMode cannot be changed after the Enable input goes high. 2) If the MLX is configured to support more than one robot, all robots must be set for the same HardwareMode. 3) The MLX may require a reboot to enter Hardware mode. |
| 9245 | Setting the Tool Transformation offset failed. A confirmational check of the expected TCP position was out of range of 0.1 on one or more of the axes. |
| 9246 | One of the GroupInputs is in a state which prevents this function block from executing. |
| 9247 | Use the MLX_Conveyor_Config Function Block to configure MLX200 Conveyors. |
| 9248 | ConveyorTracking, PalletSolver, or MotoPick is not installed on the MLX200 |
| 9249 | The Group's E-Stop input is preventing motion. |
| 9250 | The Group's guard circuit input is preventing motion. |
| 9251 | One of the Group's interference zones is violated. |
| 9252 | The Group's liveman switch is preventing manual mode operation. |
| 9253 | The Group's Safety circuit is preventing motion. |
| 9258 | MC_GroupSetPosition.SetMode can only have values of 0, 1, or 2. |
| 9259 | MC_GroupSetPosition cannot be used on remote hosted groups with simulated or virtual axes. |
| 9262 | General SetFrameOffset error. One of the lower level functions returned an error. Please call Yaskawa America motion applications for assistance. |
| 9263 | There is more than one scanner (EIP master) device trying to communicate with the same remote hosted robot controller. |
| 9264 | Although communication between the MPiec controller and the remote hosting controller has been established, valid data read is not possible. Try re-enabling the function block. |
| 9265 | The required Option Monitor value is not retaining the required UserFeedbackDataType. Maybe more than one function block is trying to use the same service. |
| 9266 | For remote hosted groups such as MLX200, the Y_GroupInputs function block cannot be used when MLX_Driver.HardwareMode = TRUE. |
| 9267 | Wrong MPiec controller hardware for configured group mechanism, part number ending in "RBT" required and a minimum of firmware version 3.4. |
| Toolbox ErrorIDs | |
| 10020 | ProductSize cannot be less than or equal to zero. |
| 10021 | Maximum allowed consecutive missed registration marks reached. |
| 10022 | Product or circular buffer overrun / full. |
| 10023 | Buffer size too small / cannot be zero. |
| 10024 | DataSize must be greater than zero. |
| 10025 | SensorMinimum must be less than SensorMaximum. |
| 10026 | Positive Position Limit must be greater than Negative Position Limit. |
| 10027 | Negative Position Limit must be less than Positive Position Limit. |
| 10028 | Positive Velocity Limit must be LREAL#0.0 or greater. |
| 10029 | Negative Velocity Limit must be LREAL#0.0 or lower. |
| 10030 | Positive Acceleration Limit must be greater than 0. |
| 10031 | Negative Acceleration Limit must be less than 0. |
| 10032 | Positive Deceleration Limit must be greater than 0. |
| 10033 | Negative Deceleration Limit must be less than 0. |
| 10034 | Interpolation calculation error. |
| 10035 | Gripper Close Error (Timeout). |
| 10036 | Latch Error. LatchReference was negative. This situation should never occur. Verify that the normal axis movement is in a positive direction. Use PLCopen Toolbox v340 which contains improved code for applications with registration marks near the end of the default move. DCR 1183 |
| 10037 | Offset cannot be in the same direction as the original motion into the limit switch. |
| 10038 | CamData.LastSegment must be greater than 0 and less than 400, or whatever value has been declared as the ARRAY size in the CTB_Types file. |

| ErrorID | Description |
|---------|--|
| 10039 | Cam Segment 'Resolution' cannot be zero unless the CurveType is TB_CurveType#StraightLine.. |
| 10040 | Curve Type selected in a segment is not valid. |
| 10041 | Total pairs required would exceed DataType definition for MS_Array_Type based on number of segments and resolution settings in CamData. |
| 10042 | Master must be always increasing from segment to segment. |
| 10043 | Tangent Match formula error, cannot have only one segment. |
| 10044 | Tangent Blend error, must have two segments, a straight line and a Tangent Blend, in either order. |
| 10045 | SlavePosition not found in Y_MS_CAM_STRUCT. |
| 10046 | Both cam tables must have the same number of point to be added together. |
| 10047 | Both tables must have the same master cycle to be added together. |
| 10048 | The IndexSpeed is less than 20. |
| 10049 | Frequency cannot be less than 1 Hz. |
| 10050 | The dwell cannot be greater than the IndexTime. |
| 10051 | There must be a whole number of oscillations in an index at a given speed. |
| 10052 | There is a discrepancy between the master values in Profile1 and Profile 2. At the same pair somewhere in the table, the masters have values differing by more than 1 user unit. |
| 10053 | DataPoint Error. |
| 10054 | One of the segments in the path has an invalid Segment Type. Valid Segments Types are defined in Group Toolbox GroupTypes file as enumeration GTB_SegmentType. |
| 10055 | The absolute sum of the motion for all axes relative travel from the previous segment cannot be zero. One axis must always be in motion from segment to segment, otherwise the virtual master distance cannot be calculated. |
| 10056 | Arc Error. |
| 10057 | Point Error. |
| 10058 | The start angle must be a value from 0.0 to 360.0 degrees. |
| 10059 | The axes got out of sync during the path motion. All Cam Slaves InSync output must be on or off at the same time, or this ErrorID is generated. |
| 10060 | The axis must be configured as a rotary type for this function block to be applicable. |
| 10061 | MasterType is something other than 0 or 1. |
| 10062 | MachineCycle must be a positive value if MasterType = 0 |
| 10063 | LastSwitch is set outside the 0-255 range. Sigma7_FT62 feature supports switch with the range of 0-31 |
| 10064 | Track Number outside the 0-31 range. Sigma7_FT62 feature supports track(signal) with the range of 0- |
| 10065 | FirstOnPosition is not equal to 0. |
| 10066 | LastOnPosition is not equal to 0. |
| 10067 | AxisDirection is not equal to 0. Direction enumeration is ranging from 0 to 2. |
| 10068 | CamSwitchMode is not equal to 0. Sigma7_FT62 supports both position mode or time mode, which is 0 OR 1. |
| 10069 | Duration is set to 0 or a negative value. |
| 10070 | OnCompensationScaler is set to an invalid value. |
| 10071 | OffCompensationScaler is set to an invalid value. Sigma7_FT62 does not support this input, should set to zero all the time. |
| 10072 | ImproperOnPos_SetError. |
| 10073 | OnOffPosition_Error. In Sigma7_FT62 feature, when it is position mode, FirstOnPosition and LastOnPosition can't be the same value. |
| 10074 | Direction must be 0 for positive, or 2 for negative. |
| 10075 | Calibration Error: Cal_X2 must be greater than Cal_X1. |
| 10076 | WindowSize must be greater than zero. |
| 10077 | Cubic Spline maximum number of consecutive segments exceeded. DataType definition for the Matrix could be increased if necessary. |

| ErrorID | Description |
|---------|--|
| 10078 | Formula 27 Error is reserved for errors with circle calculations. |
| 10079 | When using UserNoDwellModifiedConstant Velocity, there must be three contiguous segments with the same formula code applied, and the master percentages must be increasing. |
| 10080 | Formula 29 error. |
| 10081 | ControlData.DecisionPosition is ≤ 0 . The position to determine when to disengage the cam cannot be less than or equal to zero. |
| 10082 | Mode Error. ControlData.Mode can only be 1 (one way cam) or 2 (two way cam). |
| 10083 | Unsupported Cubic Spline Sequence. |
| 10084 | One of the Cam Tables has an invalid TableID. |
| 10086 | MaxPosCorrection must be zero or positive, MaxNegCorrection must be or zero or negative. |
| 10089 | Bezier Error. There should be a straight line segment before and after the bezier segment. |
| 10093 | Rate is less than or equal to 0. |
| 10094 | S_Scans is less than 2 or greater than 30000. |
| 10097 | Bezier Slope Error. The slopes of the two straight lines before and after the Bezier segment should have slopes with same signs. If the slopes are positive, the slave end point should be GE slave start point. If the slopes are negative, slave end point should be LE slave start point. |
| 10100 | Both axes must be configured for the same axis type (Rotary / Linear) and if Rotary, they must have the same Machine Cycle. |
| 10110 | Too many tabs specified. |
| 10111 | Pitch between labels would be negative, need more spacing between tabs. |
| 10112 | Tab mode must be specified as 1 (Tabbing) or 2 (Stamp). |
| 10113 | Incorrect cam table size (check the CamTable.Header.datasize) |
| 10114 | Incorrect cam table size (check the CamTable.Header.Datasize). |
| 10115 | XML Tag not found. Possibly the file is corrupt or the schema is not compatible with this function block. |
| 10116 | Problem converting string data to the output buffer. |
| 10117 | The controller already has a String Conversion Error at the rising edge of this function. Clear the alarm using Y_ClearAlarms and try again. |
| 10118 | STRING_TO_BUF Conversion Error. |
| 10119 | In the Data Structure, rows must be set greater than zero and columns must be set greater than zero. |
| 10120 | File could not be opened. Check for accurate directory path and use of "/" |
| 10121 | The CSV file was written in a format unsupported by this function block. |
| 10122 | Row Error. The data is out of sync with the expected row / column arrangement expected. |
| 10123 | Column Start Error. The data is corrupted. |
| 10124 | Unsupported Case condition. |
| 10125 | Conversion Error. Check the ErrorRow and ErrorCol / ErrorString outputs for details. |
| 10126 | NoDataError - The End Of File was reached, but the record count is zero. Verify the file is not corrupted. |
| 10127 | TooManyRecords - DataType is not large enough. |
| 10128 | MaxNotDefined - The user must set the maximum number of records that can be added to the structure. |
| 10129 | No Carriage return found in CSV buffer. The function searched the file for twice the length of the specified buffer and was unable to find a carriage return indicating the end of a row. Either the buffer size is too small, or the data is invalid. |
| 10130 | The center to co-ordinate distance for the two input co-ordinates are not the same |
| 10131 | Zero radius is invalid. |
| 10132 | Only modes 0 (center + 2 co-ordinates) and 1 (radius + 2 coordinates) are supported. |
| 10133 | The coordinates of the two data points are the same. |
| 10138 | The positions of the main and prime axes are outside the specified Allowance to permit motion on the prime axis. |
| 10139 | VelocityScaler cannot be less than or equal to zero. |

