

# Micro830, Micro850, and Micro870 Programmable Controllers

Catalog Numbers Bulletin 2080-LC30, 2080-LC50, and 2080-LC70



## Important User Information

Solid-state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication [SGI-1.1](#) available from your local Rockwell Automation sales office or online at <http://www.rockwellautomation.com/literature/>) describes some important differences between solid-state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid-state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.



**WARNING:** Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.



**ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence



**SHOCK HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.



**BURN HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.



**ARC FLASH HAZARD:** Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

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### IMPORTANT

Identifies information that is critical for successful application and understanding of the product.

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Allen-Bradley, CompactLogix, Connected Components Workbench, ControlLogix, Encompass, FactoryTalk, Kinetix, Micro800, Micro810, Micro820, Micro830, Micro850, Micro870, PanelView, PowerFlex, Rockwell Automation, Rockwell Software, RSLinx, RSLogix 500, and TechConnect are trademarks of Rockwell Automation, Inc.

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Read this preface to familiarize yourself with the rest of the manual. It provides information concerning:

- who should use this manual
- the purpose of this manual
- related documentation
- supporting information for Micro800® controllers

## Who Should Use this Manual

Use this manual if you are responsible for designing, installing, programming, or troubleshooting control systems that use Micro800 controllers.

You should have a basic understanding of electrical circuitry and familiarity with relay logic. If you do not, obtain the proper training before using this product.

## Purpose of this Manual

This manual is a reference guide for Micro800 controllers, plug-in modules and accessories. It describes the procedures you use to install, wire, and troubleshoot your controller. This manual:

- explains how to install and wire your controllers
- gives you an overview of the Micro800 controller system

Refer to the Online Help provided with Connected Components Workbench™ software for more information on programming your Micro800 controller.

## Conformal Coated Catalogs

Catalog numbers with the suffix 'K' are conformal coated and their specifications are the same as non-conformal coated catalogs.

## Additional Resources

These documents contain additional information concerning related Rockwell Automation products.

Resource	Description
Micro800 Expansion I/O Modules <a href="#">2080-UM003</a>	Information on features, configuration, wiring, installation, and specifications for the Micro800 expansion I/O modules and power supply.
Micro800 Plug-in Modules <a href="#">2080-UM004</a>	Information on features, configuration, installation, wiring, and specifications for the Micro800 plug-in modules.
Micro800 Programmable Controllers General Instructions <a href="#">2080-RM001</a>	Information on instruction sets for developing programs for use in Micro800 control systems.
Micro800 Programmable Controllers: Getting Started with Motion Control Using a Simulated Axis <a href="#">2080-QS001</a>	Provides quickstart instructions for implementing a motion control project in Connected Components Workbench software.
Micro800 Programmable Controllers: Getting Started with CIP Client Messaging <a href="#">2080-QS002</a>	Provides quickstart instructions for using CIP GENERIC and CIP Symbolic Messaging.

Resource	Description
Micro800 Programmable Controllers: Getting Started with PanelView Plus <a href="#">2080-QS003</a>	Provides quickstart instructions for using global variables for Micro800 controllers together with PanelView™ Plus HMI terminals.
Configuring Micro800 Controllers on FactoryTalk Gateway <a href="#">2080-QS005</a>	Provides quickstart instructions for configuring a Micro800 controller on FactoryTalk® Gateway.
Kinetix 3 Motion Control Indexing Application Connected Components Accel Toolkit <a href="#">CC-QS025</a>	Provides quickstart instructions for implementing a Kinetix® 3 drive indexing application using Connected Components Workbench software and a Micro800 controller.
Motion Control PTO Application Building Block <a href="#">CC-QS033</a>	Provides quickstart instructions for implementing PTO motion control of a Kinetix 3 drive using Connected Components Workbench software and a Micro800 controller.
Micro800 Programmable Controller External AC Power Supply Installation Instructions <a href="#">2080-IN001</a>	Information on mounting and wiring the optional external power supply.
Micro830 Programmable Controllers Installation Instructions <a href="#">2080-IN002</a>	Information on mounting and wiring the Micro830 10-point Controllers.
Micro830 Programmable Controllers Installation Instructions <a href="#">2080-IN003</a>	Information on mounting and wiring the Micro830 16-point Controllers.
Micro830 Programmable Controllers Installation Instructions <a href="#">2080-IN004</a>	Information on mounting and wiring the Micro830 24-point Controllers.
Micro830 Programmable Controllers Installation Instructions <a href="#">2080-IN005</a>	Information on mounting and wiring the Micro830 48-point Controllers.
Micro850 Programmable Controllers Installation Instructions <a href="#">2080-IN007</a>	Information on mounting and wiring the Micro850 24-point Controllers
Micro850 Programmable Controllers Installation Instructions <a href="#">2080-IN008</a>	Information on mounting and wiring the Micro850 48-point Controllers
Micro870 24-point Programmable Controllers Installation Instructions <a href="#">2080-IN012</a>	Information on mounting and wiring the Micro870 24-point Controllers
Micro800 16-point and 32-point 12/24V Sink/Source Input Modules Installation Instructions <a href="#">2085-IN001</a>	Information on mounting and wiring the expansion I/O modules (2085-IQ16, 2085-IQ32T)
Micro800 Bus Terminator Module Installation Instruction <a href="#">2085-IN002</a>	Information on mounting and wiring the expansion I/O bus terminator (2085-ECR)
Micro800 16-Point Sink and 16-Point Source 12/24V DC Output Modules Installation Instructions <a href="#">2085-IN003</a>	Information on mounting and wiring the expansion I/O modules (2085-OV16, 2085-OB16)
Micro800 8-Point and 16-Point AC/DC Relay Output Modules Installation Instructions <a href="#">2085-IN004</a>	Information on mounting and wiring the expansion I/O modules (2085-OW8, 2085-OW16)
Micro800 8-Point Input and 8-Point Output AC Modules Installation Instructions <a href="#">2085-IN005</a>	Information on mounting and wiring the expansion I/O modules (2085-IA8, 2085-IM8, 2085-OA8)
Micro800 4-channel and 8-channel Analog Voltage/current Input and Output Modules Installation Instructions <a href="#">2085-IN006</a>	Information on mounting and wiring the expansion I/O modules (2085-IF4, 2085-IF8, 2085-OF4)
Micro800 4-channel Thermocouple/RTD Input Module Installation Instructions <a href="#">2085-IN007</a>	Information on mounting and wiring the expansion I/O module (2085-IRT4)
Micro870 Programmable Controllers 24VDC Expansion Power Supply Installation Instructions <a href="#">2085-IN008</a>	Information on mounting and wiring the optional external power supply for expansion I/O modules.



Resource	Description
Micro800 RS232/485 Isolated Serial Port Plug-in Module Wiring Diagrams <a href="#">2080-WD002</a>	Information on mounting and wiring the Micro800 RS232/485 Isolated Serial Port Plug-in Module.
Micro800 Non-isolated Unipolar Analog Input Plug-in Module Wiring Diagrams <a href="#">2080-WD003</a>	Information on mounting and wiring the Micro800 Non-isolated Unipolar Analog Input Plug-in Module.
Micro800 Non-isolated Unipolar Analog Output Plug-in Module Wiring Diagrams <a href="#">2080-WD004</a>	Information on mounting and wiring the Micro800 Non-isolated Unipolar Analog Output Plug-in Module.
Micro800 Non-isolated RTD Plug-in Module Wiring Diagrams <a href="#">2080-WD005</a>	Information on mounting and wiring the Micro800 Non-isolated RTD Plug-in Module.
Micro800 Non-isolated Thermocouple Plug-in Module Wiring Diagrams <a href="#">2080-WD006</a>	Information on mounting and wiring the Micro800 Non-isolated Thermocouple Plug-in Module.
Micro800 Memory Backup and High Accuracy RTC Plug-In Module Wiring Diagrams <a href="#">2080-WD007</a>	Information on mounting and wiring the Micro800 Memory Backup and High Accuracy RTC Plug-In Module.
Micro800 6-Channel Trimpot Analog Input Plug-In Module Wiring Diagrams <a href="#">2080-WD008</a>	Information on mounting and wiring the Micro800 6-Channel Trimpot Analog Input Plug-In Module.
Micro800 Digital Relay Output Plug-in Module Wiring Diagrams <a href="#">2080-WD010</a>	Information on mounting and wiring the Micro800 Digital Relay Output Plug-in Module.
Micro800 Digital Input, Output, and Combination Plug-in Modules Wiring Diagrams <a href="#">2080-WD011</a>	Information on mounting and wiring the Micro800 Digital Input, Output, and Combination Plug-in Modules.
Micro800 High Speed Counter Plug-in Module <a href="#">2080-WD012</a>	Information on mounting and wiring the High Speed Counter Plug-in module.
Micro800 DeviceNet Plug-in Module <a href="#">2080-WD013</a>	Information on mounting and wiring the Micro800 DeviceNet® plug-in module.
Industrial Automation Wiring and Grounding Guidelines, publication <a href="#">1770-4.1</a>	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, <a href="https://www.rockwellautomation.com/global/certification/overview.page">https://www.rockwellautomation.com/global/certification/overview.page</a>	Provides declarations of conformity, certificates, and other certification details.
Application Considerations for Solid-State Controls <a href="#">SGI-1.1</a>	A description of important differences between solid-state programmable controller products and hard-wired electromechanical devices.
National Electrical Code - Published by the National Fire Protection Association of Boston, MA.	An article on wire sizes and types for grounding electrical equipment.
Allen-Bradley Industrial Automation Glossary <a href="#">AG-7.1</a>	A glossary of industrial automation terms and abbreviations.

You can view or download publications at <http://www.rockwellautomation.com/literature/>. To order paper copies of technical documentation, contact your local Rockwell Automation distributor or sales representative.

You can download the latest version of Connected Components Workbench software for your Micro800 controller at the URL below.  
<http://www.rockwellautomation.com/global/products-technologies/connected-components/>.

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## Hardware Overview



This chapter provides an overview of the Micro830®, Micro850®, and Micro870® controller hardware features. It has the following topics:

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Micro830 Controllers	2
Micro850 Controllers	4
Micro870 Controllers	6
Programming Cables	8
Embedded Serial Port Cables	8
Embedded Ethernet Support	8

## Hardware Features

Micro830, Micro850, and Micro870 controllers are economical brick style controllers with embedded inputs and outputs. Depending on the controller type, it can accommodate from two to five plug-in modules. The Micro850 and Micro870 controllers have expandable features and can additionally support up to eight expansion I/O modules.

**IMPORTANT** For information on supported plug-in modules and expansion I/O, see the following publications:

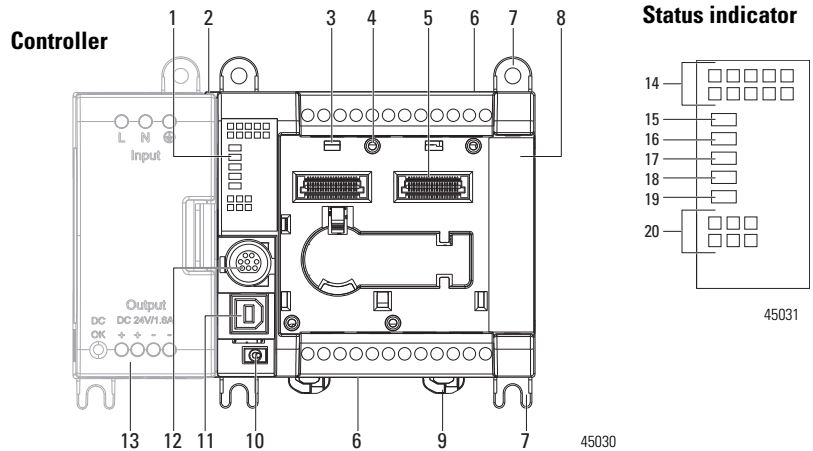
- Micro800™ Expansion I/O Modules User Manual, publication [2080-UM003](#)
- Micro800 Plug-in Modules User Manual, publication [2080-UM004](#)

The controllers also accommodate any class 2 rated 24V DC output power supply that meets minimum specifications such as the optional Micro800 power supply.

See [Troubleshooting on page 303](#) for descriptions of status indicator operation for troubleshooting purposes.