| ErrorID | Description |
|---------|--|
| 10140 | Must be greater than zero and less than 20. |
| 10150 | Theta1 Below Minimum. |
| 10151 | Theta1 Above Maximum. |
| 10152 | Theta2 Below Minimum. |
| 10153 | Theta2 Above Maximum. |
| 10154 | Imaginary ChordHeight (impossible for mechanism). |
| 10155 | Maximum Compression Reached (Mechanism squats too deeply). |
| 10156 | Locked Leg at Knee Joint B (Link2-Link3). |
| 10157 | Locked Leg at Knee Joint D (Link1-Link4). |
| 10160 | CommandString length is invalid. |
| 10161 | Invalid CommandCode. |
| 10162 | Parameter being searched for is out of range. |
| 10163 | Mode input not valid. |
| 10164 | Invalid character position input. |
| 10165 | CommandString length is too long or command delimiter not found. |
| 10166 | File Not Found |
| 10168 | Buffer Size Error. |
| 10173 | Duplicate latch values detected. Consider upgrading to firmware 3.4 or higher to avoid this issue. SCR 10736 |
| 10220 | Encoder ConfigurationError. Encoder must be configured as an absolute encoder for Sigma7_FT62 feature. Set Pn002.2 to 0. |
| 10221 | Invalid Enumeration. Sigma7_FT62 high speed output signal enumeration does not match acceptable values. |
| 10222 | Reboot Required Error. Reboot the controller to complete writing of non-volatile memory. |
| 10223 | Out Of SyncError. The current encoder position is out of sync with the current output and check-point positions. |
| 10224 | Output Delta Error. The output position cannot be changed by more than +/- 45 degrees in a single machine cycle. |
| 10230 | Winder1RevPulse cannot be less than or equal to zero. |
| 10231 | LineRoll1RevPulse cannot be less then or equal to zero. |
| 10232 | LineRollDiameter cannot be less then or equal to zero. |
| 10233 | WinderInitDiameter cannot be less then or equal to zero. |
| 10234 | WinderMinDiameter cannot be less then or equal to zero. |
| 10235 | WinderMaxDiameter cannot be less then or equal to zero. |
| 10236 | Normal_Rate cannot be less then or equal to zero. |
| 10237 | E_Stop_Rate cannot be less then or equal to zero. |
| 10238 | Sshape_Time cannot be less then or equal to zero. |
| 10239 | Rate cannot be less then or equal to zero. |
| 10240 | PI_Parameters.RefRate cannot be less then or equal to zero. |
| 10600 | Unsupported Letter Code. A G Code started with a character that was not recognized. |
| 10601 | Unsupported G Code |
| 10602 | Unsupported M Code |
| 10603 | PathData is currently in use by MC_MovePath, it is not possible to START reading data into the structure until MC_MovePath is Done. |
| 10604 | Circle Error. When specifying an arc (G02 or G03), both the I and J registers cannot be zero. |
| 10605 | Offset Error. G10 'P' parameter must be 1 through 9. |
| 10606 | User Unit Error. An invalid combination of user units between the Hardware Configuration and the G code data was found. Example: HC is configured for revolutions, and the G Code file specifies mm. The G Code Processor can only convert between linear units. |
| 10607 | Segment Error. A function inside MC_MovePath could not find a SegmentID for the current motion that matches one assiged when the motion function block was executed. |

| ErrorID | Description |
|-----------------------|--|
| 10608 | CompTypeError - There was no valid combination of motion segments (Line-Line, Line-Arc, Arc-Line, Arc-Arc) |
| 10609 | Tool Compensation Error - There was no valid solution found for an Arc - Arc combination |
| 10610 | Tool Compensation Error. No Solution Found (Logic Error) |
| 10611 | Division by zero. |
| 10612 | Tool Compensation Error. A segment transition from line to line, line to arc, arc to line, or arc to arc was not detected. |
| 10613 | Tool Compensation Error. No solution found for an arc to arc transition. |
| 10614 | Tool index as specified in the 'P' register must be between 1 and MaxTools, which is the size of the ToolDataStruct in the Group Toolbox GCode ypes file. |
| 10615 | G10 Error. The 'L' register must be 1 or 2. |
| 10616 | OperationMode Error. The VAR_INPUT is requesting "Infinite Repeat" but the path is too large to fit within the PathData.Segment struct at once, and the beginning of the path was overwritten. Infinite repeat mode is only possible if the entire path can be contained in the PathData struture. |
| 10617 | Group Name Error. Check AxesGroup.Name for validity. |
| 10618 | ControllerInfo Error. Connect a Global variable of datatype CONTROLLER_INFO and locate it at address %MD3.66560 |
| 10620 | Spindle Speed Calculation Error. PathData.HC_UserUnits is invalid or not supported. |
| 10633 | Queue Size Error occurs if the Motion Queue Size set in the Hardware Configuration is larger than the DataType MC_PATH_DATA_REF.Segment[] in the Group Toolbox. |
| 10634 | The Motion Queue Size set in the Hardware Configuration is larger than the DataType MC_PATH_DATA_REF.Segment[] in the Group Toolbox. Adjust the Motion Queue Size so it is smaller than the size declared for MC_PATH_DATA_REF.Segment[]. |
| 10635 | Program List Error. The G Code data refers to more program labels (typically from an IF or M98 command) than the declared size of ProgramList.Name[], which is typcially 16. |
| 10636 | Logic Type Error. The command is not formatted correctly. Examples: N25 IF [#500 LT 25] N35 or N10 #3=0 |
| 10637 | Conversion Error. A logical expression could not be converted from a byte array to a string. Contact technical support for assitance. |
| 10638 | JumpError. The IF instruction must include a line number reference as Nxx where the first character is "N" and the remaining characters are numeric. Example: N25 IF [#500 LT 25] N35 |
| 10639 | Operand Error. The following operands are supported in an IF instruction: EQ, GE, GT, LE, LT, NE, =, >=, <, <=, <, <> |
| 10640 | Tool Length Error - G Code Register._H is not 0,1, or 2. |
| 10641 | Evaluation Error. There was something wrong with a logical command such as a missing # sign, unsupported or improperly formatted logical comaprison, or divide by zero. |
| 11050 | Cam correction (shift/offset) has been aborted by another function block. |
| 11051 | Segment Error, could not find the previous motion segment to determine change in XYZ coordinates. Maximum search is 20 segments. Contact Yaskawa Electric America for support. |
| 11052 | There are no degrees of freedom defined for the Group. The could be a group configuration error. At least one of the first 6 AxesGroup.Machine.Label[] must be populated with a string name, or the AxesGroup.HostID must indicate a remote hosted robot. |
| 12000 | Read response timeout, no response was received within the supplied TimeOut. |
| 12010 | Not a response (QR should be 1 but it was 0). |
| 12011 | Response was truncated because it extended beyond the 512byte UDP packet size. |
| 12012 | Recursive is not available but was requested by the Query packet |
| 12021 | Format error, the name server was unable to interpret the query. |
| 12022 | Server failure, the name server was unable to process the query due to an internal problem. |
| 12023 | Name error, not valid for this block (only valid for Authoritative servers). |
| 12030 | Address length was less than 3 characters which is not possible. |
| 12031 | Address format was incorrect as it does not contain a '.'. |
| 12100 | Connect to SMTP server timeout, no connection was established within the supplied TimeOut. |

| ErrorID | Description |
|-------------------|---|
| 12101 | DATA portion of e-mail was not successful and therefore the e-mail may not send/be malformed. |
| 12102 | QUIT error, there was an error sending the 'QUIT' command to the server. |
| 12103 | NumRcpt cannot equal 0. |
| 12200 | Connect to FTP server timeout, no connection was established within the supplied TimeOut. |
| 12201 | Connect to FTP data socket timeout, no connection was established within the supplied TimeOut. |
| 12202 | QUIT error, there was an error sending the 'QUIT' command to the server. |
| 12203 | The credentials for the FTP server were incorrect (either one or both username and password). |
| 12300 | File Error, no error information available. |
| 12301 | Invalid file handle. |
| 12302 | Maximum number of files are already opened. |
| 12304 | File is already opened. |
| 12305 | File is write protected or access denied. |
| 12306 | File name not defined. |
| 12310 | End of data reached. |
| 12312 | The number of characters to be read from file is greater than the data buffer. |
| 12322 | No data could be read from file. |
| 12421 | Service not available, closing control connection. This may be a reply to any command if the service knows it must shut down. |
| 12425 | Can't open data connection. |
| 12426 | Connection closed; transfer aborted. |
| 12430 | Invalid username or password. |
| 12434 | Requested host unavailable. |
| 12450 | Requested file action not taken / Requested mail action not take (mailbox unavailable). |
| 12451 | Requested action aborted. Local error in processing. |
| 12452 | Requested action not taken, insufficient storage space in system (FTP: File unavailable) |
| 12500 | Syntax error, command unrecognized. |
| 12501 | Syntax error in parameters or arguments. |
| 12502 | Command not implemented. |
| 12503 | Bad sequence of commands. |
| 12504 | Command not implemented for that parameter. |
| 12521 | [domain] does not accept mail. |
| 12530 | Not logged in / Access denied. |
| 12532 | Need account for storing files. |
| 12550 | Requested action not taken. File unavailable (e.g., file not found, no access) / Mailbox unavailable. |
| 12551 | Requested action aborted. Page type unknown / User not local. |
| 12552 | Requested file action aborted, exceeded storage allocation / Requested mail action aborted, exceeded storage allocation. |
| 12553 | Requested action not taken, file name not allowed / mailbox name not allowed. |
| 12554 | Transaction failed. |
| 12560 | Invalid Equipment Module number. |
| 12561 | Equipment Module not enable in the system. |
| 12562 | Invalid number of enabled Control Modules in selected Equipment Module. |
| 12563 | Time rollover warning. |
| Axis Error | |
| 40960 | RESERVED |
| 45332 | Sending clear alarms command to servo drive failed. |
| 45335 | Failed to initialize absolute encoder. |
| 45336 | Function block could not be executed because a program download was in progress. |
| 45337 | Rebooting the controller is prohibited while an axis is enabled. |

| ErrorID | Description |
|-------------------------------|--|
| Operating System Error | |
| 57620 | The DataType connected to a function block parameter specified as ANY type does not match the required data size. Right click on the function block and select "Object Properties" to determine which parameters are ANY type. The size of the variable connected to these parameters is not checked during the compilation but validated at run time. Typically errors occur when a variable of type AXIS_REF is not connected to an Axis VAR_IN_OUT, or a variable of type Y_Engage_Data is not connected to the Y_CamIn function block. |
| 57873 | InvalidStructureSize. The structure size does not match. Check all the variables connected to the function block. A common mistake is to connect a structure element, not the entire structure. Example: EngageData.StartMode is connected instead of just EngageData |
| 57874 | Argument data is NULL. The EngageData input must be connected. |
| Kernel Error | |
| 61713 | This function block caused an internal error. Possible causes: MC_Power – Check if multiple instances of this block are executed for the same axis. Y_CamIn - Check in the cam table if the master values are the same for two datapoints or decreasing. Y_CamStructSelect – Y_MS_CAM_TABLE.Header.DataSize must not be zero. |

Controller AlarmID List

Toolbox Help Documentation

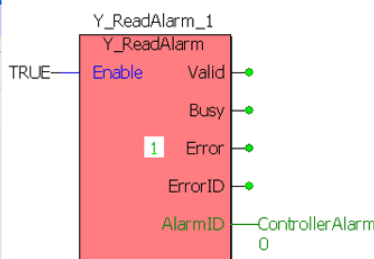
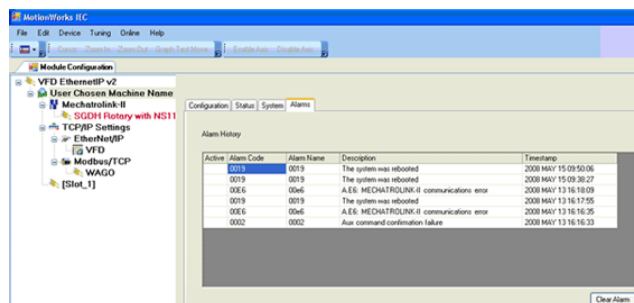
Help version created 1/31/2018

YASKAWA



Controller AlarmID List

The following is a list of alarm codes that are reported in the Hardware Configuration's Controller Alarms tab, [Y_ReadAlarm](#) and [MC_GroupReadError](#) function blocks, and the webUI. These are non axis specific system alarms.



| | Hex Code | | Description |
|--------------|----------------------|---|---|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| motionKernel | 1201 | 0103 | An alarm task queue was full when a new alarm was posted. This indicates that the task is being starved of execution time or that the system is generating many alarms simultaneously. |
| app | 1401 | 0005 | The script environment ran out of memory. This is a serious condition because it may prevent further errors from being handled correctly. |
| app | 1401 | 0006 | An error occurred while running the standard error handler for a general script error. This is a serious condition because it indicates the standard error handler is malfunctioning. |
| app | 1401 | 0007 | This error should never occur and is included only for completeness. It indicates that an unknown and potentially fatal problem has occurred within the script engine. |
| app | 1401 | 000A | The script task failed to stop cleanly, which may result in unreleased system resources. Error recovery requires the controller be reset. |
| app | 1401 | 000B | The command line task failed to stop cleanly, which may result in unreleased system resources. Error recovery requires the controller be reset. |
| app | 1403 | 0002 | The task responsible for publishing events to a remote client failed to stop cleanly, which may result in unreleased system resources. Error recovery requires the controller be reset. |

| | Hex Code | | Description |
|--------------|-------------------|---|---|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| app | 1403 | 0003 | The task responsible for replying to remote clients failed to stop cleanly, which may result in unreleased system resources. Error recovery requires the controller be reset. |
| app | 1403 | 0004 | The task responsible starting and stopping connections to remote clients failed to stop cleanly, which may result in unreleased system resources. Error recovery requires the controller be reset. |
| app | 1407 | 0001 | The file system on which the configuration file directory resides could not be read and may be unmounted or corrupted. The system has booted in a minimal configuration mode, and most functionality is limited. If possible, the file system should be recovered or reformatted and new config files uploaded if applicable. |
| app | 1407 | 0103 | The watchdog timer expired. |
| app | 1407 | 0108 | A CPU exception occurred. |
| app | 1407 | 0109 | The firmware files on the controller do not match the expected check-sums. |
| app | 1407 | 010A | The manufacturing procedure failed. The controller probably could not fetch the current time from the network. |
| app | 140A | 0009 | Network reset detected multiple Axes connected to the same servo network node. |
| app | 140A | 000A | Network reset detected multiple I/O connected to the same network node. |
| app | 140A | 0015 | Controller memory was corrupted during network reset resulting in a lost logical Axis data structure. |
| app | 140A | 0016 | Controller memory was corrupted during network reset resulting in a lost logical I/O data structure. |
| app | 140A | 0018 | An Abort input specified in the configuration could not be found. The abort condition is considered permanently asserted. No motion is possible until the I/O configuration can be matched to the abort inputs (restart required). |
| app | 140A | 0021 | Too many events were posted from the system ISR. The motion scan and servo net loop have been shut down. |
| app | 140B | 0002 | The controller ran out of free memory, possibly resulting in an unrecoverable failure. Please reboot the controller. A common cause for this alarm is when an application uses camming, and continues to create new cam tables without releasing the memory (Y_ReleaseCamTable) for old cam tables that are no longer needed. See the Cam Toolbox for a function to help called "CamTableManager." If using the Gantry toolbox and the MovePath function block, a similar function called PathIDManager is available. |
| app | 140B | 0004 | The largest free memory block is too small, possibly resulting in an unrecoverable failure. Please reboot the controller. |
| app | 140C | 1035 | The manufacturing data on the controller is invalid. The controller needs to be returned to Yaskawa for reprogramming. |
| Mechatrolink | 2301 | 0001 | The drive returned an invalid watch dog code indicating a possible dropped communication packet. |
| Mechatrolink | 2301 | 0002 | The drive failed to return confirmation of last aux command within the default timeout period. |
| Mechatrolink | 2301 | 0003 | An unrecoverable error occurred during auto configuration. As a result, one or more drives are excluded from the servo network. |

| | Hex Code | | Description |
|--------------|----------------------|---|---|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| Mechatrolink | 2301 | 0004 | Overriding the auto configured axes parameters failed. As a result, one or more drives are excluded from the servo network. |
| Mechatrolink | 2301 | 0005 | Two or more nodes have the same ID. As a result, all servo network communication has been suspended. |
| Mechatrolink | 2301 | 0006 | The controller must be the root node on the servo network. All servo network communication has been suspended |
| Mechatrolink | 2301 | 0007 | The servo network communication device failed to initialize. Servo network communication is not possible. |
| Mechatrolink | 2301 | 0008 | An error occurred sending command to a node during initialization. The node may not support the configured communications rate. Communication with this node has been prohibited, but communication with other nodes may be possible. |
| Mechatrolink | 2301 | 000E | The drive does not return response packet. |
| Mechatrolink | 2301 | 000F | Bus reset generation that controller is not demanding. |
| Mechatrolink | 2301 | 0010 | It receives response with the same channel at the same Iso cycle. |
| Mechatrolink | 2301 | 0011 | The ID in the response packet is not same to ID of AxisNode. |
| Mechatrolink | 2301 | 0012 | The data length in the response packet is not same to value of CSR register(SEND_DSP_DATA_LENGTH) of drive. |
| Mechatrolink | 2301 | 0013 | The packet type in the response packet is not same S-DSP. |
| Mechatrolink | 2301 | 0014 | Invalid cycle time has passed with configuration file 'servonet.xml'. As a result, all servo network communication has been suspended. |
| Mechatrolink | 2301 | 0015 | Node is not found on 1394 network. |
| Mechatrolink | 2301 | 0016 | Invalid node. |
| Mechatrolink | 2301 | 0017 | Error matching node IDs. |
| DPRAM | 2309 | 0001 | Invalid watch dog code from drive |
| DPRAM | 2309 | 0002 | Aux command confirmation failure |
| DPRAM | 2309 | 0003 | Auto configuration failed |
| DPRAM | 2309 | 0004 | Overriding auto configuration failed |
| DPRAM | 2309 | 0005 | Invalid cyclic check sum from drive |
| DPRAM | 2309 | 0006 | Invalid watch dog from drive |
| DPRAM | 2309 | 0007 | Control mode is not supported |
| DPRAM | 2309 | 0008 | Communication with a node failed during servo network startup |
| motionKernel | 3103 | 0100 | Controller SRAM battery is low |
| motionKernel | 3103 | 0101 | The file system failed the integral consistency check. Remedy: Power up the controller in supervisory mode using the SUP switch. (On 3000 series controllers, this switch is labeled 'MNT' as in Maintenance.) Clear the alarm. Turn off the SUP switch. Power cycle the controller. |
| motionKernel | 3201 | 0001 | The motion kernel didn't request to enable axis. But, the axis is enabled. |
| motionKernel | 3201 | 0002 | The motion kernel didn't request to disable axis. But, the axis is disabled. |
| motionKernel | 3201 | 0004 | The encoder position stored in SRAM could not be validated. The value has been reset. |
| motionKernel | 3201 | 0005 | Main bus power was disconnected while the axis was enabled. Main power must be restored and this alarm cleared before motion can continue. |
| motionKernel | 3201 | 0101 | Configuration error: multiple alarm tasks with duplicate priority. |
| motionKernel | 3201 | 0102 | Configuration error: Alarm task not configured. Using default priority and name. |

| | Hex Code | | Description |
|--------------|----------------------|---|--|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| motionKernel | 3202 | 0001 | Axis Coordinate System: The command position was outside the allowable range for the axis in the positive direction (positive overtravel). The axis may not be moved again until the alarm condition is cleared. After the alarm is cleared, it is permissible to execute a move which brings the axis back toward the allowed region, even though the axis is probably still outside the allowed region. Any move which pulls the axis further away from the allowed region will re-trigger the alarm. |
| motionKernel | 3202 | 0002 | Axis Coordinate System: The command position was outside the allowable range for the axis in the negative direction (negative overtravel). The axis may not be moved again until the alarm condition is cleared. After the alarm is cleared, it is permissible to execute a move which brings the axis back toward the allowed region, even though the axis is probably still outside the allowed region. Any move which pulls the axis further away from the allowed region will re-trigger the alarm. |
| motionKernel | 3202 | 0003 | Axis Coordinate System: The command speed was greater than the allowable range for the axis in the positive direction (overspeed). The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 3202 | 0004 | Axis Coordinate System: The command speed was greater than the allowable range for the axis in the negative direction (overspeed). The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 3202 | 0005 | Axis Coordinate System: The command acceleration was greater than the allowable range for the axis in the positive direction. The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 3202 | 0006 | Axis Coordinate System: The command acceleration was greater than the allowable range for the axis in the negative direction. The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 3202 | 0007 | Axis Coordinate System: The command torque was greater than the allowable range for the axis in the positive direction (overtorque). The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 3202 | 0008 | Axis Coordinate System: The command torque was greater than the allowable range for the axis in the negative direction (overtorque). The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 3202 | 0011 | Joint Coordinate System: The command position was outside the allowable range for the axis in the positive direction (positive overtravel). The axis may not be moved again until the alarm condition is cleared. After the alarm is cleared, it is permissible to execute a move which brings the axis back toward the allowed region, even though the axis is probably still outside the allowed region. Any move which pulls the axis further away from the allowed region will re-trigger the alarm. |
| motionKernel | 3202 | 0012 | Joint Coordinate System: The command position was outside the allowable range for the axis in the negative direction (negative overtravel). The axis may not be moved again until the alarm condition is cleared. After the alarm is cleared, it is permissible to execute a move which brings the axis back toward the allowed region, even though the axis is probably still outside the allowed region. Any move which pulls the axis further away from the allowed region will re-trigger the alarm. |
| motionKernel | 3202 | 0013 | Joint Coordinate System: The command speed was greater than the allowable range for the axis in the positive direction (overspeed). The axis may not be moved again until the alarm condition is cleared. |