### Micro830 Controllers

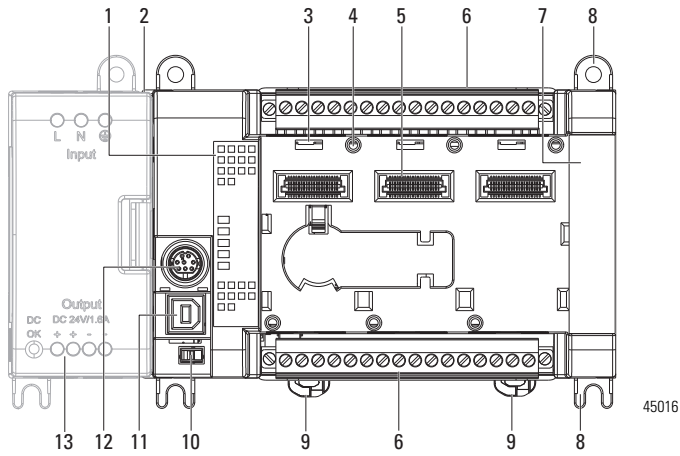
Micro830 10/16-point controllers and status indicators



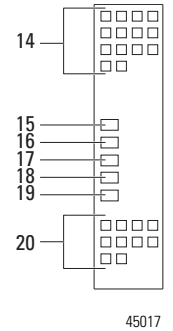


**Micro830 24-point controllers and status indicators**

**Controller**

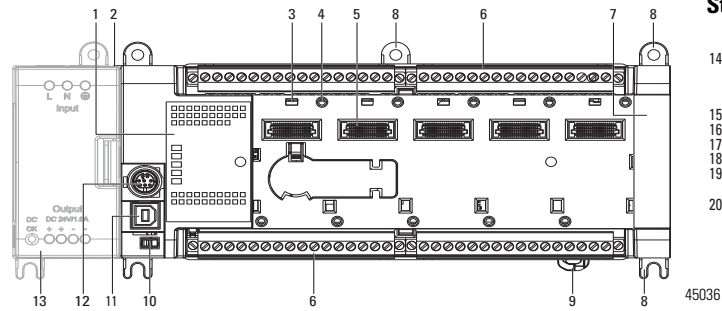


**Status indicator**

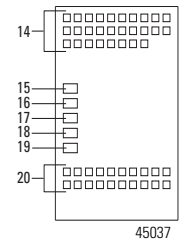


**Micro830 48-point controllers and status indicators**

**Controller**



**Status indicator**



**Controller Description**

	Description		Description
1	Status indicators	8	Mounting screw hole / mounting foot
2	Optional power supply slot	9	DIN rail mounting latch
3	Plug-in latch	10	Mode switch
4	Plug-in screw hole	11	Type B connector USB port
5	40 pin high speed plug-in connector	12	RS-232/RS-485 non-isolated combo serial port
6	Removable I/O terminal block	13	Optional AC power supply
7	Right-side cover		

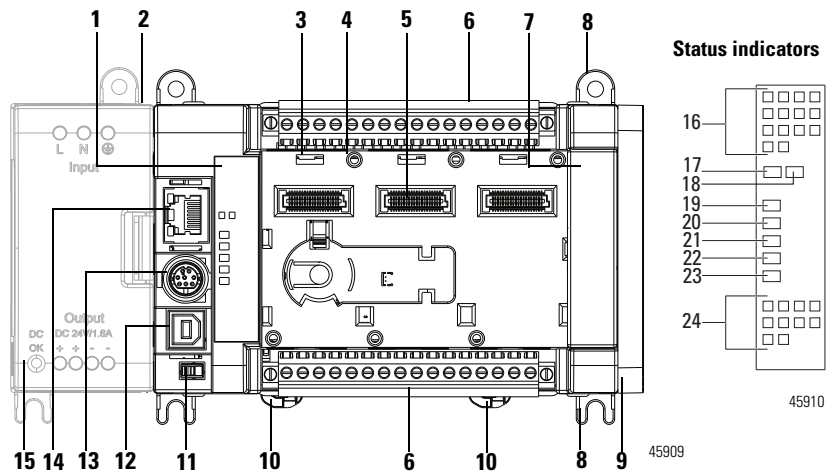
**Status Indicator Description<sup>(1)</sup>**

	Description		Description
14	Input status	18	Force status
15	Power status	19	Serial communications status
16	Run status	20	Output status
17	Fault status		

(1) For detailed description of the different status LED indicators, see [Troubleshooting on page 303](#).

## Micro850 Controllers

### Micro850 24-point controllers and status indicators



### Controller Description

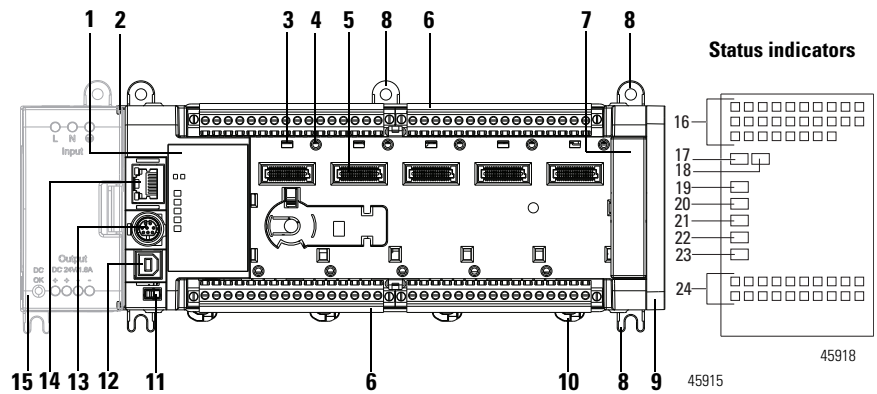
	Description		Description
1	Status indicators	9	Expansion I/O slot cover
2	Optional power supply slot	10	DIN rail mounting latch
3	Plug-in latch	11	Mode switch
4	Plug-in screw hole	12	Type B connector USB port
5	40 pin high speed plug-in connector	13	RS232/RS485 non-isolated combo serial port
6	Removable I/O terminal block	14	RJ-45 Ethernet connector (with embedded green and yellow LED indicators)
7	Right-side cover	15	Optional power supply
8	Mounting screw hole / mounting foot		

### Status Indicator Description<sup>(1)</sup>

	Description		Description
16	Input status	21	Fault status
17	Module Status	22	Force status
18	Network Status	23	Serial communications status
19	Power status	24	Output status
20	Run status		

(1) For detailed descriptions of the different status LED indicators, see [Troubleshooting on page 303](#).

**Micro850 48-point controllers and status indicators**



**Controller Description**

	Description		Description
1	Status indicators	9	Expansion I/O slot cover
2	Optional power supply slot	10	DIN rail mounting latch
3	Plug-in latch	11	Mode switch
4	Plug-in screw hole	12	Type B connector USB port
5	40-pin high speed plug-in connector	13	RS232/RS485 non-isolated combo serial port
6	Removable I/O terminal block	14	RJ-45 EtherNet/IP connector (with embedded yellow and green LED indicators)
7	Right-side cover	15	Optional AC power supply
8	Mounting screw hole / mounting foot		

**Status Indicator Description<sup>(1)</sup>**

	Description		Description
16	Input status	21	Fault status
17	Module status	22	Force status
18	Network status	23	Serial communications status
19	Power status	24	Output status
20	Run status		

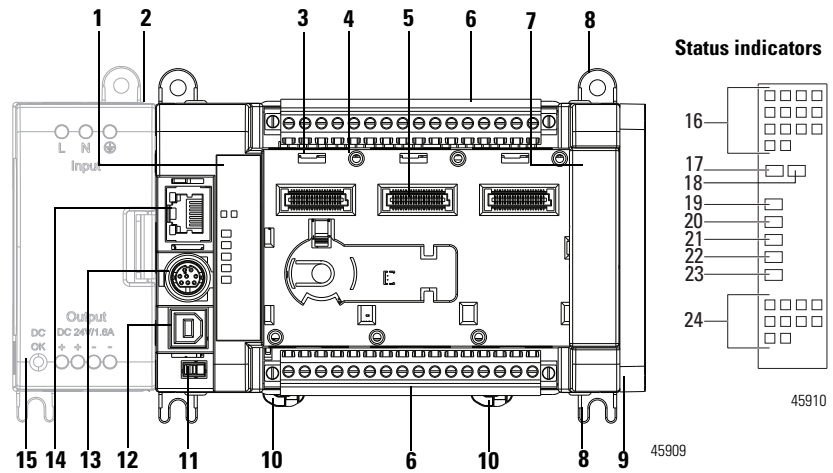
(1) For detailed descriptions of these LED status indicators, see [Troubleshooting on page 303](#).

**Note:** You can order the following replacement terminal blocks separately:

- 2080-RPL24RTB for 24-point base controllers
- 2080-RPL48RTB for 48-point base controllers

## Micro870 Controllers

### Micro870 24-point controllers and status indicators



### Controller Description

	Description		Description
1	Status indicators	9	Expansion I/O slot cover
2	Optional power supply slot	10	DIN rail mounting latch
3	Plug-in latch	11	Mode switch
4	Plug-in screw hole	12	Type B connector USB port
5	40 pin high speed plug-in connector	13	RS232/RS485 non-isolated combo serial port
6	Removable I/O terminal block	14	RJ-45 Ethernet connector (with embedded green and yellow LED indicators)
7	Right-side cover	15	Optional power supply
8	Mounting screw hole / mounting foot		

### Status Indicator Description<sup>(1)</sup>

	Description		Description
16	Input status	21	Fault status
17	Module Status	22	Force status
18	Network Status	23	Serial communications status
19	Power status	24	Output status
20	Run status		

(1) For detailed descriptions of the different status LED indicators, see [Troubleshooting on page 303](#).

**Note:** You can order replacement terminal blocks, catalog number 2080-RPL24RTB, separately.

**Micro830 Controllers – Number and Types of Inputs/Outputs**

Catalog Number	Inputs		Outputs			PTO Support	HSC Support
	110V AC	24V DC/V AC	Relay	24V Sink	24V Source		
2080-LC30-10QWB	–	6	4	–	–	–	2
2080-LC30-10QVB	–	6	–	4	–	1	2
2080-LC30-16AWB	10	–	6	–	–	–	–
2080-LC30-16QWB	–	10	6	–	–	–	2
2080-LC30-16QVB	–	10	–	6	–	1	2
2080-LC30-24QWB	–	14	10	–	–	–	4
2080-LC30-24QVB	–	14	–	10	–	2	4
2080-LC30-24QBB	–	14	–	–	10	2	4
2080-LC30-48AWB	28	–	20	–	–	–	–
2080-LC30-48QWB	–	28	20	–	–	–	6
2080-LC30-48QVB	–	28	–	20	–	3	6
2080-LC30-48QBB	–	28	–	–	20	3	6

**Micro850 Controllers – Number and Types of Inputs/Outputs**

Catalog Number	Inputs		Outputs			PTO Support	HSC Support
	120V AC	24V DC/V AC	Relay	24V Sink	24V Source		
2080-LC50-24AWB	14	–	10	–	–	–	–
2080-LC50-24QWB	–	14	10	–	–	–	4
2080-LC50-24QVB	–	14	–	10	–	2	4
2080-LC50-24QBB	–	14	–	–	10	2	4
2080-LC50-48AWB	28	–	20	–	–	–	–
2080-LC50-48QWB	–	28	20	–	–	–	6
2080-LC50-48QVB	–	28	–	20	–	3	6
2080-LC50-48QBB	–	28	–	–	20	3	6

**Micro870 Controllers – Number and Types of Inputs/Outputs**

Catalog Number	Inputs		Outputs			PTO Support	HSC Support
	120V AC	24V DC/V AC	Relay	24V Sink	24V Source		
2080-LC70-24AWB	14	–	10	–	–	–	–
2080-LC70-24QWB	–	14	10	–	–	–	4
2080-LC70-24QWBK	–	14	10	–	–	–	4
2080-LC70-24QBB	–	14	–	–	10	2	4
2080-LC70-24QBBK	–	14	–	–	10	2	4

## Programming Cables

Micro800 controllers have a USB interface, making standard USB cables usable as programming cables.

Use a standard USB A Male to B Male cable for programming the controller.



## Embedded Serial Port Cables

Embedded serial port cables for communication are listed here. All embedded serial port cables must be 3 meters in length, or shorter.

### Embedded Serial Port Cable Selection Chart

Connectors	Length	Cat. No.	Connectors	Length	Cat. No.
8-pin Mini DIN to 8-pin Mini DIN	0.5 m (1.5 ft)	1761-CBL-AM00 <sup>(1)</sup>	8-pin Mini DIN to 9-pin D Shell	0.5 m (1.5 ft)	1761-CBL-AP00 <sup>(1)</sup>
8-pin Mini DIN to 8-pin Mini DIN	2 m (6.5 ft)	1761-CBL-HM02 <sup>(1)</sup>	8-pin Mini DIN to 9-pin D Shell	2 m (6.5 ft)	1761-CBL-PM02 <sup>(1)</sup>
8-pin Mini DIN to 8-pin Mini DIN (with lock mechanism on both connectors)	2 m (6.5 ft)	1761-CBL-AH02	8-pin Mini DIN with lock mechanism to 9-pin D Shell	2 m (6.5 ft)	1761-CBL-PH02
—			8-pin Mini DIN to 6-pin RS-485 terminal block	30 cm (11.8in.)	1763-NC01 series A

(1) Series C or later for Class 1 Div 2 applications.

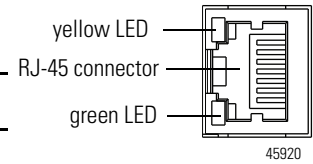
## Embedded Ethernet Support

For Micro850 and Micro870 controllers, a 10/100 Base-T Port (with embedded green and yellow LED indicators) is available for connection to an Ethernet network through any standard RJ-45 Ethernet cable. The LED indicators serve as indicators for transmit and receive status.



**RJ-45 Ethernet Port Pin Mapping**

Contact Number	Signal	Direction	Primary Function
1	TX+	OUT	Transmit data +
2	TX-	OUT	Transmit data -
3	RX+	IN	Differential Ethernet Receive Data +
4			Terminated
5			Terminated
6	RX-	IN	Differential Ethernet Receive Data -
7			Terminated
8			Terminated
Shield			Chassis Ground



The yellow status LED indicates Link (solid yellow) or No Link (off).

The green status LED indicates activity (blinking green) or no activity (off).

Micro850 and Micro870 controllers support Ethernet crossover cables (2711P-CBL-EX04).

*Ethernet Status Indication*

Micro850 and Micro870 controllers also support two LEDs for EtherNet/IP™ to indicate the following:

- Module status
- Network status

See [Troubleshooting on page 303](#) for descriptions of Module and Network status indicators.

**Notes:**

## About Your Controller

### Programming Software for Micro800 Controllers

Connected Components Workbench software is a set of collaborative tools supporting Micro800 controllers. It is based on Rockwell Automation and Microsoft Visual Studio technology and offers controller programming, device configuration and integration with HMI editor. Use this software to program your controllers, configure your devices and design your operator interface applications.

Connected Components Workbench software provides a choice of IEC 61131-3 programming languages (ladder diagram, function block diagram, structured text) with user defined function block support that optimizes machine control.

### Obtain Connected Components Workbench Software

A free download is available at:

<http://www.rockwellautomation.com/global/products-technologies/connected-components/>.

### Use Connected Components Workbench Software

To help you program your controller through the Connected Components Workbench software, you can refer to the Connected Components Workbench Online Help (it comes with the software).

### Controller Changes in Run Mode

Micro820\*/Micro830/Micro850/Micro870 controllers allow you to make certain changes while in run mode by using the following features:

- Run Mode Change (RMC)  
This feature allows logic modifications to a running project without going to remote program mode.  
For more information, see [Using Run Mode Change \(RMC\) on page 12](#).
- Run Mode Configuration Change (RMCC)|  
This feature allows changing the address configuration of the controller to be made within a program during run mode.  
For more information, see [Using Run Mode Configuration Change \(RMCC\) on page 17](#).

## Using Run Mode Change (RMC)

Run Mode Change (RMC) is a productivity enhancement feature introduced in Release 8 for Micro820/Micro830/Micro850 controllers. It saves the user time by allowing logic modifications to a running project without going to remote program mode and without disconnecting from the controller. It requires the Connected Components Workbench Developer Edition Release 8 software to use this feature.

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**IMPORTANT** Micro820/Micro830/Micro850 controller firmware revision 8.xxx or higher is also required to use Run Mode Change.

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RMC is useful when the user is developing a project by incrementally adding small changes to the logic and immediately wants to see the effects of the changes on the machine. With RMC, since the controller stays in remote run mode, the controller logic and machine actuators will not have to constantly reinitialize, which can occur if the controller is switched to remote program mode (for example, first scan bit is checked in program logic to clear outputs).

When user is editing, building, and downloading a project without using RMC, a full build of the entire controller project is performed and also a full download of the project is performed. During RMC an incremental build is performed and only incremental changes are downloaded to the controller.

---

**IMPORTANT** Do not disconnect from the controller after performing Run Mode Change, do a full build, and try to reconnect. Connected Components Workbench will treat the project in the controller as different from the project in Connected Components Workbench, and ask to either upload or download even though the logic is identical.

---

RMC is performed incrementally at the end of every program scan in order to prevent a large delay in the program scan. This adds up to an additional 12 ms to the scan time. For example, if the program scan is normally 10 ms, it may increase to 22 ms during RMC until the update is finished. Similarly user interrupts may be delayed.

### Example of the Benefits of Using RMC – 20% Reduction in Download Time

Number of Changes	Time to Perform Conventional Download (seconds)	Time to Test Logic and Accept Changes (seconds)
1	36	29
5	180	130
10	360	255

Memory size of project used for comparison:

Data = 14784 bytes; Program = 2352 bytes

Note: The duration starts when the RMC button is clicked while connected to the controller and ends when the accept is finished. For example:

1. When connected to the controller, click RMC
  2. Modify program
  3. Click Test Logic
  4. Click Accept to finish, or click Test Logic to make another change
-



**ATTENTION:** Use extreme caution when you use Run Mode Change. Mistakes can injure personnel and damage equipment. Before using Run Mode Change:

- assess how machinery will respond to the changes.
- notify all personnel about the changes.

A new global variable `__SYSVA_PROJ_INCOMPLETE` has been added to indicate when Run Mode Changes are being made. This can be used to notify personnel on the HMI that there are uncommitted changes in the controller.

#### Bit Definitions of Global Variable – `__SYSVA_PROJ_INCOMPLETE`

Bit	Definition
0	Set when the Run Mode Change process starts. Cleared once the Run Mode Change is written permanently to the controller (completion of Accept or Undo). This bit can be used to warn operators that a run mode change is in progress and that there are uncommitted changes in the controller.
1	Set if an error occurred while saving the changes to flash or an integrity check failed during Run Mode Change. Cleared on the next successful Run Mode change.

When you perform a Test Logic Change, the value of the variable is changed from zero to one. After you choose to accept or undo the changes, the value of the variable is reset to zero.

**IMPORTANT** When a Test Logic is performed, or undoing changes after the Test Logic is completed, any active communication instructions will be aborted while the changes are downloaded to the controller.

## Uncommitted Changes

Uncommitted changes are changes made in RMC that have not been accepted or undone after a Test Logic Change has been performed.

If the controller power loses power while there are uncommitted changes, you will not be able to re-enter RMC upon reconnection. You can choose to re-download the project to keep the changes, or upload if the uncommitted changes are not wanted.

If you choose to upload a project with uncommitted changes from the controller, you cannot enter RMC until you have done a full download.

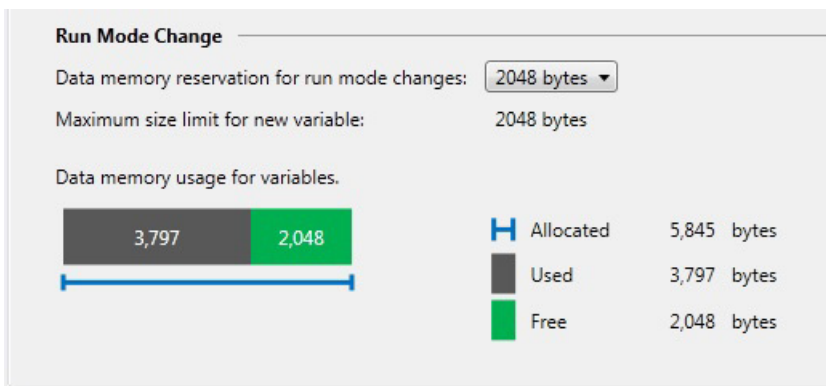
## RMC Memory

Run Mode Change (RMC) memory is used to store both the logic and user variable changes made during RMC. The default amount of memory allocated is 2KB and can be increased up to 8KB. However there is still a limit of 2KB for logic and user variables changes per Test Logic. To adjust the amount of RMC memory, the controller must be offline. After you have adjusted the amount, you must build the project and download it to the controller.

**IMPORTANT** In a Connected Components Workbench Release 8 project, the available user data space was reduced by 6 KB to support optimal project settings for the new RMC feature.

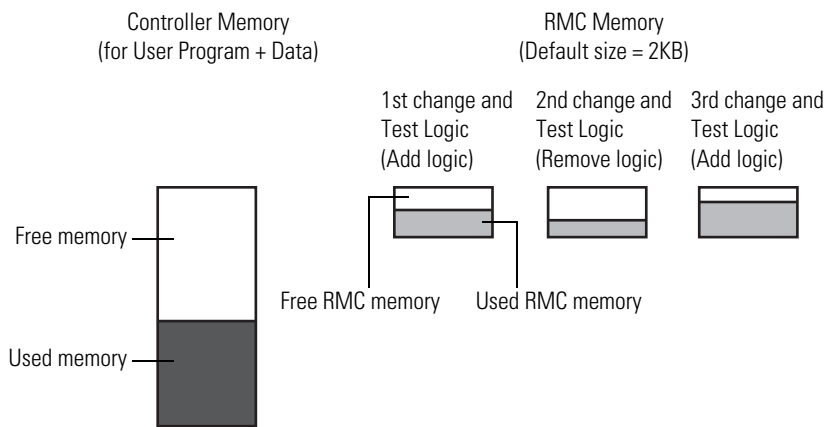
If you have a project that was developed before Release 8, you may need to reduce the default "Allocated" 8 KB Temporary Variables section from the Memory page in order to compile the project successfully.

### Controller Memory Diagnostics Page in Connected Components Workbench



During RMC an incremental build is performed and only incremental changes are downloaded to the controller until the RMC memory has been filled.

### RMC Memory Usage Example



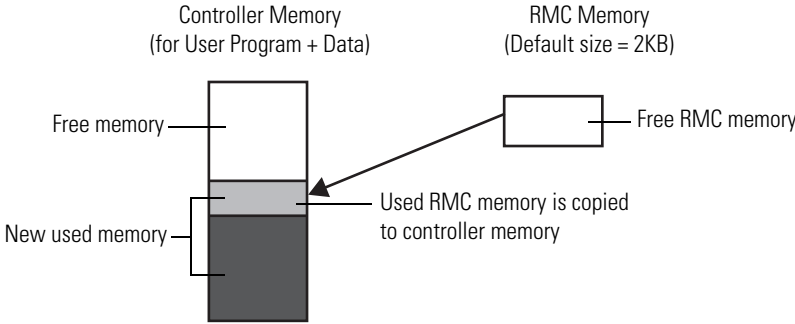


If not enough RMC memory is available to make more changes (for example, a “not enough memory” error message appears during RMC build or Test Logic), then a full download must be performed to transfer the incremental changes from the RMC memory to standard user program and data memory.

*Transferring Contents in RMC Memory to Controller Memory*

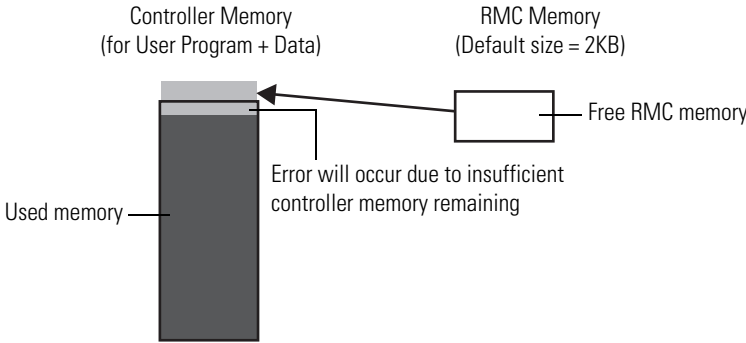
The changes that you have made during RMC are stored in RMC memory and will remain there until you perform a full build and download (while the controller is disconnected).

**RMC Memory Usage When Performing Full Build and Download Example**



However if the controller memory does not have enough space remaining to copy the contents of the RMC memory as shown below, the operation will fail and a “not enough memory” error message will appear. Do not use RMC if you are near the limits of your controller memory.