| | Hex Code | | Description |
|--------------|----------------------|---|--|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| motionKernel | 3202 | 0014 | Joint Coordinate System: The command speed was greater than the allowable range for the axis in the negative direction (overspeed). The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 3202 | 0015 | Joint Coordinate System: The command acceleration was greater than the allowable range for the axis in the positive direction. The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 3202 | 0016 | Joint Coordinate System: The command acceleration was greater than the allowable range for the axis in the negative direction. The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 3202 | 0017 | Joint Coordinate System: The command torque was greater than the allowable range for the axis in the positive direction (overtorque). The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 3202 | 0018 | Joint Coordinate System: The command torque was greater than the allowable range for the axis in the negative direction (overtorque). The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 3202 | 0021 | World Coordinate System: The command position was outside the allowable range for the axis in the positive direction (positive overtravel). The axis may not be moved again until the alarm condition is cleared. After the alarm is cleared, it is permissible to execute a move which brings the axis back toward the allowed region, even though the axis is probably still outside the allowed region. Any move which pulls the axis further away from the allowed region will re-trigger the alarm. |
| motionKernel | 3202 | 0022 | World Coordinate System: The command position was outside the allowable range for the axis in the negative direction (negative overtravel). The axis may not be moved again until the alarm condition is cleared. After the alarm is cleared, it is permissible to execute a move which brings the axis back toward the allowed region, even though the axis is probably still outside the allowed region. Any move which pulls the axis further away from the allowed region will re-trigger the alarm. |
| motionKernel | 3202 | 0023 | World Coordinate System: The command speed was greater than the allowable range for the axis in the positive direction (overspeed). The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 3202 | 0024 | World Coordinate System: The command speed was greater than the allowable range for the axis in the negative direction (overspeed). The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 3202 | 0025 | World Coordinate System: The command acceleration was greater than the allowable range for the axis in the positive direction. The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 3202 | 0026 | World Coordinate System: The command acceleration was greater than the allowable range for the axis in the negative direction. The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 3202 | 0027 | World Coordinate System: The command torque was greater than the allowable range for the axis in the positive direction (overtorque). The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 3202 | 0028 | World Coordinate System: The command torque was greater than the allowable range for the axis in the negative direction (overtorque). The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 3202 | 0031 | The move specified would exceed the software position limits in the positive direction and was rejected before being started. The group may be moved again immediately if desired. |

| | Hex Code | | Description |
|--------------|----------------------|---|---|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| motionKernel | 3202 | 0032 | The move specified would exceed the software position limits in the negative direction and was rejected before being started. The group may be moved again immediately if desired. |
| motionKernel | 3202 | 0033 | The move specified would exceed the software speed limits in the positive direction and was rejected before being started. The group may be moved again immediately if desired. |
| motionKernel | 3202 | 0034 | The move specified would exceed the software speed limits in the negative direction and was rejected before being started. The group may be moved again immediately if desired. |
| motionKernel | 3202 | 0035 | The move specified would exceed the software acceleration limits in the positive direction and was rejected before being started. The group may be moved again immediately if desired. |
| motionKernel | 3202 | 0036 | The move specified would exceed the software acceleration limits in the negative direction and was rejected before being started. The group may be moved again immediately if desired. |
| motionKernel | 3202 | 0037 | The move specified would exceed the software torque limits in the positive direction and was rejected before being started. The group may be moved again immediately if desired. |
| motionKernel | 3202 | 0038 | The move specified would exceed the software torque limits in the negative direction and was rejected before being started. The group may be moved again immediately if desired. |
| motionKernel | 3202 | 0039 | The predictive soft limit encountered a segment that doesn't support the predicted stopping point. |
| motionKernel | 3202 | 0041 | Cam and Contour tables must have a header indicating the number of rows and columns and a feed forward velocity flag. Comma separated data values following the header. |
| motionKernel | 3202 | 0042 | In CamTables, the first (master) column must be either increasing or decreasing. |
| motionKernel | 3202 | 0043 | In ContourTables, the first (time) column must start at zero and be increasing. |
| motionKernel | 3202 | 0044 | The master position was outside the range of the CamTable, which automatically stopped the cam motion. |
| motionKernel | 3202 | 0045 | One or more slave axes could not attain the target position and velocity within the user specified time limit for the Cam or Gear motion. |
| motionKernel | 3202 | 0046 | One or more slave axes could not attain the target position and velocity within the user specified distance limit for the Cam or Gear motion. |
| motionKernel | 3202 | 0051 | Axis enable failed. This problem is usually a result of communication problems with the servo drive. |
| motionKernel | 3202 | 0052 | Runtime computation detected an invalid motion parameter. This alarm ID can occur if a discrete move has to be completed but the commanded deceleration for that move is not sufficient. For example if a MC_MoveAbsolute aborts another move and the axis has to stop at a position that will come up in a couple of scans, but the deceleration input on the MC_MoveAbsolute is not high enough to make the desired profile, this alarm will occur. |
| motionKernel | 3202 | 0061 | The axis Positive Overtravel (P-OT) limit has been exceeded. Motion is prevented in the positive direction. The axis may not be moved again until the alarm condition is cleared. |

| | Hex Code | | Description |
|--------------|----------------------|---|--|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| motionKernel | 3202 | 0062 | The axis Negative Overtravel (N-OT) limit has been exceeded. Motion is prevented in the negative direction. The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 3202 | 0100 | The inverse kinematics computation detected a world position that can not be reached. |
| motionKernel | 3202 | 0101 | The inverse kinematics computation detected that the elbow 'handedness' (orientation) does not match the configuration. The 'handedness' must be fixed by commanding the individual axes or manually moving the robot. |
| motionKernel | 3202 | 0102 | The robot XY position intruded into the configured dead zone area near the origin. |
| Mechatrolink | 3301 | 0009 | Some motor properties, such as encoder resolution, maximum speed, and maximum torque, could not be determined for the attached motor. The serial encoder may be malfunctioning, incorrectly programmed, or unplugged. |
| Mechatrolink | 3301 | 000B | Setting of Pn002, digits 3 and 4, disables torque limit and/or velocity limit in velocity and/or torque control modes. Set Pn002 = xx11 to initialize. Saving in the Hardware Configuration will automatically set Pn002. |
| Mechatrolink | 3301 | 000D | The servo network does not support this motion control mode. |
| | | | |
| Mechatrolink | 3301 | 0018 | The command position specified an instantaneous jump too large relative to the current position. Sigma-5 amplifiers give an A.94b warning and ignore subsequent position commands for any absolute position reference greater than 2,097,152 encoder pulses (2 revolutions of a 20-bit encoder). The controller watches for deviation between command position and actual motor position greater than 1,966,080 encoder pulses and issues an alarm. This is at 1.875 revolutions of a 20-bit motor little bit of margin. Sigma-II/III drives have a lower maximum following error limit of 1,048,576 encoder pulses. The position error limit on the Servopack (Pn520) should not be set greater than 1.875 rev = 1,966,080. |
| Mechatrolink | 3301 | 0019 | Setting of Pn002 digit 4 specifies torque feed-forward, but the SERVOPACK model does not support torque FF in position mode. |
| Mechatrolink | 3302 | 00E4 | The setting of the MECHATROLINK-II transmission cycle is out of the allowable range. |
| Mechatrolink | 3304 | 0000 | The base code for io alarms. The io's alarm value is bitwise OR'd in with this base value. |
| DPRAM | 3309 | 0009 | An error occurred sending command to a servo |
| DPRAM | 3309 | 000A | The drive has an alarm |
| DPRAM | 3309 | 000B | The data buffer for reading drive parameters via the messaging interface was too small |
| DPRAM | 3309 | 1000 | Error code prefix for data link errors |
| DPRAM | 3309 | 100F | Servo check sum error for data link |
| DPRAM | 3309 | 1010 | Invalid function code for data link |
| DPRAM | 3309 | 1040 | Option card computed an invalid check sum |
| DPRAM | 3309 | 1041 | Invalid data size from the option card |
| DPRAM | 3309 | 2000 | Error code prefix for message errors |
| DPRAM | 3309 | 2001 | Unsupported message function code |
| DPRAM | 3309 | 20A0 | Controller option card detected bad CRC |
| DPRAM | 3309 | 3000 | Error code prefix for data link errors |

| | Hex Code | | Description |
|--------------|----------------------|---|--|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| Mechatrolink | 3312 | 0000 | The base code for inverter alarms. The inverter's alarm value is bitwise OR'd in with this base value. |
| Mechatrolink | 3312 | 0001 | reserved |
| Mechatrolink | 3312 | 0002 | reserved |
| Mechatrolink | 3312 | 0003 | reserved |
| Mechatrolink | 3312 | 0004 | reserved |
| Mechatrolink | 3312 | 0005 | reserved |
| Mechatrolink | 3312 | 0006 | reserved |
| Mechatrolink | 3312 | 0007 | reserved |
| Mechatrolink | 3312 | 0008 | reserved |
| Mechatrolink | 3312 | 0009 | reserved |
| Mechatrolink | 3312 | 000A | reserved |
| Mechatrolink | 3312 | 000B | reserved |
| Mechatrolink | 3312 | 000C | reserved |
| Mechatrolink | 3312 | 000D | reserved |
| Mechatrolink | 3312 | 000E | reserved |
| Mechatrolink | 3312 | 000F | reserved |
| Mechatrolink | 3312 | 0010 | reserved |
| Mechatrolink | 3312 | 0011 | reserved |
| Mechatrolink | 3312 | 0012 | reserved |
| Mechatrolink | 3312 | 0013 | reserved |
| Mechatrolink | 3312 | 0014 | reserved |
| Mechatrolink | 3312 | 0015 | reserved |
| Mechatrolink | 3312 | 0016 | reserved |
| Mechatrolink | 3312 | 0018 | reserved |
| Mechatrolink | 3312 | 0019 | reserved |
| Mechatrolink | 3312 | 001A | reserved |
| Mechatrolink | 3312 | 001B | reserved |
| Mechatrolink | 3312 | 001C | reserved |
| Mechatrolink | 3312 | 001D | reserved |
| Mechatrolink | 3312 | 001E | reserved |
| Mechatrolink | 3312 | 001F | reserved |
| Mechatrolink | 3312 | 0020 | reserved |
| Mechatrolink | 3312 | 0021 | reserved |
| Mechatrolink | 3312 | 0025 | reserved |
| Mechatrolink | 3312 | 0026 | reserved |
| Mechatrolink | 3312 | 0027 | reserved |
| Mechatrolink | 3312 | 0028 | reserved |
| Mechatrolink | 3312 | 0029 | reserved |
| Mechatrolink | 3312 | 002A | reserved |
| Mechatrolink | 3312 | 002B | reserved |
| Mechatrolink | 3312 | 002C | reserved |
| Mechatrolink | 3312 | 002D | reserved |
| Mechatrolink | 3312 | 002E | reserved |
| Mechatrolink | 3312 | 002F | reserved |