**Insufficient Controller Memory Example**



## Limitations of RMC

Take note of the following limitations when using the Run Mode Change (RMC) feature:

- Configuration changes cannot be made (for example, change filter times).
- Up to 2KB of logic (approximately 150 boolean instructions) and user variables and can be added for each Test Logic.
- Total memory allocated for RMC (cumulative of all Test Logic Changes) can be increased from 2KB to 8KB, but the 2KB limit for logic and user variables per Test Logic remains.
- Up to 20 POU (Program Organizational Units) can be added for each change (for example, if you currently have 5 POU, you can add 20 more for a total of 25 POU).
- If a User Defined Function Block is modified that changes the local variables, the local variables will be reinitialized or reset to zero and a warning message will be shown during the build. If you want to reapply the initial value, right-click on the UDFB and select Refactor -> Reset Initial Values of Instances.
- RMC is not possible after doing a Discover Project operation if a new module is detected because the configuration has changed.
- Exchange files cannot be imported when in RMC because it is considered a configuration change.
- Making changes to the display configuration (for example, hiding comments) are treated as logic changes and require you to build the project.
- Global variables cannot be deleted or modified in RMC, but can be added. To delete or modify a global variable, Connected Components Workbench must be disconnected from the controller.
- When using CIP™ messaging in RMC, setting the CIPTARGETCFG data type parameter ConnClose to TRUE has no effect. The Ethernet session does not close immediately upon successful messaging and you have to wait for the connection to timeout after 60 seconds. This applies to Release 9 or earlier projects. For Release 10 or later projects, the CIP connection timeout is configurable.



**WARNING:** If you delete the output rung when in Run Mode Change and accept the changes, the output on the controller will remain ON.

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See [Using Run Mode Change on page 279](#) for an example on how to use this feature.

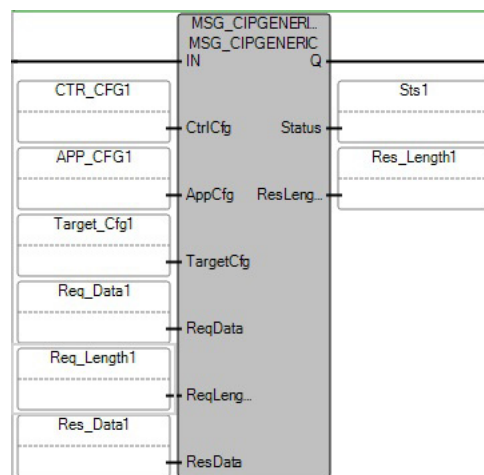
## Using Run Mode Configuration Change (RMCC)

Run Mode Configuration Change (RMCC) is a productivity enhancement feature introduced in Release 9 for Micro820/Micro830/Micro850 controllers. It allows users to reuse an identical program with multiple controllers simply by changing the address configuration of a controller within the program during run mode. Micro820/Micro830/Micro850 controller firmware revision 9.xxx or higher is required to use this feature.

RMCC can be used to change the address configuration of the controller during run mode when the communication protocol is set to Modbus RTU for serial ports or EtherNet/IP for the Ethernet port. RMCC uses a CIP Generic message which can only be sent from within a controller program and not from an external device to the controller.

**IMPORTANT** During RMCC the scan time may increase to close to 100 ms. Do not perform RMCC if the controller is performing time critical operations.

### CIP Generic Message Instruction for Run Mode Configuration Change



Run Mode Configuration Change (RMCC) can only be performed by the controller that is sending the message. To do that, you need to configure the CIP Generic message as a loop-back message by setting the path to “0,0”.

### Configure CIP Generic Message as a Loop-back Message

Name	Data Type	Dimension	String Size	Initial
Target_Cfg1	CIPTARGETCFG			...
Target_Cfg1.Path	STRING		80	'0,0'
Target_Cfg1.CipConnMode	USINT			0
Target_Cfg1.UcmmTimeout	UDINT			0
Target_Cfg1.ConnMsgTimeout	UDINT			0
Target_Cfg1.ConnClose	BOOL			

For Micro830/Micro850/Micro870 controllers, the address configuration change is permanent and will be retained when the controller is power cycled. From firmware revision 10 onwards, Micro820 controllers also retain the address configuration when the controller is power cycled.

## Using Modbus RTU Communication

To use RMCC with the Modbus RTU communication protocol, the serial port must be set to the Modbus slave role. A CIP Generic message is sent from within a program with the following parameters.

### CIP Generic Message Parameters for RMCC using Modbus RTU

Parameter	Value
Service	16
Class	70
Instance	2 – Embedded serial port 5, 6, 7, 8, or 9 – Plug-in modules
Attribute	100
ReqData	New node address, 1
ReqLen	2

### RMCC Modbus Example – Set the Parameters

Name	Data Type	Dimension	String Size	Initial Value	Access
APP_CFG1	CIPAPPCFG			...	Read
APP_CFG1.Service	USINT			16	Read
APP_CFG1.Class	UINT			70	Read
APP_CFG1.Instance	UDINT			2	Read
APP_CFG1.Attribute	UINT			100	Read
APP_CFG1.MemberCnt	USINT				Read
APP_CFG1.MemberId	CIPMEMBERID			...	Read

### RMCC Modbus Example – Set the New Node Address

Name	Data Type	Dimension	String Size	Initial Value	Access
Req_Data1	USINT	[1..70]		...	Read
Req_Data1[1]	USINT			3	Read
Req_Data1[2]	USINT			1	Read

The first byte indicates the new node address for the controller. For this example, the new node address is “3”. The second byte must always be “1”, this indicates that the Modbus role is configured as Slave.

### RMCC Modbus Example – Set the Message Length

Name	Data Type	Dimension	String Size	Initial Value	Access
Req_Length1	UINT			2	Read
Res_Length1	UINT				Read

When the new node address is configured and applied, the port is not restarted.

**IMPORTANT** You must ensure that the new node address being configured is unique as it will not be checked against existing node addresses of other devices.

You can verify that the node address has changed after performing RMCC by looking at the Communication Diagnostics tab for the controller.

### RMCC Modbus Example – Verify Address Change

The screenshot shows the 'Micro850 - Communication Diagnostics' window. The 'Communication' dropdown is set to 'Serial Port', and the 'Channel' dropdown is set to 'Slot 1 | 2080-SERIALISOL at port 5'. The 'Drivers' section shows 'Modbus RTU'. A 'Reset Counters' button is visible. Below this, the 'Link Counters' section displays the following data:

Link Counters			
Characters Received:	3,088	Characters Sent:	2,464
Frame Received:	386	Frames Sent:	352
Good Transactions:	352	Broadcasts:	0
Good Exceptions:	0	Mismatch Errors:	0
Bad CRC:	0	No Response:	0
		Other Errors:	0

Below the link counters, the 'Common Settings' section shows 'Unit Address: 3'.

## Using EtherNet/IP Communication

To use RMCC with the EtherNet/IP communication protocol, the controller must be configured to use a static IP address. If the controller is configured to use BOOTP or DHCP, the change will be rejected. A CIP Generic message is sent from within a program with the following parameters.

Use RMCC when configuring the controller during commissioning. Immediately after changing the IP address, the cycle time may increase up to 100 ms for one program scan.

### CIP Generic Message Parameters for RMCC using EtherNet/IP

Parameter	Value
Service	16
Class	245
Instance	1

### CIP Generic Message Parameters for RMCC using EtherNet/IP

Parameter	Value
Attribute	5
ReqData	IP address, Subnet mask, Gateway address
ReqLen	22 bytes

### RMCC EtherNet/IP Example – Set the Parameters

Name	Data Type	Dimension	String Size	Initial Value	Attrib
APP_CFG1	CIPAPPCFG				
APP_CFG1.Service	USINT			16	Read/Wr
APP_CFG1.Class	UINT			245	Read/Wr
APP_CFG1.Instance	UDINT			1	Read/Wr
APP_CFG1.Attribute	UINT			5	Read/Wr
APP_CFG1.MemberCnt	USINT				Read/Wr
APP_CFG1.MemberId	CIPMEMBERID				Read/Wr

### RMCC EtherNet/IP Example – Set the New IP Address

Name	Data Type	Dimension	String Size	Initial Value
Req_Data1	USINT	[1..70]		...
Req_Data1[1]	USINT			10
Req_Data1[2]	USINT			1
Req_Data1[3]	USINT			168
Req_Data1[4]	USINT			192
Req_Data1[5]	USINT			0
Req_Data1[6]	USINT			255
Req_Data1[7]	USINT			255
Req_Data1[8]	USINT			255
Req_Data1[9]	USINT			1
Req_Data1[10]	USINT			1
Req_Data1[11]	USINT			168
Req_Data1[12]	USINT			192
Req_Data1[13]	USINT			0
Req_Data1[14]	USINT			0
Req_Data1[15]	USINT			0
Req_Data1[16]	USINT			0
Req_Data1[17]	USINT			0
Req_Data1[18]	USINT			0
Req_Data1[19]	USINT			0
Req_Data1[20]	USINT			0
Req_Data1[21]	USINT			0

For this example, the new IP Address is set to the following:

- IP address = 192.168.1.10
- Subnet mask = 255.255.255.0
- Gateway address = 192.168.1.1

### RMCC EtherNet/IP Example – Set the Message Length

Name	Data Type	Dimension	String Size	Initial Value
Req_Length1	UINT			22
Res_Length1	UINT			

After the new IP address is configured and applied, the controller will disconnect from Connected Components Workbench if communication is through Ethernet.

---

**IMPORTANT** Micro830 controllers do not support Run Mode Configuration Change using EtherNet/IP.

---

**IMPORTANT** You should not perform IP address changes continuously. Allow an interval of at least six seconds before performing the next IP address change in order for duplicate address detection to work properly.

---

You can verify that the IP address has changed after performing RMCC by looking at the Ethernet settings for the controller.

### RMCC EtherNet/IP Example – Verify Address Change

The screenshot shows the 'Controller - Ethernet' configuration window. It features a 'Diagnose' button at the top left. Below it, there are two main sections: 'Internet Protocol (IP) Settings' and 'Port Settings'. In the IP settings, 'Configure IP address and settings' is selected with a radio button. The IP Address is set to 192.168.1.10, Subnet Mask to 255.255.255.0, and Gateway Address to 192.168.1.1. A checkbox for 'Detect duplicate IP address' is checked. In the Port Settings section, 'Port State' is set to 'Enabled' and 'Auto-Negotiate Speed and Duplex Mode' is checked.

## Agency Certifications

- UL Listed Industrial Control Equipment, certified for US and Canada. UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada.
- CE marked for all applicable directives
- RCM marked for all applicable acts
- KC - Korean Registration of Broadcasting and Communications Equipment, compliant with: Article 58-2 of Radio Waves Act, Clause 3.

## Compliance to European Union Directives

This product has the CE mark and is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.



## EMC Directive

This product is tested to meet Council Directive 2014/30/EU Electromagnetic Compatibility (EMC) Directive and the following standards, in whole or in part, documented in a technical construction file:

- EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)
- EN 61131-2; Programmable Controllers (Clause 11)
- EN 61000-6-4  
EMC - Part 6-4: Generic Standards - Emission Standard for Industrial Environments
- EN 61000-6-2  
EMC - Part 6-2: Generic Standards - Immunity for Industrial Environments

This product is intended for use in an industrial environment.

## Low Voltage Directive

This product is tested to meet Council Directive 2014/35/EU Low Voltage Directive, by applying the safety requirements of EN 61131-2 Programmable Controllers, Part 2 - Equipment Requirements and Tests.

For specific information required by EN 61131-2, see the appropriate sections in this publication, as well as the following Allen-Bradley publications:

- *Industrial Automation Wiring and Grounding Guidelines for Noise Immunity*, publication [1770-4.1](#).
- *Guidelines for Handling Lithium Batteries*, publication AG-5.4
- *Automation Systems Catalog*, publication B115

## Installation Considerations

Most applications require installation in an industrial enclosure (Pollution Degree 2<sup>(1)</sup>) to reduce the effects of electrical interference (Over Voltage Category II<sup>(2)</sup>) and environmental exposure.

Locate your controller as far as possible from power lines, load lines, and other sources of electrical noise such as hard-contact switches, relays, and AC motor drives. For more information on proper grounding guidelines, see the *Industrial Automation Wiring and Grounding Guidelines* publication [1770-4.1](#).

(1) Pollution Degree 2 is an environment where normally only non-conductive pollution occurs except that occasionally temporary conductivity caused by condensation shall be expected.

(2) Overvoltage Category II is the load level section of the electrical distribution system. At this level, transient voltages are controlled and do not exceed the impulse voltage capability of the products insulation.





**WARNING:** When used in a Class I, Division 2, hazardous location, this equipment must be mounted in a suitable enclosure with proper wiring method that complies with the governing electrical codes.

**WARNING:** If you connect or disconnect the serial cable with power applied to this module or the serial device on the other end of the cable, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

**WARNING:** The local programming terminal port is intended for temporary use only and must not be connected or disconnected unless the area is assured to be nonhazardous.

**WARNING:** The USB port is intended for temporary local programming purposes only and not intended for permanent connection. If you connect or disconnect the USB cable with power applied to this module or any device on the USB network, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding. The USB port is a nonincendive field wiring connection for Class I, Division 2 Groups A, B, C and D.

**WARNING:** Exposure to some chemicals may degrade the sealing properties of materials used in the Relays. It is recommended that the User periodically inspect these devices for any degradation of properties and replace the module if degradation is found.

**WARNING:** If you insert or remove the plug-in module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

**WARNING:** When you connect or disconnect the Removable Terminal Block (RTB) with field side power applied, an electrical arc can occur. This could cause an explosion in hazardous location installations.

**WARNING:** Be sure that power is removed or the area is nonhazardous before proceeding.

---



**ATTENTION:** To comply with the CE Low Voltage Directive (LVD), this equipment must be powered from a source compliant with the following: Safety Extra Low Voltage (SELV) or Protected Extra Low Voltage (PELV).

**ATTENTION:** To comply with UL restrictions, this equipment must be powered from a Class 2 source.

**ATTENTION:** Be careful when stripping wires. Wire fragments that fall into the controller could cause damage. Once wiring is complete, make sure the controller is free of all metal fragments.

**ATTENTION:** Do not remove the protective debris strips until after the controller and all other equipment in the panel near the module are mounted and wired. Remove strips before operating the controller. Failure to remove strips before operating can cause overheating.

**ATTENTION:** Electrostatic discharge can damage semiconductor devices inside the module. Do not touch the connector pins or other sensitive areas.

**ATTENTION:** The USB and serial cables are not to exceed 3.0 m (9.84 ft).

**ATTENTION:** Do not wire more than 2 conductors on any single terminal.

**ATTENTION:** Do not remove the Removable Terminal Block (RTB) until power is removed.

---

## Environment and Enclosure

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**ATTENTION:** This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC 60664-1), at altitudes up to 2000 m (6562 ft) without derating. This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR 11. Without appropriate precautions, there may be difficulties with electromagnetic compatibility in residential and other environments due to conducted and radiated disturbances.

This equipment is supplied as open-type equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The enclosure must have suitable flame-retardant properties to prevent or minimize the spread of flame, complying with a flame spread rating of 5VA or be approved for the application if nonmetallic. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

In addition to this publication, see:

- Industrial Automation Wiring and Grounding Guidelines, Rockwell Automation publication [1770-4.1](#), for more installation requirements.
- NEMA Standard 250 and IEC 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosure.

---

## Preventing Electrostatic Discharge

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**ATTENTION:** This equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- Touch a grounded object to discharge potential static.
  - Wear an approved grounding wriststrap.
  - Do not touch connectors or pins on component boards.
  - Do not touch circuit components inside the equipment.
  - Use a static-safe workstation, if available.
  - Store the equipment in appropriate static-safe packaging when not in use.
-

## Safety Considerations

Safety considerations are an important element of proper system installation. Actively thinking about the safety of yourself and others, as well as the condition of your equipment, is of primary importance. We recommend reviewing the following safety considerations.

### North American Hazardous Location Approval

The following information applies when operating this equipment in hazardous locations:	Informations sur l'utilisation de cet équipement en environnements dangereux:
<p>Products marked "CL I, DIV 2, GP A, B, C, D" are suitable for use in Class I Division 2 Groups A, B, C, D, Hazardous Locations and nonhazardous locations only. Each product is supplied with markings on the rating nameplate indicating the hazardous location temperature code. When combining products within a system, the most adverse temperature code (lowest "T" number) may be used to help determine the overall temperature code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation.</p>	<p>Les produits marqués "CL I, DIV 2, GP A, B, C, D" ne conviennent qu'à une utilisation en environnements de Classe I Division 2 Groupes A, B, C, D dangereux et non dangereux. Chaque produit est livré avec des marquages sur sa plaque d'identification qui indiquent le code de température pour les environnements dangereux. Lorsque plusieurs produits sont combinés dans un système, le code de température le plus défavorable (code de température le plus faible) peut être utilisé pour déterminer le code de température global du système. Les combinaisons d'équipements dans le système sont sujettes à inspection par les autorités locales qualifiées au moment de l'installation.</p>
<div style="display: flex; align-items: center;">  <div> <p><b>EXPLOSION HAZARD</b></p> <ul style="list-style-type: none"> <li>Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.</li> <li>Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.</li> <li>Substitution of any component may impair suitability for Class I, Division 2.</li> <li>If this product contains batteries, they must only be changed in an area known to be nonhazardous.</li> </ul> </div> </div>	<div style="display: flex; align-items: center;">  <div> <p><b>RISQUE D'EXPLOSION</b></p> <ul style="list-style-type: none"> <li>Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement.</li> <li>Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs externes reliés à cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens fournis avec ce produit.</li> <li>La substitution de tout composant peut rendre cet équipement inadapté à une utilisation en environnement de Classe I, Division 2.</li> <li>S'assurer que l'environnement est classé non dangereux avant de changer les piles.</li> </ul> </div> </div>

### Disconnecting Main Power



**WARNING:** Explosion Hazard

Do not replace components, connect equipment, or disconnect equipment unless power has been switched off.

The main power disconnect switch should be located where operators and maintenance personnel have quick and easy access to it. In addition to disconnecting electrical power, all other sources of power (pneumatic and hydraulic) should be de-energized before working on a machine or process controlled by a controller.

## Safety Circuits



**WARNING:** Explosion Hazard  
Do not connect or disconnect connectors while circuit is live.

---

Circuits installed on the machine for safety reasons, like overtravel limit switches, stop push buttons, and interlocks, should always be hard-wired directly to the master control relay. These devices must be wired in series so that when any one device opens, the master control relay is de-energized, thereby removing power to the machine. Never alter these circuits to defeat their function. Serious injury or machine damage could result.

## Power Distribution

There are some points about power distribution that you should know:

- The master control relay must be able to inhibit all machine motion by removing power to the machine I/O devices when the relay is de-energized. It is recommended that the controller remain powered even when the master control relay is de-energized.
- If you are using a DC power supply, interrupt the load side rather than the AC line power. This avoids the additional delay of power supply turn-off. The DC power supply should be powered directly from the fused secondary of the transformer. Power to the DC input and output circuits should be connected through a set of master control relay contacts.

## Periodic Tests of Master Control Relay Circuit

Any part can fail, including the switches in a master control relay circuit. The failure of one of these switches would most likely cause an open circuit, which would be a safe power-off failure. However, if one of these switches shorts out, it no longer provides any safety protection. These switches should be tested periodically to assure they will stop machine motion when needed.

## Power Considerations

The following explains power considerations for the micro controllers.

### Isolation Transformers

You may want to use an isolation transformer in the AC line to the controller. This type of transformer provides isolation from your power distribution system to reduce the electrical noise that enters the controller and is often used as a step-down transformer to reduce line voltage. Any transformer used with the controller must have a sufficient power rating for its load. The power rating is expressed in volt-amperes (VA).

### Power Supply Inrush

During power-up, the Micro800 power supply allows a brief inrush current to charge internal capacitors. Many power lines and control transformers can supply inrush current for a brief time. If the power source cannot supply this inrush current, the source voltage may sag momentarily.

The only effect of limited inrush current and voltage sag on the Micro800 is that the power supply capacitors charge more slowly. However, the effect of a voltage sag on other equipment should be considered. For example, a deep voltage sag may reset a computer connected to the same power source. The following considerations determine whether the power source must be required to supply high inrush current:

- The power-up sequence of devices in a system.
- The amount of the power source voltage sag if the inrush current cannot be supplied.
- The effect of voltage sag on other equipment in the system.

If the entire system is powered-up at the same time, a brief sag in the power source voltage typically will not affect any equipment.

### Loss of Power Source

The optional Micro800 AC power supply is designed to withstand brief power losses without affecting the operation of the system. The time the system is operational during power loss is called program scan hold-up time after loss of power. The duration of the power supply hold-up time depends on power consumption of controller system, but is typically between 10 milliseconds and 3 seconds.

## Input States on Power Down

The power supply hold-up time as described above is generally longer than the turn-on and turn-off times of the inputs. Because of this, the input state change from “On” to “Off” that occurs when power is removed may be recorded by the processor before the power supply shuts down the system. Understanding this concept is important. The user program should be written to take this effect into account.

## Other Types of Line Conditions

Occasionally the power source to the system can be temporarily interrupted. It is also possible that the voltage level may drop substantially below the normal line voltage range for a period of time. Both of these conditions are considered to be a loss of power for the system.

## Preventing Excessive Heat

For most applications, normal convective cooling keeps the controller within the specified operating range. Ensure that the specified temperature range is maintained. Proper spacing of components within an enclosure is usually sufficient for heat dissipation.

In some applications, a substantial amount of heat is produced by other equipment inside or outside the enclosure. In this case, place blower fans inside the enclosure to assist in air circulation and to reduce “hot spots” near the controller.

Additional cooling provisions might be necessary when high ambient temperatures are encountered.

**TIP** Do not bring in unfiltered outside air. Place the controller in an enclosure to protect it from a corrosive atmosphere. Harmful contaminants or dirt could cause improper operation or damage to components. In extreme cases, you may need to use air conditioning to protect against heat build-up within the enclosure.

## Master Control Relay

A hard-wired master control relay (MCR) provides a reliable means for emergency machine shutdown. Since the master control relay allows the placement of several emergency-stop switches in different locations, its installation is important from a safety standpoint. Overtravel limit switches or mushroom-head push buttons are wired in series so that when any of them opens, the master control relay is de-energized. This removes power to input and output device circuits. See illustrations [Schematic – Using IEC Symbols on page 31](#) and [Schematic – Using ANSI/CSA Symbols on page 32](#).



**WARNING:** Never alter these circuits to defeat their function since serious injury and/or machine damage could result.

**TIP** If you are using an external DC power supply, interrupt the DC output side rather than the AC line side of the supply to avoid the additional delay of power supply turn-off.

The AC line of the DC output power supply should be fused.

Connect a set of master control relays in series with the DC power supplying the input and output circuits.

Place the main power disconnect switch where operators and maintenance personnel have quick and easy access to it. If you mount a disconnect switch inside the controller enclosure, place the switch operating handle on the outside of the enclosure, so that you can disconnect power without opening the enclosure.

Whenever any of the emergency-stop switches are opened, power to input and output devices should be removed.

When you use the master control relay to remove power from the external I/O circuits, power continues to be provided to the controller's power supply so that diagnostic indicators on the processor can still be observed.

The master control relay is not a substitute for a disconnect to the controller. It is intended for any situation where the operator must quickly de-energize I/O devices only. When inspecting or installing terminal connections, replacing output fuses, or working on equipment within the enclosure, use the disconnect to shut off power to the rest of the system.

**TIP** Do not control the master control relay with the controller. Provide the operator with the safety of a direct connection between an emergency-stop switch and the master control relay.

## Using Emergency-Stop Switches

When using emergency-stop switches, adhere to the following points:

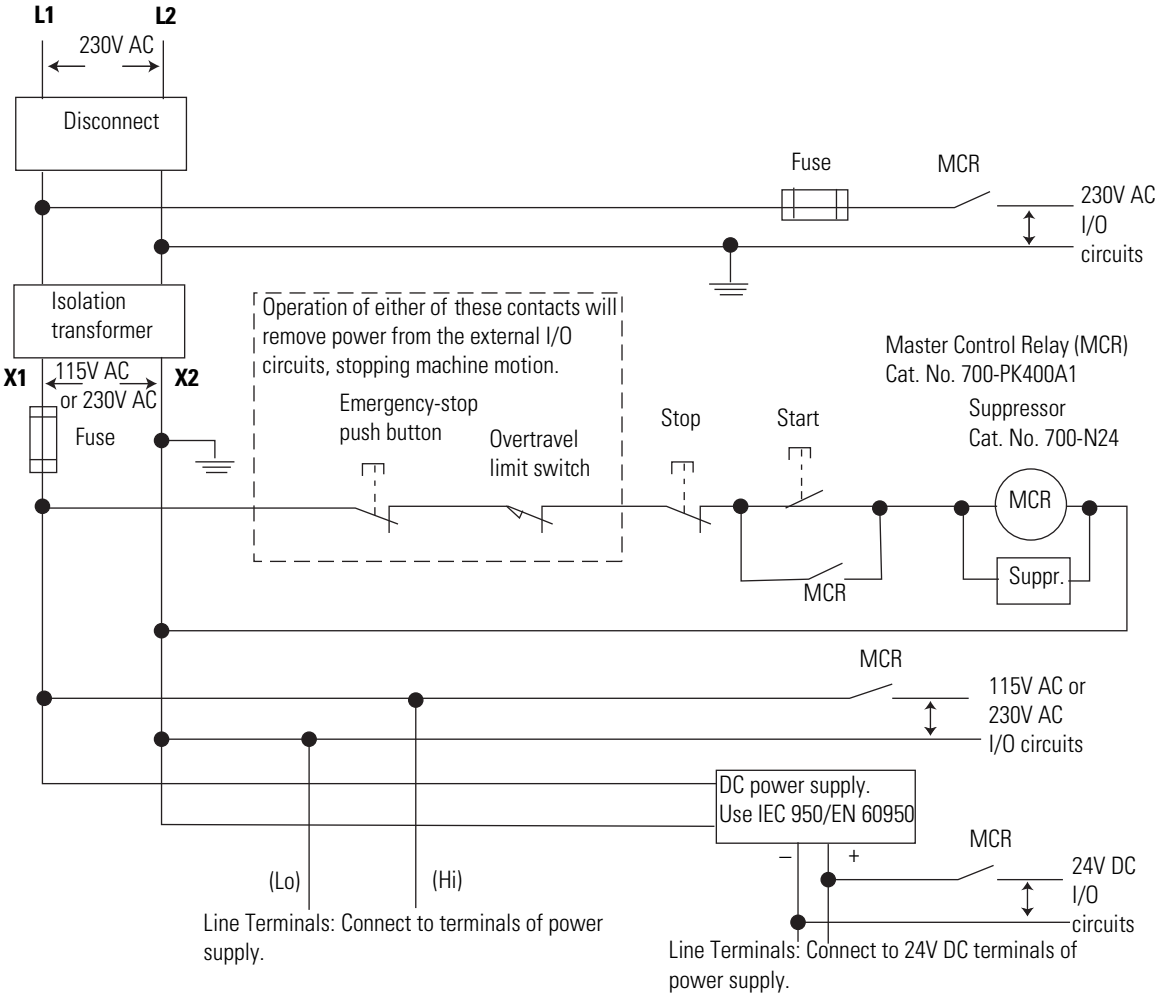
- Do not program emergency-stop switches in the controller program. Any emergency-stop switch should turn off all machine power by turning off the master control relay.
- Observe all applicable local codes concerning the placement and labeling of emergency-stop switches.
- Install emergency-stop switches and the master control relay in your system. Make certain that relay contacts have a sufficient rating for your application. Emergency-stop switches must be easy to reach.
- In the following illustration, input and output circuits are shown with MCR protection. However, in most applications, only output circuits require MCR protection.

The following illustrations show the Master Control Relay wired in a grounded system.

**TIP** In most applications input circuits do not require MCR protection; however, if you need to remove power from all field devices, you must include MCR contacts in series with input power wiring.

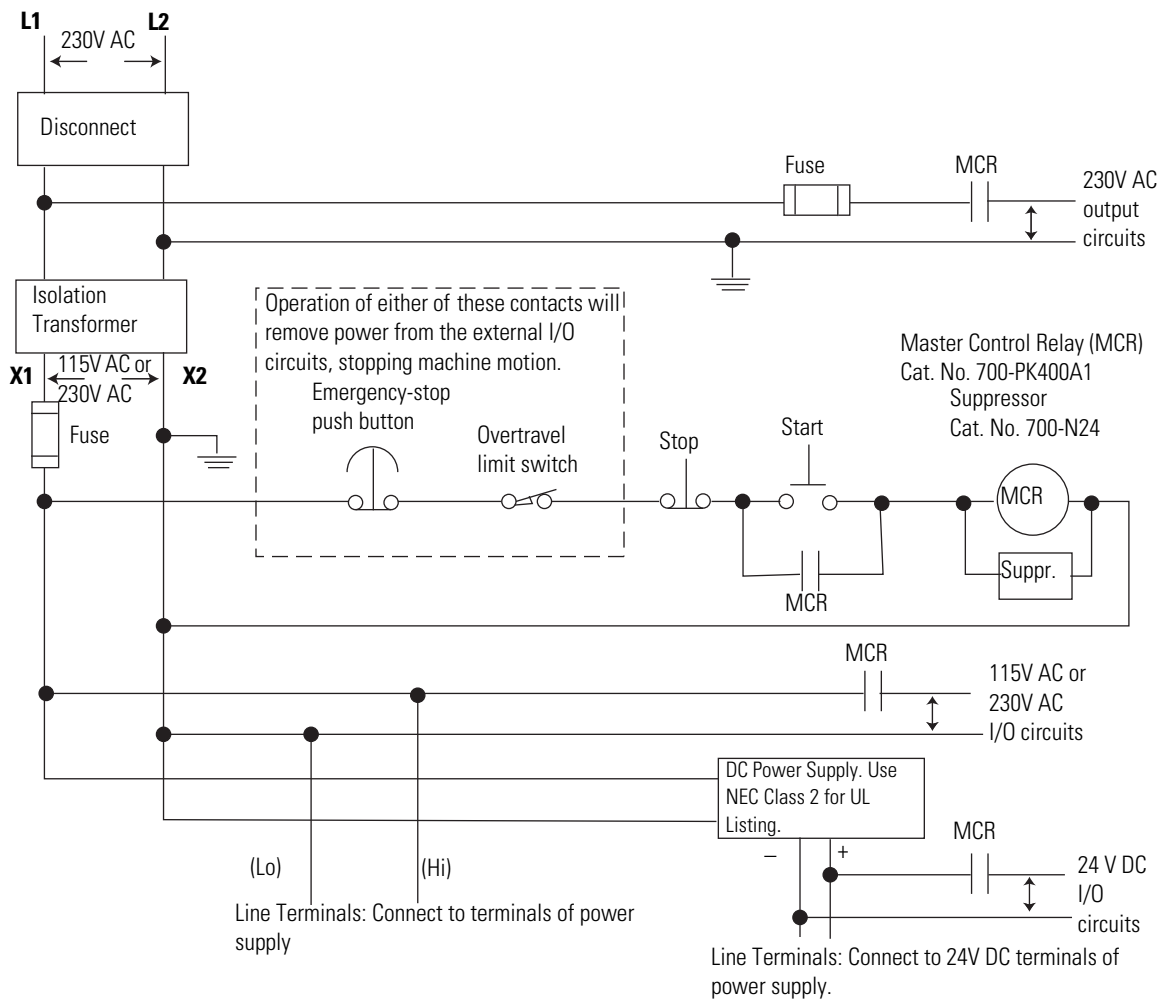


### Schematic – Using IEC Symbols



44564

### Schematic – Using ANSI/CSA Symbols



44565

## Install Your Controller

This chapter serves to guide the user on installing the controller. It includes the following topics.

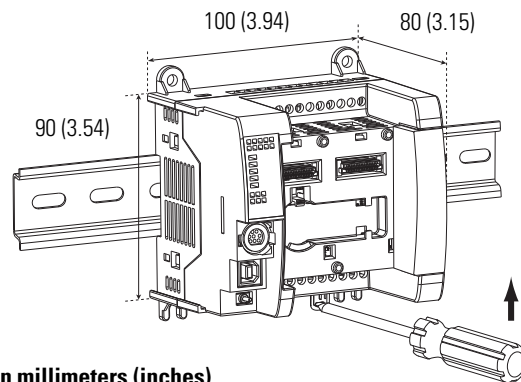
Topic	Page
Controller Mounting Dimensions	33
Mounting Dimensions	33
DIN Rail Mounting	36
Panel Mounting	36

### Controller Mounting Dimensions

### Mounting Dimensions

Mounting dimensions do not include mounting feet or DIN rail latches.

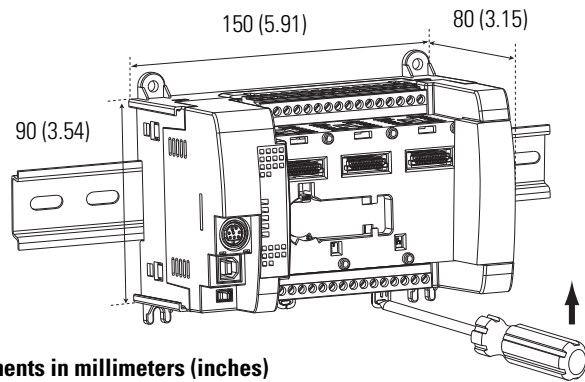
*Micro830 10-Point and 16-Point Controllers*  
 2080-LC30-10QWB, 2080-LC30-10QVB,  
 2080-LC30-16AWB, 2080-LC30-16QWB, 2080-LC30-16QVB



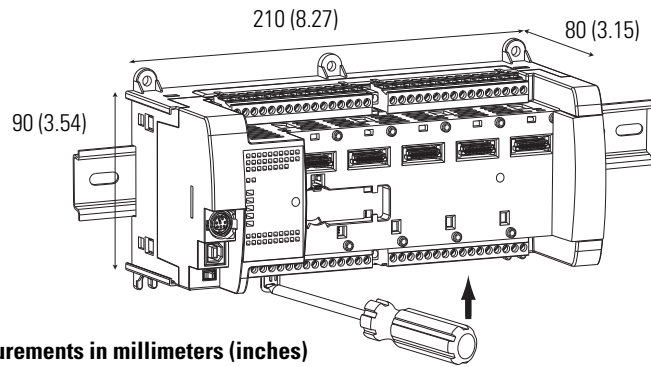
45032

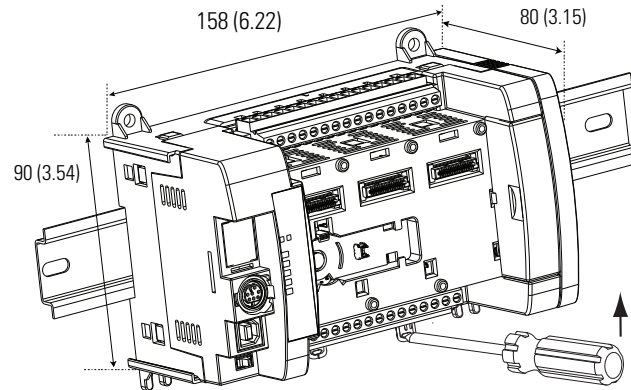
**Measurements in millimeters (inches)**

*Micro830 24-Point Controllers*  
*2080-LC30-24QWB, 2080-LC30-24QVB, 2080-LC30-24QBB*

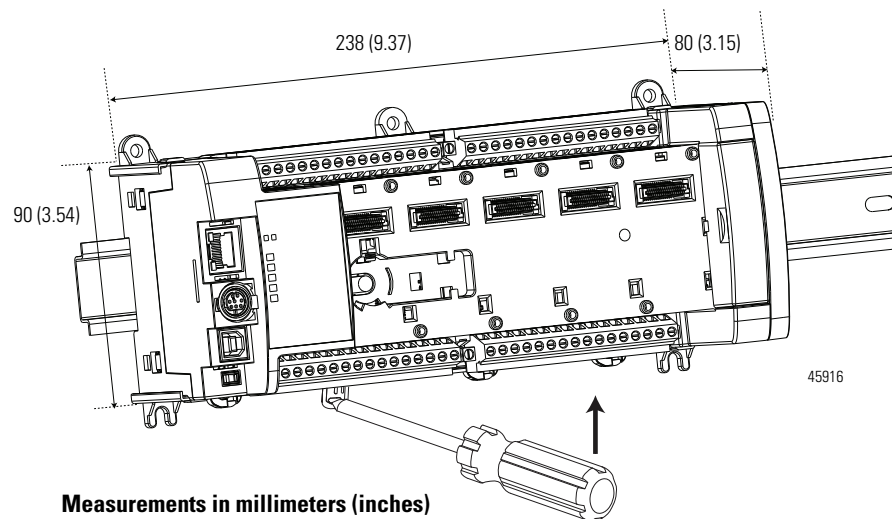


*Micro830 48-Point Controllers*  
*2080-LC30-48AWB, 2080-LC30-48QWB, 2080-LC30-48QVB,*  
*2080-LC30-48QBB*



*Micro850 24-Point Controllers**2080-LC50-24AWB, 2080-LC50-24QBB, 2080-LC50-24QVB, 2080-LC50-24QWB**Micro870 24-Point Controllers**2080-LC70-24AWB, 2080-LC70-24QWB, 2080-LC70-24QWBK,  
2080-LC70-24QBB, 2080-LC70-24QBBK***Measurements in millimeters (inches)**

45912

*Micro850 48-Point Controllers**2080-LC50-48AWB, 2080-LC50-48QWB, 2080-LC50-48QBB, 2080-LC50-48QVB***Measurements in millimeters (inches)**

45916

Maintain spacing from objects such as enclosure walls, wireways and adjacent equipment. Allow 50.8 mm (2 in.) of space on all sides for adequate ventilation. If optional accessories/modules are attached to the controller, such as the power supply 2080-PS120-240VAC or expansion I/O modules, make sure that there is 50.8 mm (2 in.) of space on all sides after attaching the optional parts.