| | Hex Code | | Description |
|--------------|----------------------|---|---|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| Mechatrolink | 3312 | 0031 | reserved |
| Mechatrolink | 3312 | 0083 | reserved |
| Mechatrolink | 3312 | 0084 | reserved |
| Mechatrolink | 3312 | 0085 | reserved |
| Mechatrolink | 3312 | 0086 | reserved |
| Mechatrolink | 3312 | 0087 | reserved |
| Mechatrolink | 3312 | 0088 | reserved |
| Mechatrolink | 3312 | 0089 | reserved |
| Mechatrolink | 3312 | 008A | reserved |
| Mechatrolink | 3312 | 008B | reserved |
| Mechatrolink | 3312 | 0091 | reserved |
| Mechatrolink | 3312 | 0092 | reserved |
| Mechatrolink | 3312 | 0093 | reserved |
| Mechatrolink | 3312 | 0094 | reserved |
| Mechatrolink | 3312 | 00E6 | reserved |
| Mechatrolink | 3312 | 00EC | Power reset required. |
| Mechatrolink | 3312 | 00ED | (Access not possible 10 consecutive times). Power reset required. |
| Mechatrolink | 3312 | 00EE | (1s elapsed). Power reset required. |
| app | 3401 | 0001 | The user script encountered an alarm, suspending its operation. |
| app | 3401 | 0002 | Script syntax errors are detected before the script is actually executed, during the pre-compile phase. The syntax must be corrected before the script can be run successfully. |
| app | 3401 | 0003 | Script runtime errors can be caused by a variety of incorrect script routines. The most common error is an attempt to use a 'nil' object where it should not be used. |
| app | 3401 | 0004 | The system could not find the file specified. |
| app | 3401 | 0011 | A data value argument provided to the API function was out of the expected range. |
| app | 3401 | 0012 | An argument provided to the API function was not the expected type. |
| app | 3401 | 0013 | An object argument provided to the API function was not the expected object type. |
| app | 3401 | 0014 | A scalar value was provided where a vector was expected, or a vector value was provided where a scalar was expected. |
| app | 3401 | 0015 | The script attempted to write to a read-only variable. |
| app | 3401 | 0016 | Use of that API function is not permitted with the current conditions and/or arguments. |
| app | 3401 | 0017 | The number of data values provided did not match the expected number of axes. |
| app | 3401 | 0018 | CamTable must have a header indicating the number of rows and columns and a feed forward velocity flag. Comma separated data values follows the header. The first (master) column must be either increasing or decreasing. |
| app | 3401 | 0019 | ContourTables must have a header indicating the number of rows and columns and a feed forward velocity flag. Comma separated data values follow the header. In ContourTables, the first (time) column must start at zero and be increasing. |

| | Hex Code | | Description |
|---------------|----------------------|---|--|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| app | 3401 | 001A | It is prohibited to start a torque (or velocity) move when any moves other than torque moves (or velocity moves) are currently in progress or queued. |
| app | 3401 | 00ED | 'LastMove' events should be detected when a move completes normally or is aborted. However, the controller detected a situation in which the move finished but the event did not occur. Please submit an SCR. |
| communication | 3403 | 0200 | Invalid EtherNet/IP I/O configuration. Common causes of invalid configuration include duplicate t2o/o2t assembly instances or invalid client connection parameters. |
| communication | 3403 | 0202 | EtherNet/IP remote server unreachable. There is no route to the EtherNet/IP server. Common causes include: invalid remote server address, invalid gateway, invalid subnet mask, or the Ethernet network is not correctly configured. |
| communication | 3403 | 0203 | EtherNet/IP remote server unreachable. There is no route to the EtherNet/IP server. Common causes include: invalid remote server address, invalid gateway, invalid subnet mask, or the Ethernet network is not correctly configured. |
| communication | 3403 | 0204 | EtherNet/IP network unreachable. Unable to reach the network for the EtherNet/IP server. Common causes include: invalid remote server address, invalid gateway, invalid subnet mask, or the Ethernet network is not correctly configured. |
| communication | 3403 | 0205 | EtherNet/IP connection refused. Remote server rejected connection attempt. The remote server may not be listening for connections or there may be a firewall preventing the connection. |
| communication | 3403 | 0206 | Too many EtherNet/IP connections. The Ethernet/IP client ran out of connection slot resources. Reduce the number of concurrent client connections. |
| communication | 3403 | 0302 | Error connecting to the Modbus TCP slave. Unable to connect to the Modbus TCP slave. Common causes include: invalid Modbus TCP slave address, invalid gateway, invalid subnet mask, or the Ethernet network is not correctly configured. |
| communication | 3403 | 0303 | Modbus TCP slave unreachable. There is no route to the Modbus TCP slave. Common causes include: invalid Modbus TCP slave address, invalid gateway, invalid subnet mask, or the Ethernet network is not correctly configured. |
| communication | 3403 | 0304 | Modbus TCP network unreachable. Unable to reach the network for the Modbus TCP slave. Common causes include: invalid Modbus TCP slave address, invalid gateway, invalid subnet mask, or the Ethernet network is not correctly configured. |
| communication | 3403 | 0305 | Modbus TCP slave connection refused. Modbus TCP slave rejected connection attempt. The Modbus TCP slave may not be listening for connections or there may be a firewall preventing the connection. |
| communication | 3403 | 0306 | |
| app | 3406 | 0001 | A web server login user was assigned to a group which did not exist. The system is unaffected, but that user will have limited (default) access. |
| app | 3406 | 0002 | The default login group for the web server was assigned to a group which did not exist. Access control has been disabled, because a minimal amount of access is required in order to log in. The configuration file should be fixed before continuing. |

| | Hex Code | | Description |
|-----|----------------------|---|---|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| app | 3406 | 0003 | The web server configuration specified access control should be enabled, but did not specify at least one path to control access to. Access control has been disabled. The configuration file should be fixed before continuing. |
| app | 3407 | 0002 | The base directory for configuration files was missing and has been created automatically. The system has booted in a minimal configuration mode, and most functionality is limited. Please upload a new complete configuration file set. |
| app | 3407 | 0003 | A required default configuration file was missing. A minimal configuration for the corresponding component has been loaded, and some functionality may be limited. |
| app | 3407 | 0004 | A required default configuration file was incorrectly formatted. A minimal configuration for the corresponding component has been loaded, and some functionality may be disabled. |
| app | 3407 | 0005 | A configuration file specified by the user configuration file set was incorrectly formatted. The corresponding default configuration file is being used instead. |
| app | 3407 | 0006 | The file describing which configuration set to use was corrupted. The default configuration set is being used. |
| app | 3407 | 0007 | An error occurred while writing a config file. The file system may be full or damaged. |
| app | 3407 | 0101 | The configured RAM disk on the controller was unable to be created. |
| app | 3407 | 0102 | Detected an unsupported option card inserted in the controller. |
| app | 3407 | 0104 | Data in the controller SRAM did not match the expected value. It should be treated as corrupted until it is re-initialized. |
| app | 3407 | 0106 | The SRAM battery backup power failed. SRAM data should be treated as corrupted until it is re-initialized. |
| app | 3407 | 0107 | The controller's time-of-day clock detected a voltage decrease in the backup battery. The current time and date is likely to be incorrect. This alarm can be cleared, but will recur when the controller is powered ON until the time and day is reset and the battery is replaced. |
| app | 3407 | 0204 | Unable to set configured network default gateway |
| app | 3409 | 0001 | The servo network axis node for the axis specified in the configuration file was not found. |
| app | 3409 | 0002 | Axis enable failed. This problem is usually a result of communication problems with the servo drive. It may occur after a drive was disconnected from the network. In this case, use Y_ResetMechatrolink to establish communication with the drives once again. |
| app | 3409 | 0003 | Axis group motion activation failed. Some axes in the group are currently under control of another group, or motion has been blocked by the user. |
| app | 3409 | 0004 | The motion segment could not be added to the motion queue because it is already queued. |
| app | 3409 | 0005 | Moves are prohibited when any of the group's axes are disabled, have an alarm, or are in violation of their soft limits. |
| app | 340A | 0001 | The source for the logical input was not found, the configured input will not be available. |
| app | 340A | 0002 | The source for the logical output was not found, the configured output will not be available. |
| app | 340A | 0003 | Two or more axis in the configuration file had the same axis ID. |

| | Hex Code | | Description |
|-----|----------------------|---|---|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| app | 340A | 0004 | The servo network axis node for the axis specified in the configuration file was not found. |
| app | 340A | 0005 | The axis group specified in the configuration file could not be created because either one or more of its axes are invalid or the group name is already being used. |
| app | 340A | 0006 | The type of AtTargetAgent specified in the configuration file is unknown. This is because AtTargetAgent could not be created. |
| app | 340A | 0007 | The number of constraints for axis group soft limit must be the same as the number of axes in the axis group. |
| app | 340A | 0008 | The axis group doesn't have the configured frame. |
| app | 340A | 000B | A continuous-wrap range for an axis causes its position to automatically wrap around between two user-specified numbers. Generally these numbers evaluate to full revolutions of the encoder but other ranges are permitted. However, all ranges specified in user units must map exactly to an integral number of encoder pulses. This alarm indicates that the mapping from user units to encoder ticks was inexact. Use more precise numbers to describe the range or choose a different range that evaluates to an integral number of encoder pulses. When this alarm occurs at startup or servo-net reset, it indicates that the axis has not been connected to an axis node and cannot be servoed on. Otherwise, this alarm indicates that the specified continuous-wrap range was not put into effect. |
| app | 340A | 000D | Two or more logical outputs specified in the I/O configuration file use the same physical bit. This can cause writes to not correctly generate value-change events on logical outputs for the shared bits. The configuration file should be fixed. |
| app | 340A | 000E | One or more of the data parameters in the axis configuration file were out-of-range or otherwise incorrectly specified for the axis. The axis was not created and is not available. |
| app | 340A | 0010 | After servo network reset, the Axis failed to reconnect to the servo network. The drive might have been removed from the network, the node ID of the drive might have changed or there might be a communication problem. |
| app | 340A | 0012 | After servo network reset, the network I/O failed to reconnect to the servo network. The network I/O module might have been removed from the network, the node ID of the network I/O module might have changed or there might be a network communication problem. |
| app | 340A | 0013 | After servo network reset, a new axis node was discovered. This axis node is not associated with any existing axes and will not be available. To make this node available, update the configuration and power cycle the controller. |
| app | 340A | 0014 | After servo network reset, a new I/O node was discovered. This I/O node is not associated with any existing I/O and will not be available. To make this node available, update the configuration and power cycle the controller. |
| app | 340A | 0017 | One or more of the axis data or configuration parameters were inconsistent or incompatible with the axis node specified. The axis was created but was not connected to the servo node. |
| app | 340A | 001B | Two or more LogicalInput have the same ID. The configuration file should be fixed. |