## DIN Rail Mounting

The module can be mounted using the following DIN rails: 35 x 7.5 x 1 mm (EN 50 022 - 35 x 7.5).

**TIP** For environments with greater vibration and shock concerns, use the panel mounting method, instead of DIN rail mounting.

Before mounting the module on a DIN rail, use a flat-blade screwdriver in the DIN rail latch and pry it downwards until it is in the unlatched position.

1. Hook the top of the DIN rail mounting area of the controller onto the DIN rail, and then press the bottom until the controller snaps onto the DIN rail.
2. Push the DIN rail latch back into the latched position.  
Use DIN rail end anchors (Allen-Bradley part number 1492-EAJ35 or 1492-EAHJ35) for vibration or shock environments.

To remove your controller from the DIN rail, pry the DIN rail latch downwards until it is in the unlatched position.

## Panel Mounting

The preferred mounting method is to use four M4 (#8) screws per module. Hole spacing tolerance:  $\pm 0.4$  mm (0.016 in.).

Follow these steps to install your controller using mounting screws.

1. Place the controller against the panel where you are mounting it. Make sure the controller is spaced properly.
2. Mark drilling holes through the mounting screw holes and mounting feet then remove the controller.
3. Drill the holes at the markings, then replace the controller and mount it. Leave the protective debris strip in place until you are finished wiring the controller and any other devices.

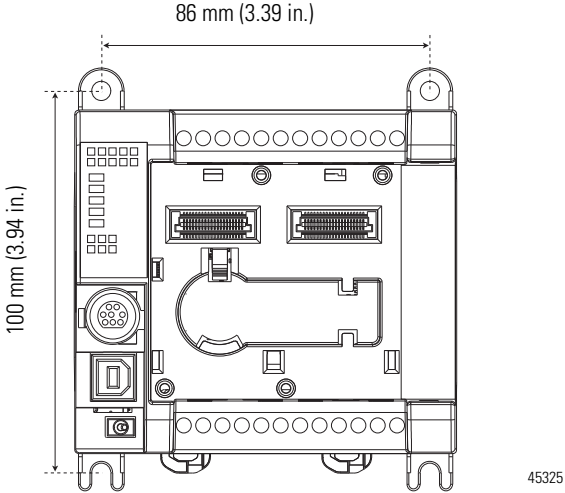
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**IMPORTANT** For instructions on how to install your Micro800 system with expansion I/O, see the User Manual for Micro800 Expansion I/O Modules, [2080-UM003](#).

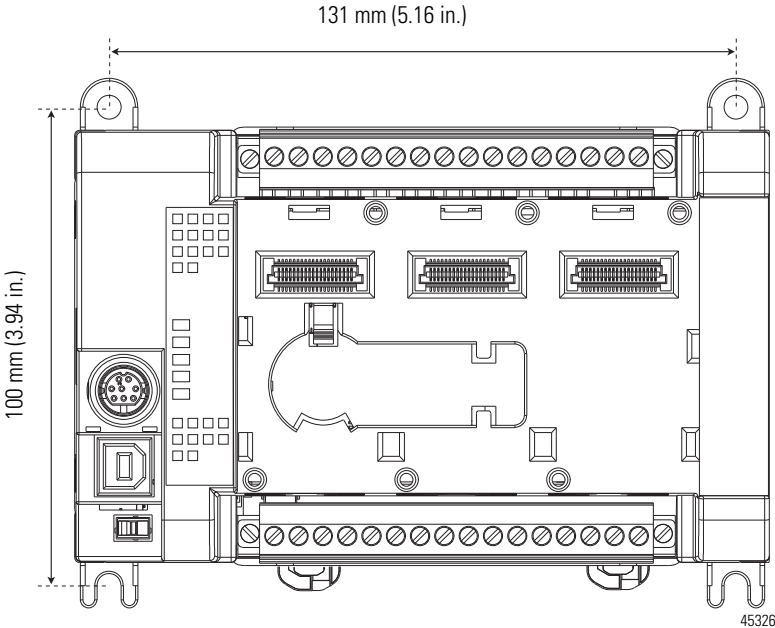
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### Panel Mounting Dimensions

*Micro830 10-Point and 16-Point Controllers*  
*2080-LC30-10QWB, 2080-LC30-10QVB,*  
*2080-LC30-16AWB, 2080-LC30-16QWB, 2080-LC30-16QVB*



*Micro830 24-Point Controllers*  
*2080-LC30-24QWB, 2080-LC30-24QVB, 2080-LC30-24QBB*



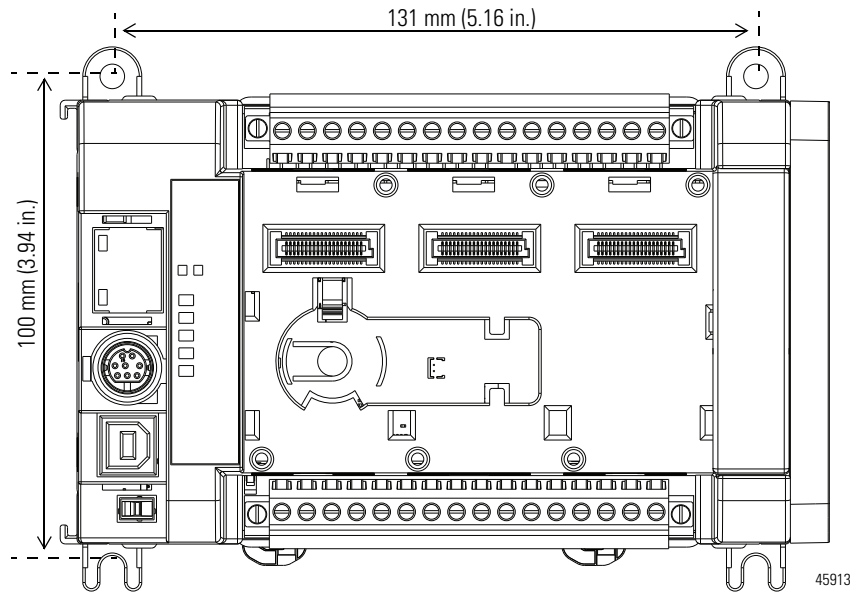
*Micro850 24-Point Controllers*

*2080-LC50-24AWB, 2080-LC50-24QBB, 2080-LC50-24QVB, 2080-LC50-24QWB*

*Micro870 24-Point Controllers*

*2080-LC70-24AWB, 2080-LC70-24QWB, 2080-LC70-24QWBK,*

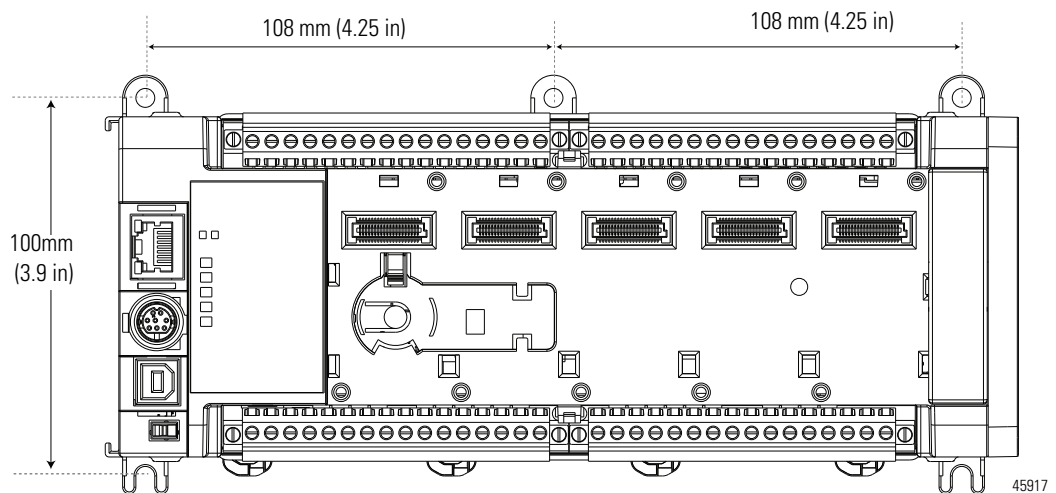
*2080-LC70-24QBB, 2080-LC70-24QBBK*



*Micro830 48-Point Controllers*

*2080-LC30-48AWB, 2080-LC30-48QWB, 2080-LC30-48QVB,*

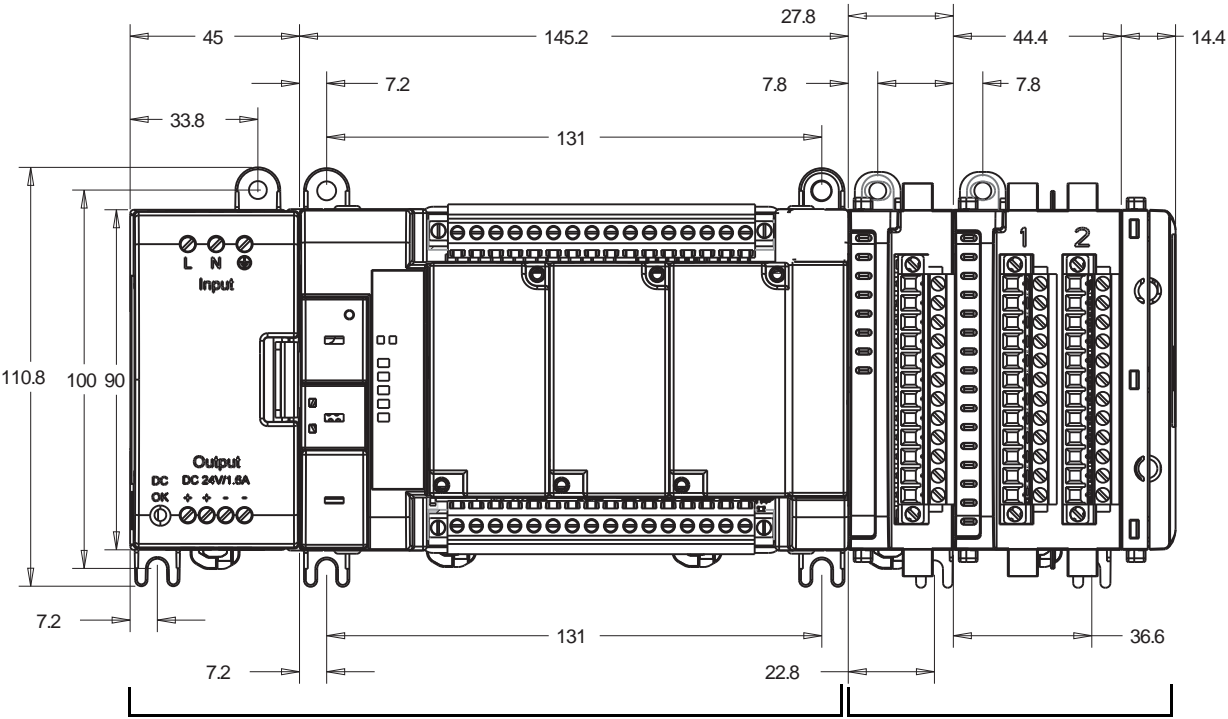
*2080-LC30-48QBB*





### System Assembly

#### Micro830, Micro850, and Micro870 24-point Controllers (Front)

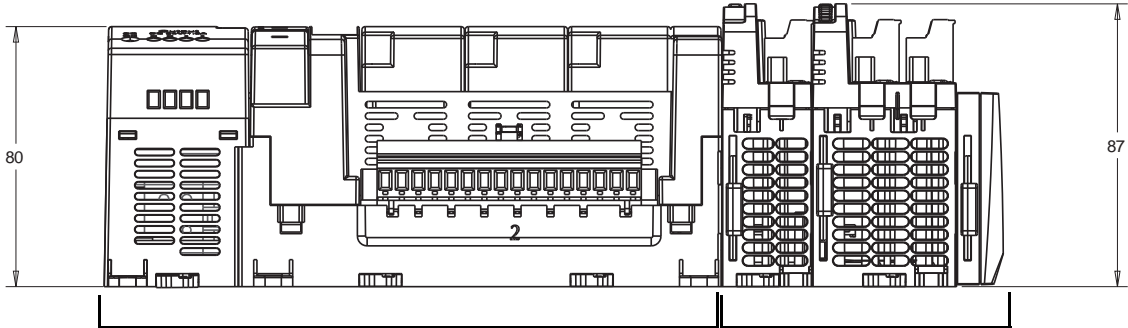


Measurements in millimeters

**Micro830/Micro850/Micro870 24pt Controller with Micro800 Power Supply**

**Expansion I/O Slots**  
*(Applicable to Micro850 and Micro870 only)*  
 Single-width (1st slot)  
 Double-width (2nd slot)  
 2085-ECR (terminator)