| | Hex Code | | Description |
|-----|----------------------|---|---|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| app | 340A | 001C | Two or more LogicalOutput have the same ID. The configuration file should be fixed. |
| app | 340A | 001D | Two or more AnalogInput have the same ID. The configuration file should be fixed. |
| app | 340A | 001E | Two or more AnalogOutput have the same ID. The configuration file should be fixed. |
| app | 340A | 001F | Analog I/O configuration is missing the 'hardwareConfig' element, and configuration could not be resolved by the physical hardware. The configuration file should be fixed by adding this element to the analog I/O element. |
| app | 340A | 0020 | One or more axes failed to respond to a servo-off command during a system I/O initiated abort. This is normally the result of communication problems with the drive, which also causes an automatic servo-off. |
| app | 340A | 0022 | Reset of a servo node failed. |
| app | 340A | 0023 | The axis position may not be valid because the persistent axis data was corrupted. SRAM should be reinitialized and the axis should be homed. |
| app | 340C | 0001 | Time limit exceeded. |
| app | 340C | 0002 | Distance limit exceeded. |
| app | 340C | 0003 | Torque limit exceeded. |
| app | 340C | 0100 | Modbus TCP I/O Driver Error on Server because of invalid address range |
| app | 340C | 0101 | MBTCP Client I/O driver, MBTCP Connection config is missing input member |
| app | 340C | 0102 | I/O memory area is not aligned to the correct byte to accommodate reading and writing. |
| app | 340C | 0103 | Watchdog Error |
| app | 340C | 0104 | Reserved |
| app | 340C | 0106 | Reserved |
| app | 340C | 0107 | Reserved |
| app | 340C | 0108 | Reserved |
| app | 340C | 0109 | Reserved |
| app | 340C | 010A | Not enough memory on PLC for POU during insertion. Project size must be reduced. |
| app | 340C | 010B | Internal PLC Error in memory management. This error can occur if an older project was loaded on the controller which was compiled to use less of the controllers total memory space. By using the "Resource" Dialog box, perform "Delete On target," for the bootproject, and then download the application code again. |
| app | 340C | 010C | Internal PLC Error: POU invalid |
| app | 340C | 010D | Internal PLC Error: Unknown POU type |
| app | 340C | 010E | Cannot insert a POU because there is no project. |
| app | 340C | 010F | Internal PLC Error: Cannot insert a POU because it does not belong to the project. |
| app | 340C | 0110 | Internal PLC Error: Cannot insert a POU. |
| app | 340C | 0111 | Internal PLC Error: Invalid POU type |
| app | 340C | 0112 | Internal PLC Error: Memory reorganization not possible; PLC stopped. |
| app | 340C | 0113 | Internal PLC Error: SPG defined more than once. |
| app | 340C | 0114 | Internal PLC Error: Memory error for initialized data of POU. |

| | Hex Code | | Description |
|-----|----------------------|---|--|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| app | 340C | 0115 | Internal PLC Error: Retain CRC failed. Possible reasons: (1) actual project does not have any retain data, (2) actual project is 'old style' without retain CRC (3) PLC isn't in STOP mode |
| app | 340C | 0116 | Internal PLC Error: FB defined more than once. |
| app | 340C | 0117 | Internal PLC Error: Not all POU sent. |
| app | 340C | 0118 | Internal PLC Error: No program memory defined. |
| app | 340C | 0119 | Internal PLC Error: Invalid FB number. |
| app | 340C | 011A | Internal PLC Error: Invalid PG number. |
| app | 340C | 011B | Internal PLC Error: Invalid SPG number. |
| app | 340C | 011C | POU uses more than 80 percent of POU memory. |
| app | 340C | 011D | Project uses more than 80 percent of program memory. |
| app | 340C | 011E | Internal PLC Error: Invalid function or function block. |
| app | 340C | 011F | Internal PLC Error: Invalid firmware function or function block. |
| app | 340C | 0120 | Internal PLC Error: Invalid program. |
| app | 340C | 0121 | Internal PLC Error: Invalid change of mode. |
| app | 340C | 0122 | Internal PLC Error: Unknown system mode! PLC stopped! |
| app | 340C | 0123 | Stack overflow. Increase stack size. |
| app | 340C | 0124 | System error in module. Check debugging output via controller's web interface. |
| app | 340C | 0125 | System error in module. Check debugging output via controller's web interface. |
| app | 340C | 0126 | Internal PLC Error: Error during indirect variable access. |
| app | 340C | 0127 | PLC CPU overload. |
| app | 340C | 0128 | Internal PLC Error: Breakpoint unexpected. |
| app | 340C | 0129 | Internal PLC Error: Error in data configuration. |
| app | 340C | 012A | Internal PLC Error: Error in retain data configuration. |
| app | 340C | 012B | Internal PLC Error: Floating point error. |
| app | 340C | 012C | Internal PLC Error: Fatal error. |
| app | 340C | 012D | Output string is too short. |
| app | 340C | 012E | Input string is too short. |
| app | 340C | 012F | Invalid input parameter 'p' or 'l' (position or length). |
| app | 340C | 0130 | String is identical to the output string. |
| app | 340C | 0131 | Invalid string comparison. |
| app | 340C | 0132 | Invalid data type for string conversion. |
| app | 340C | 0133 | Error in format string. |
| app | 340C | 0134 | Error during string conversion. |
| app | 340C | 0135 | Error in I/O configuration. |
| app | 340C | 0136 | Initializing I/O driver failed. |
| app | 340C | 0137 | Board not instantiated. |
| app | 340C | 0138 | Board number not allowed. |
| app | 340C | 0139 | Input Group doesn't fit. |
| app | 340C | 013A | Output Group doesn't fit. |
| app | 340C | 013B | Board not found. |
| app | 340C | 013C | Error reading inputs. |
| app | 340C | 013D | Error writing outputs. |
| app | 340C | 013E | Error creating I/O semaphore. |

| | Hex Code | | Description |
|-----|----------------------|---|---|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| app | 340C | 013F | Invalid memory size. |
| app | 340C | 0140 | Invalid I/O memory address. |
| app | 340C | 0141 | Internal PLC Error: PG defined more than once. |
| app | 340C | 0142 | POU exceeds 64K module size during insertion. POU size must be reduced. |
| app | 340C | 0143 | Internal PLC Error: Error in task configuration. |
| app | 340C | 0143 | Unknown I/O Driver. |
| app | 340C | 0200 | Ethernet/IP I/O driver not initialized: change configuration to include Ethernet/IP driver. |
| app | 340C | 0201 | Modbus/TCP I/O driver not initialized: change configuration to include Modbus/TCP driver. |
| app | 340C | 0201 | PLC Controller initialization failed. |
| app | 340C | 0202 | Modbus/TCP I/O driver ran out of resources. This can be caused by using too many poll blocks per server. |
| app | 340C | 0202 | PLC Domain initialization failed. |
| app | 340C | 0203 | PLC Communication server initialization failed. |
| app | 340C | 0204 | PLC initialization failed. |
| app | 340C | 0205 | PLC System Error. |
| app | 340C | 0206 | Unspecified PLC Error. Could be divide by zero in application code? |
| app | 340C | 1028 | The driver parameter specified in the axis configuration caused an exception |
| app | 340C | 1029 | The driver parameter did not match the axis configuration |
| app | 340C | 1030 | The configured axis count exceeded the allowable limit. |
| app | 340C | 1031 | The axis count exceeded the allowable limit due to an auto-detected axis. |
| app | 340C | 1033 | Using an incompatible version of the PLCopenPlus firmware function block library may result in controller instability. Consequently, the PLC application will not be allowed to run. Please change either the controller's firmware or the firmware function block library. |
| app | 340C | 1110 | All motion error codes are in the range from 0x1111 to 0x111f. |
| app | 340C | 1111 | The move could not be buffered because the motion queue for that axis is full. |
| app | 340C | 1112 | The move could not be started because motion is prohibited. |
| app | 340C | 1113 | The servo drive failed to enable or disable. |
| app | 340C | 1114 | Drive parameter read/write did not complete. |
| app | 340C | 1115 | Drive parameter read/write failed |
| app | 340C | 1116 | Torque move prohibited while non-torque moves queued or in progress. |
| app | 340C | 1117 | Y_CamOut called while not camming. |
| app | 340C | 1118 | The master slave relationship can not be modified because the master axis has not been set yet. |
| app | 340C | 1119 | Y_CamFileSelect can not open a second cam table while the first cam table is still being opened. |
| app | 340C | 111A | The function block can not command an external axis. |
| app | 340C | 111B | The homing sequence is already in progress. |
| app | 340C | 111C | MC_SetPosition can not be called while the axis is moving. |
| app | 340C | 111D | Motion aborted due to axis alarm. |
| app | 340C | 111E | MC_SetPosition can not set the position to be outside the configured wrap range (Machine Cycle). |

| | Hex Code | | Description |
|-----|----------------------|---|--|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| app | 340C | 111F | Can not transition to homing state; must be in StandStill state first. |
| app | 340C | 1120 | Clear alarms is already in progress. |
| app | 340C | 1121 | Axis reset is already in progress. |
| app | 340C | 1122 | Mechatrolink reset is already in progress. |
| app | 340C | 1123 | Y_CamStructSelect cannot transfer a second cam structure while the first cam structure is being transferred. |
| app | 340C | 1124 | Y_ReadCamTable cannot be read a second cam structure while the first cam structure is being read. |
| app | 340C | 1125 | Y_WriteCamTable cannot write a second cam structure while the first cam structure is being written. |
| app | 340C | 1126 | MC_SetPosition cannot be called while either the master or slave axis is camming. |
| app | 340C | 1127 | The function block can not be used with a virtual axis. |
| app | 340C | 1128 | The function block can not be used with an inverter axis. |
| app | 340C | 1129 | Y_VerifyParameters and Y_WriteParameters can not be called a second time while the first one is in progress. |
| app | 340C | 1210 | All error codes for structures are in the range from 0x1211 to 0x121f. |
| app | 340C | 1211 | Axis ID does not correspond to an axis. |
| app | 340C | 1212 | The master slave relationship is not defined. |
| app | 340C | 1213 | The input reference does not correspond to a real input |
| app | 340C | 1214 | The output reference does not correspond to a real output. |
| app | 340C | 1215 | The input/output number does not correspond to a real input or output bit. |
| app | 340C | 1216 | Trigger reference is not valid. |
| app | 340C | 1217 | The cam switch structure is not valid. |
| app | 340C | 1218 | The track structure is not valid. |
| app | 340C | 1219 | Table size results in misaligned data. |
| app | 340C | 121A | Buffer size results in misaligned data. |
| app | 340C | 121B | Table type is not supported. |
| app | 340C | 121C | Invalid start index. |
| app | 340C | 121D | Invalid end index. |
| app | 340C | 1220 | All error codes for invalid enumeration values are in the range from 0x1221 to 0x122f. |
| app | 340C | 1221 | 'BufferMode' does not correspond to a valid enumeration value. |
| app | 340C | 1222 | 'Direction' does not correspond to a valid enumeration value. |
| app | 340C | 1223 | 'StartMode' does not correspond to a valid enumeration value. |
| app | 340C | 1224 | 'ShiftMode' does not correspond to a valid enumeration value. |
| app | 340C | 1225 | 'OffsetMode' does not correspond to a valid enumeration value. |
| app | 340C | 1226 | 'Mode' does not correspond to a valid enumeration value. |
| app | 340C | 1227 | 'SynchMode' does not correspond to a valid enumeration value. |
| app | 340C | 1228 | 'Parameter' does not correspond to a valid enumeration value. |
| app | 340C | 1229 | 'AdjustMode' does not correspond to a valid enumeration value. |
| app | 340C | 122A | 'RampIn' does not correspond to a valid enumeration value. |
| app | 340C | 122B | 'ControlMode' does not correspond to a valid enumeration value. |
| app | 340C | 1230 | All error codes for range errors are from 0x1221 to 0x122f. |
| app | 340C | 1231 | Distance parameter is less than zero. |

| | Hex Code | | Description |
|-----|----------------------|---|---|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| app | 340C | 1232 | Velocity parameter is less than or equal to zero. |
| app | 340C | 1233 | Acceleration is less than or equal to zero. |
| app | 340C | 1234 | Deceleration is less than or equal to zero. |
| app | 340C | 1235 | Torque is less than or equal to zero. |
| app | 340C | 1236 | Time is less than or equal to zero |
| app | 340C | 1237 | Specified time was less than zero. |
| app | 340C | 1238 | Specified scale was less than or equal to zero. |
| app | 340C | 1239 | Velocity is negative. |
| app | 340C | 123A | Denominator is zero. |
| app | 340C | 123B | Jerk is less than or equal to zero. |
| app | 340C | 123C | TorqueRamp is less than or equal to zero. |
| app | 340C | 123D | Engage position is outside the table domain. |
| app | 340C | 123E | Negative engage width. |
| app | 340C | 123F | Disengage position is outside the table domain. |
| app | 340C | 1240 | Negative disengage width. |
| app | 340C | 1241 | StartPosition is outside of master's range. |
| app | 340C | 1242 | EndPosition is outside of master's range. |
| app | 340C | 1310 | All error codes for invalid input data range from 0x1211 to 0x121f. |
| app | 340C | 1311 | The specified Pn does not exist. |
| app | 340C | 1312 | The mask does not correspond to valid tracks. |
| app | 340C | 1313 | The profile must start with relative time equal to zero, and the time must be increasing. |
| app | 340C | 1314 | The specified cam file does not exist. |
| app | 340C | 1315 | Invalid header for the cam file. Cam tables must have a header indicating the number of rows, number of columns and a feed forward velocity flag |
| app | 340C | 1316 | The first (master) column must be either increasing or decreasing. |
| app | 340C | 1317 | Cam table reference does not refer to a valid cam table. |
| app | 340C | 1318 | The engage phase exceeded the time limit. Slave axis could not attain the target position and velocity within the user specified time limit. |
| app | 340C | 1319 | The engage phase exceeded the distance limit. Slave axis could not attain the target position and velocity within the user specified master distance. |
| app | 340C | 131A | Invalid width input. Width is an enumeration type with the following allowable values 'WIDTH_8'=0, 'WIDTH_16'=1, and 'WIDTH_32'=2. |
| app | 340C | 131B | The slave axis can not be the same as the master axis. |
| app | 340C | 131C | Default drive parameter info is not available for this parameter. |
| app | 340C | 131D | Invalid external axis. |
| app | 340C | 131E | Invalid virtual axis. |
| app | 340C | 131F | File extension is not recognized or missing. |
| app | 340C | 1320 | Could not find the axis parameter file. |
| app | 340C | 2110 | All log error codes are in the range from 0x2111 to 0x211f. |
| app | 340C | 2111 | Adding log items or setting up log is not possible because the data log is already set up. |
| app | 340C | 2112 | Starting or stopping logging is not possible because the data log is not set up. |
| app | 340C | 2113 | Invalid handle for user log item. |
| app | 340C | 2114 | Data log can not be created because too many data logs are in use. |

| | Hex Code | | Description |
|--------------|----------------------|---|---|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| app | 340C | 2115 | Invalid handle for data log. |
| app | 340C | 2116 | A user log item can only support eight inputs for each type. |
| app | 340C | 2117 | Saving the log failed. |
| app | 340C | 2300 | Invalid group handle |
| app | 340C | 2301 | An axis is already owned by another group |
| app | 340C | 2302 | Group activation is blocked |
| app | 340C | 2303 | Invalid coordinate system |
| app | 340C | 2304 | Move prohibited because group has an alarm |
| app | 340C | 2305 | Group activation prohibited, invalid axis/joint config |
| app | 340C | 2306 | Group activation prohibited, mismatched axis command position |
| app | 340C | 2307 | The group reports one or more of its axes has an error. |
| app | 340C | 2308 | Axis group reset is already in progress. |
| app | 340C | 2309 | Invalid circular path method |
| app | 340C | 230A | Invalid circular path direction |
| app | 340C | 230B | Invalid circle geometry |
| app | 340C | 230C | Grouped axis is disabled. |
| app | 340C | 230D | Invalid transition mode. |
| app | 340C | 230E | Invalid transition parameter. |
| app | 340C | 230F | Invalid transition geometry. The values for the acceleration, deceleration, and/or velocity of the transition yield an invalid geometry. Can't create the corner geometry to meet the specification. |
| app | 340C | B114 | Failed to send clear alarms command. |
| app | 340C | B115 | Failed to reset Mechatrolink. |
| app | 340C | B116 | Mechatrolink reset is prohibited while axes are moving. |
| app | 340C | B117 | Failed to initialize absolute encoder. |
| app | 340C | E110 | All error codes for ProConOS errors range from 0xE111 to 0xE11f. |
| app | 340C | E111 | Instance object is NULL. |
| app | 340C | E112 | The instance data is NULL. |
| app | 340C | E113 | The structure pointer check sum is invalid. |
| app | 340C | E114 | The structure size does not match. |
| app | 340C | EDED | This function block was implemented in a later firmware version. If you would like to use this function block, then the controller must be updated. |
| app | 340C | F110 | All error codes for kernel errors range from 0xF111 to 0xF11f. |
| app | 340C | F111 | An internal assertion in the motion kernel failed indicating the controller is not in a stable state. This error should be reported to Yaskawa Electric America. |
| user | 3501 | 0000 | A user script task posted an alarm directly. |
| motionKernel | 4202 | 0001 | The command position will soon reach the allowable range for the axis in the positive direction (positive overtravel). The axis may not be moved again until the alarm condition is cleared. After the alarm is cleared, it is permissible to execute a move which brings the axis back toward the allowed region, even though the axis is probably still outside the allowed region. Any move which pulls the axis further away from the allowed region will re-trigger the alarm. |

| | Hex Code | | Description |
|--------------|----------------------|---|---|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| motionKernel | 4202 | 0002 | The command position will soon reach the allowable range for the axis in the negative direction (negative overtravel). The axis may not be moved again until the alarm condition is cleared. After the alarm is cleared, it is permissible to execute a move which brings the axis back toward the allowed region, even though the axis is probably still outside the allowed region. Any move which pulls the axis further away from the allowed region will re-trigger the alarm. |
| motionKernel | 4202 | 0003 | The command speed will soon reach the allowable range for the axis in the positive direction (overspeed). The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 4202 | 0004 | The command speed will soon reach the allowable range for the axis in the negative direction (overspeed). The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 4202 | 0005 | The command acceleration will soon reach the allowable range for the axis in the positive direction. The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 4202 | 0006 | The command acceleration will soon reach the allowable range for the axis in the negative direction. The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 4202 | 0007 | The command torque will soon reach the allowable range for the axis in the positive direction (overtorque). The axis may not be moved again until the alarm condition is cleared. |
| | | | |
| Memory | | | |
| motionKernel | 4202 | 0008 | The command torque will soon reach the allowable range for the axis in the negative direction (overtorque). The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 4202 | 0011 | The command position will soon reach the allowable range for the axis in the positive direction (positive overtravel). The axis may not be moved again until the alarm condition is cleared. After the alarm is cleared, it is permissible to execute a move which brings the axis back toward the allowed region, even though the axis is probably still outside the allowed region. Any move which pulls the axis further away from the allowed region will re-trigger the alarm. |
| motionKernel | 4202 | 0012 | The command position will soon reach the allowable range for the axis in the negative direction (negative overtravel). The axis may not be moved again until the alarm condition is cleared. After the alarm is cleared, it is permissible to execute a move which brings the axis back toward the allowed region, even though the axis is probably still outside the allowed region. Any move which pulls the axis further away from the allowed region will re-trigger the alarm. |
| motionKernel | 4202 | 0013 | The command speed will soon reach the allowable range for the axis in the positive direction (overspeed). The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 4202 | 0014 | The command speed will soon reach the allowable range for the axis in the negative direction (overspeed). The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 4202 | 0015 | The command acceleration will soon reach the allowable range for the axis in the positive direction. The axis may not be moved again until the alarm condition is cleared. |

| | Hex Code | | Description |
|--------------|----------------------|---|---|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| motionKernel | 4202 | 0016 | The command acceleration will soon reach the allowable range for the axis in the negative direction. The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 4202 | 0017 | The command torque will soon reach the allowable range for the axis in the positive direction (over torque). The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 4202 | 0018 | The command torque will soon reach the allowable range for the axis in the negative direction (over torque). The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 4202 | 0021 | The command position will soon reach the allowable range for the axis in the positive direction (positive overtravel). The axis may not be moved again until the alarm condition is cleared. After the alarm is cleared, it is permissible to execute a move which brings the axis back toward the allowed region, even though the axis is probably still outside the allowed region. Any move which pulls the axis further away from the allowed region will re-trigger the alarm. |
| motionKernel | 4202 | 0022 | The command position will soon reach the allowable range for the axis in the negative direction (negative overtravel). The axis may not be moved again until the alarm condition is cleared. After the alarm is cleared, it is permissible to execute a move which brings the axis back toward the allowed region, even though the axis is probably still outside the allowed region. Any move which pulls the axis further away from the allowed region will re-trigger the alarm. |
| motionKernel | 4202 | 0023 | The command speed will soon reach the allowable range for the axis in the positive direction (over speed). The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 4202 | 0024 | The command speed will soon reach the allowable range for the axis in the negative direction (over speed). The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 4202 | 0025 | The command acceleration will soon reach the allowable range for the axis in the positive direction. The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 4202 | 0026 | The command acceleration will soon reach the allowable range for the axis in the negative direction. The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 4202 | 0027 | The command torque will soon reach the allowable range for the axis in the positive direction (over torque). The axis may not be moved again until the alarm condition is cleared. |
| motionKernel | 4202 | 0028 | The command torque will soon reach the allowable range for the axis in the negative direction (over torque). The axis may not be moved again until the alarm condition is cleared. |
| Mechatrolink | 4301 | 000A | The SERVOPACK model type was unable to be determined. This can indicate that some parameters may be incorrect. |
| Mechatrolink | 4301 | 000C | The controller was unable to send the drive command because servo network resources were allocated to motion. Brake on, brake off, absolute encoder initialization and alarm clear can only be sent when not moving. |
| Mechatrolink | 4301 | 001C | The Mechatrolink.xml file specified duplicate configuration structures for a node. The first match was used, subsequent matches were ignored. |

| | Hex Code | | Description |
|--------------|----------------------|---|---|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| Mechatrolink | 4301 | 001D | The Mechatrolink.xml file specified duplicate default configuration structures for a node type. The first default structure was used, subsequent structures were ignored. |
| Mechatrolink | 4301 | 001E | A node was detected on the Mechatrolink network, but it is not supported by the software. |
| Mechatrolink | 4301 | 001F | The Mechatrolink comm board inverter control reference/run control is not enabled. Change the settings in parameters b1-01 and b1-02 to '3' to select PCB reference/run source. |
| Mechatrolink | 4301 | 0020 | The drive returned an invalid watch dog code indicating a possible dropped communication packet. |
| Mechatrolink | 4302 | 0000 | The base code for Sigma-II drive warnings. The drive's warning value is bitwise OR'd in with this base value. |
| Mechatrolink | 4302 | 0091 | This warning occurs before the overload alarms (A.710 or A.720) occur. If the warning is ignored and operation continues, an overload alarm may occur. |
| Mechatrolink | 4302 | 0092 | This warning occurs before the regenerative overload alarm (A.32) occurs. If the warning is ignored and operation continues, a regenerative overload alarm may occur. |
| Mechatrolink | 4302 | 0093 | This warning occurs when the absolute encoder battery voltage is lowered. Continuing the operation in this status may cause an alarm. |
| Mechatrolink | 4302 | 0094 | A value outside the setting range was set using MECHATROLINK-II communications. |
| Mechatrolink | 4302 | 0095 | A command not supported in the product specifications was sent, OR the command reception conditions were not met. |
| Mechatrolink | 4302 | 0096 | A communications error occurred (once). |
| Mechatrolink | 4303 | 0000 | The base code for Sigma-III drive warnings. The drive's warning value is bitwise OR'd in with this base value. |
| Mechatrolink | 4303 | 0900 | Position error pulse exceeded the parameter settings (Pn520 x Pn51E/100). |
| Mechatrolink | 4303 | 0901 | When the servo turned ON, the position error pulses exceeded the parameter setting (Pn526 x Pn528/100). |
| Mechatrolink | 4303 | 0910 | This warning occurs before the overload alarms (A.710 or A.720) occur. If the warning is ignored and operation continues, an overload alarm may occur. |
| Mechatrolink | 4303 | 0911 | Abnormal vibration at the motor speed was detected. The detection level is the same as A.520. Set whether to output an alarm or warning by "Vibration Detection Switch" of Pn310. |
| Mechatrolink | 4303 | 0920 | This warning occurs before the regenerative overload alarm (A.320) occurs. If the warning is ignored and operation continues, a regenerative overload alarm may occur. |
| Mechatrolink | 4303 | 0930 | This warning occurs when the absolute encoder battery voltage is lowered. Continuing the operation in this status may cause an alarm. |
| Mechatrolink | 4303 | 0941 | The change of the parameters can be validated only after turning the power ON from OFF. |
| Mechatrolink | 4303 | 094A | Incorrect command parameter number was set. |
| Mechatrolink | 4303 | 094B | Command input data is out of range. |
| Mechatrolink | 4303 | 094C | Calculation error was detected. |
| Mechatrolink | 4303 | 094D | Data size does not match. |
| Mechatrolink | 4303 | 095A | Command was sent though command sending condition was not satisfied. |

| | Hex Code | | Description |
|--------------|-------------------|---|--|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| Mechatrolink | 4303 | 095B | Unsupported command was sent. |
| Mechatrolink | 4303 | 095C | Command condition is not satisfied for parameter settings. |
| Mechatrolink | 4303 | 095D | Command, especially latch command, interferes. |
| Mechatrolink | 4303 | 095E | Subcommand and main command interfere. |
| Mechatrolink | 4303 | 0960 | Communications error occurred during MECHATROLINK communications. |
| Mechatrolink | 4304 | 0000 | The base code for io warnings. The io's warning value is bitwise OR'd in with this base value. |
| DPRAM | 4309 | 1000 | Error code prefix for data link errors |
| DPRAM | 4309 | 1011 | Invalid register |
| DPRAM | 4309 | 1012 | Value exceeded data limit |
| DPRAM | 4309 | 1013 | Data math error |
| DPRAM | 4309 | 1014 | Register number and data size do not agree |
| DPRAM | 4309 | 1015 | Invalid data size |
| DPRAM | 4309 | 1030 | Servo and option card accessed data link channel at the same time |
| DPRAM | 4309 | 10FF | Unknown data link error |
| DPRAM | 4309 | 2000 | Error code prefix for message errors |
| DPRAM | 4309 | 2002 | Invalid register |
| DPRAM | 4309 | 2003 | Message size and data quantity do no match |
| DPRAM | 4309 | 2030 | Invalid register |
| DPRAM | 4309 | 2031 | Register access not allowed |
| DPRAM | 4309 | 2032 | Setting value is out of range |
| DPRAM | 4309 | 2033 | Messaging accessed only part of a register group or spanned register groups |
| DPRAM | 4309 | 2034 | Message command could not be processed because pre-conditions have not been met |
| DPRAM | 4309 | 2035 | Command processing is not possible due to conflict |
| DPRAM | 4309 | 20A1 | Controller option card received an empty message response |
| Mechatrolink | 4312 | 0000 | The base code for inverter warnings. The inverters warning value is bit-wise OR'd in with this base value. |
| Mechatrolink | 4312 | 0001 | Reserved |
| Mechatrolink | 4312 | 0002 | Reserved |
| Mechatrolink | 4312 | 0003 | Reserved |
| Mechatrolink | 4312 | 0004 | Reserved |
| Mechatrolink | 4312 | 0005 | Reserved |
| Mechatrolink | 4312 | 0006 | Reserved |
| Mechatrolink | 4312 | 0007 | Reserved |
| Mechatrolink | 4312 | 0008 | Reserved |
| Mechatrolink | 4312 | 0009 | Reserved |
| Mechatrolink | 4312 | 000A | Reserved |
| Mechatrolink | 4312 | 000B | Reserved |
| Mechatrolink | 4312 | 000C | Reserved |
| Mechatrolink | 4312 | 000D | Reserved |
| Mechatrolink | 4312 | 000E | Reserved |
| Mechatrolink | 4312 | 0010 | Reserved |
| Mechatrolink | 4312 | 0011 | Reserved |
| Mechatrolink | 4312 | 0012 | Reserved |

| | Hex Code | | Description |
|--------------|----------------------|---|---|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| Mechatrolink | 4312 | 0013 | Reserved |
| Mechatrolink | 4312 | 0014 | Reserved |
| Mechatrolink | 4312 | 0017 | Reserved |
| Mechatrolink | 4312 | 0018 | Reserved |
| Mechatrolink | 4312 | 001A | Reserved |
| Mechatrolink | 4312 | 001B | Reserved |
| Mechatrolink | 4312 | 001C | Reserved |
| Mechatrolink | 4312 | 001D | Reserved |
| Mechatrolink | 4312 | 001E | Reserved |
| Mechatrolink | 4312 | 001F | Reserved |
| Mechatrolink | 4312 | 0022 | Reserved |
| Mechatrolink | 4312 | 0023 | Reserved |
| Mechatrolink | 4312 | 0024 | Reserved |
| Mechatrolink | 4312 | 0025 | Reserved |
| Mechatrolink | 4312 | 0026 | Reserved |
| Mechatrolink | 4312 | 0094 | Reserved |
| Mechatrolink | 4312 | 0095 | Reserved |
| Mechatrolink | 4312 | 0096 | Reserved |
| Mechatrolink | 4312 | 00E5 | Reserved |
| app | 4401 | 0008 | Each call to groupAxes() must be matched by a corresponding call to ungroupAxes(). If a script exits without such a matching call (thus leaving an 'orphaned' group behind), this warning is issued. Clearing the warning also ungroups the orphaned group. |
| app | 4401 | 0009 | The debug stack trace was longer than expected. It may be clipped. |
| app | 4403 | 0001 | The event queue for the remote client was full, and an event was dropped. This is generally caused either by exceeding the network bandwidth or exceeding the general system processing power (starving the connection). When an event is dropped in this manner, the connection is terminated. |
| app | 4403 | 0005 | An RMI connection was attempted by an external client and rejected due to the concurrent connection limit. |
| app | 4407 | 0001 | The configuration file directory is read-only or resides on a read-only file system. Attempts to update the configuration or create directories will fail. |
| app | 4407 | 0002 | An attempt was made to write to a read-only configuration file. The write failed. |
| app | 4407 | 0105 | There was an indication that the SRAM battery backup power may have failed temporarily. SRAM data may have been compromised. |
| app | 4408 | 0001 | The alarm history was configured to use NVRAM storage, but either the available NVRAM was not sufficient to contain the configured buffer size, or the configured buffer size was not large enough to contain the configured number of records. The alarm history will contain fewer records than configured. |
| app | 4408 | 0002 | The alarm history was configured to use NVRAM storage and the data was found to be corrupted. The alarm history has been lost. NOTE: this alarm also occurs if the configured size of the alarm history has been changed. |

| | Hex Code | | Description |
|------------|----------------------|---|--|
| | ErrorClass (UINT) | AxisErrorID (UINT) GroupErrorID (UINT) | ErrorClass+AxisErrorID output from MC_ReadAxisError |
| | AlarmID (UDINT) | | AlarmID output from Y_ReadAlarm |
| app | 440A | 000C | The position and torque scales specified in the configuration file have different signs. As a result, a positive acceleration results in a negative torque, and position limits are opposite in sign as the torque limits. |
| app | 440A | 000F | The axis was temporarily disconnected from the servo network during reset. During this time, the feedback data is not valid and the axis cannot be moved. |
| app | 440A | 0011 | The network I/O was temporarily disconnected from the servo network during reset. During this time, any network I/O state change will be unobservable to the controller. |
| app | 440A | 0019 | The system was rebooted by the user. |
| app | 440A | 001A | The system failed to shut down gracefully during a reboot, although the reboot did occur. This does not necessarily indicate that the software is damaged. |
| app | 440B | 0001 | The controller is running out of memory. Memory should be freed as soon as possible. Try closing connections to the controller or stopping scripts. |
| app | 440B | 0003 | The largest free memory block is approaching the critical level. Memory should be freed as soon as possible. Try closing connections to the controller or stopping scripts. |
| Axes Group | 440C | 0103 | Unable to add AxesGroup to groupIODriver. Check the validity of the AXES_GROUP_REF.Handle. |
| app | 440C | 0105 | Reserved |
| app | 440C | 0207 | If the minor version on the controller is less than the one in the IDE, then some function blocks will not be supported. However, since the major version matches, those that are supported have identical interfaces. |
| app | 440C | 1032 | The configuration file version is not compatible with the firmware version. Please use the configuration tool to update the configuration files to match the firmware version. |
| app | 440C | 1034 | Some function blocks are not supported by the controller firmware. If these function blocks are used in the PLC application, then their ErrorID will always equal 60909. If these function blocks are needed, then please upgrade the controller's firmware. |
| app | 4501 | 0000 | A user script task posted a warning directly. |