#### Micro830, Micro850, and Micro870 24-point Controllers (Side)

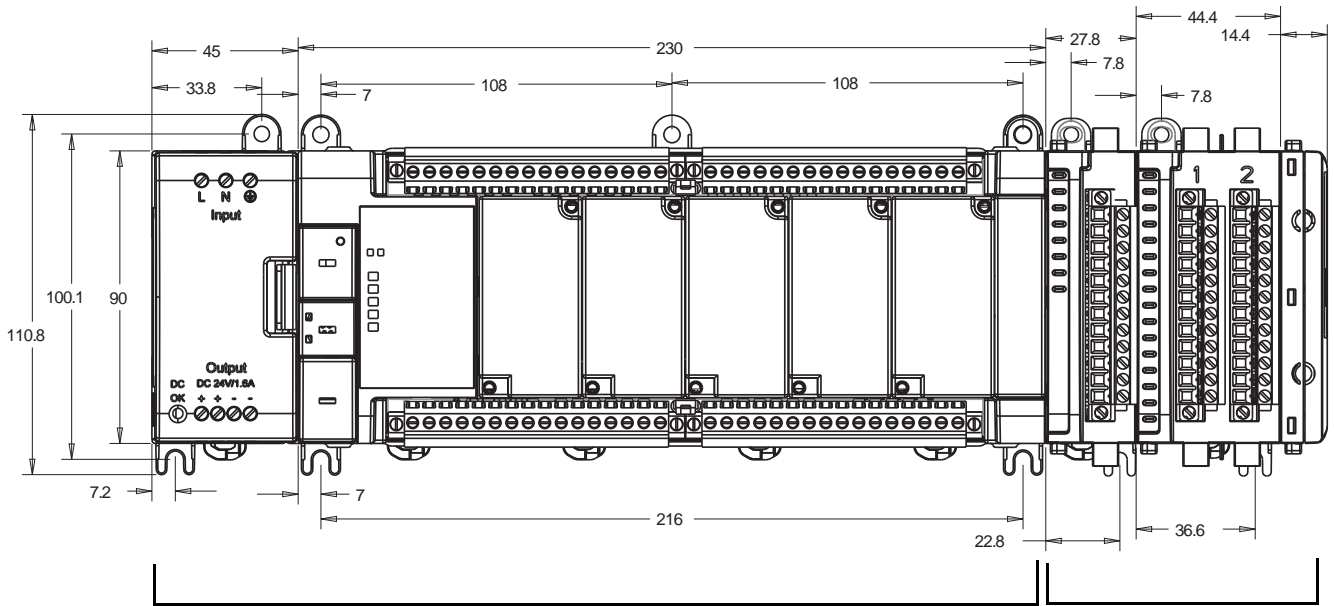


Measurements in millimeters

**Micro830/Micro850/Micro870 24pt Controller with Micro800 Power Supply**

**Expansion I/O Slots**  
*(Applicable to Micro850 and Micro870 only)*  
 Single-width (1st slot)  
 Double-width (2nd slot)  
 2085-ECR (terminator)

### Micro830 and Micro850 48-point Controllers (Front)



Micro830/Micro850 48pt Controller with Micro800 Power Supply

Measurements in millimeters

#### Expansion I/O Slots

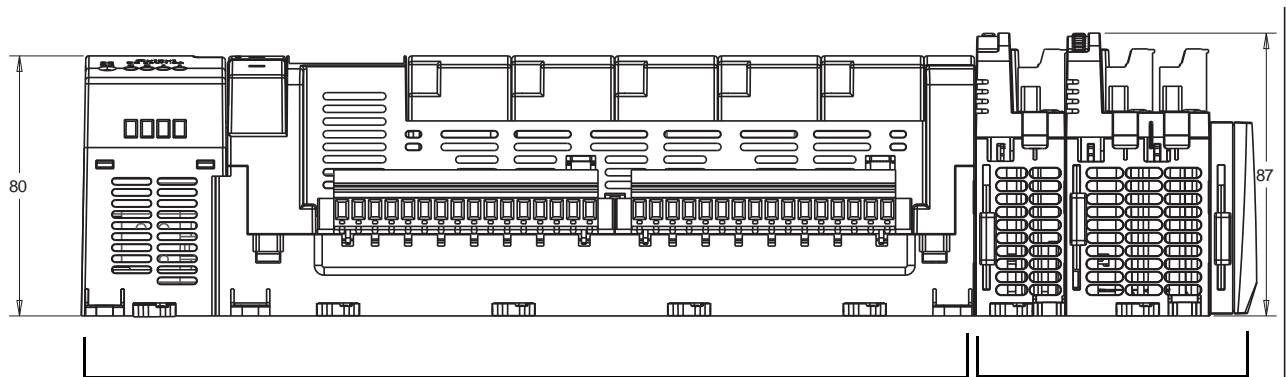
(Applicable to Micro850 only)

Single-width (1st slot)

Double-width (2nd slot)

2085-ECR (terminator)

### Micro830 and Micro850 48-point Controllers (Side)



Micro830/Micro850 48pt Controller with Micro800 Power Supply

Measurements in millimeters

#### Expansion I/O Slots

(Applicable to Micro850 only)

Single-width (1st slot)

Double-width (2nd slot)

2085-ECR (terminator)

## Wire Your Controller

This chapter provides information on the Micro830, Micro850, and Micro870 controller wiring requirements. It includes the following sections:

Topic	Page
Wiring Requirements and Recommendation	41
Use Surge Suppressors	42
Recommended Surge Suppressors	44
Grounding the Controller	45
Wiring Diagrams	46
Controller I/O Wiring	52
Minimize Electrical Noise	52
Analog Channel Wiring Guidelines	52
Minimize Electrical Noise on Analog Channels	52
Grounding Your Analog Cable	53
Wiring Examples	53
Embedded Serial Port Wiring	55

### Wiring Requirements and Recommendation



**WARNING:** Before you install and wire any device, disconnect power to the controller system.



**WARNING:** Calculate the maximum possible current in each power and common wire. Observe all electrical codes dictating the maximum current allowable for each wire size. Current above the maximum ratings may cause wiring to overheat, which can cause damage.

*United States Only:* If the controller is installed within a potentially hazardous environment, all wiring must comply with the requirements stated in the National Electrical Code 501-10 (b).

- Allow for at least 50 mm (2 in.) between I/O wiring ducts or terminal strips and the controller.

- Route incoming power to the controller by a path separate from the device wiring. Where paths must cross, their intersection should be perpendicular.

**TIP** Do not run signal or communications wiring and power wiring in the same conduit. Wires with different signal characteristics should be routed by separate paths.

- Separate wiring by signal type. Bundle wiring with similar electrical characteristics together.
- Separate input wiring from output wiring.
- Label wiring to all devices in the system. Use tape, shrink-tubing, or other dependable means for labeling purposes. In addition to labeling, use colored insulation to identify wiring based on signal characteristics. For example, you may use blue for DC wiring and red for AC wiring.

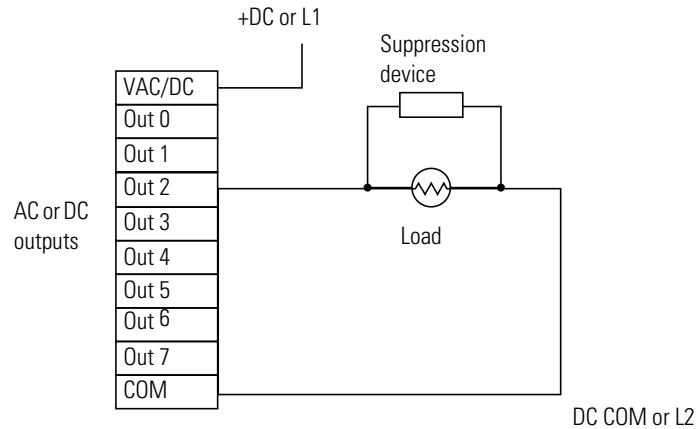
**Wire Requirements**

	Wire Size			
	Type	Min	Max	
Micro830/ Micro850/ Micro870 Controllers	Solid	0.2 mm <sup>2</sup> (24 AWG)	2.5 mm <sup>2</sup> (12 AWG)	rated @ 90 °C (194 °F) insulation max
	Stranded	0.2 mm <sup>2</sup> (24 AWG)	2.5 mm <sup>2</sup> (12 AWG)	

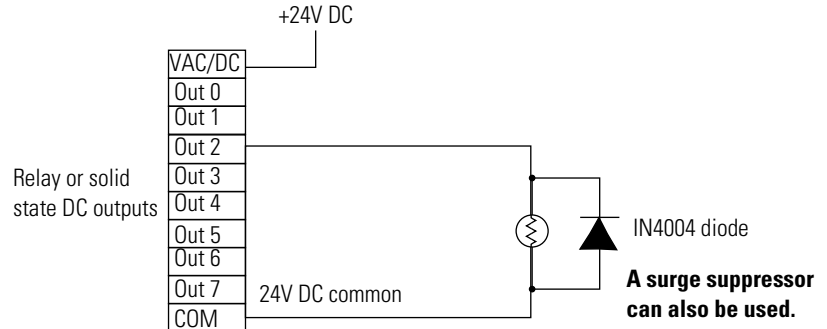
**Use Surge Suppressors**

Because of the potentially high current surges that occur when switching inductive load devices, such as motor starters and solenoids, the use of some type of surge suppression to protect and extend the operating life of the controllers output contacts is required. Switching inductive loads without surge suppression can *significantly* reduce the life expectancy of relay contacts. By adding a suppression device directly across the coil of an inductive device, you prolong the life of the output or relay contacts. You also reduce the effects of voltage transients and electrical noise from radiating into adjacent systems.

The following diagram shows an output with a suppression device. We recommend that you locate the suppression device as close as possible to the load device.



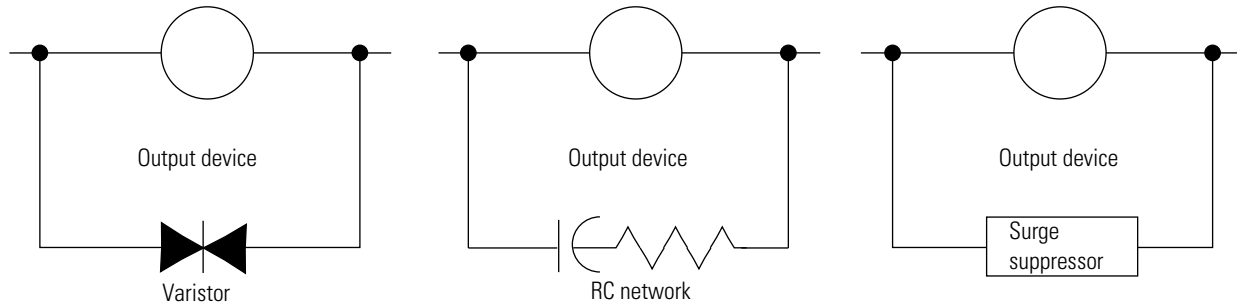
If the outputs are DC, we recommend that you use an 1N4004 diode for surge suppression, as shown below. For inductive DC load devices, a diode is suitable. A 1N4004 diode is acceptable for most applications. A surge suppressor can also be used. See [Recommended Surge Suppressors on page 44](#). As shown below, these surge suppression circuits connect directly across the load device.



Suitable surge suppression methods for inductive AC load devices include a varistor, an RC network, or an Allen-Bradley surge suppressor, all shown below. These components must be appropriately rated to suppress the switching

transient characteristic of the particular inductive device. See [Recommended Surge Suppressors on page 44](#) for recommended suppressors.

Surge Suppression for Inductive AC Load Devices



### Recommended Surge Suppressors

Use the Allen-Bradley surge suppressors shown in the following table for use with relays, contactors, and starters.

#### Recommended Surge Suppressors

Device	Coil Voltage	Suppressor Catalog Number	Type <sup>(4)</sup>	
Bulletin 100/104K 700K	24...48V AC	100-KFSC50	RC	
	110...280V AC	100-KFSC280		
	380...480V AC	100-KFSC480		
		12...55 V AC, 12...77V DC	100-KFSV55	MOV
		56...136 VAC, 78...180V DC	100-KFSV136	
		137...277V AC, 181...250 V DC	100-KFSV277	
		12...250V DC	100-KFSD250	
Bulletin 100C, (C09 - C97)	24...48V AC	100-FSC48 <sup>(1)</sup>	RC	
	110...280V AC	100-FSC280 <sup>(1)</sup>		
	380...480V AC	100-FSC480 <sup>(1)</sup>		
		12...55V AC, 12...77V DC	100-FSV55 <sup>(1)</sup>	MOV
		56...136V AC, 78...180V DC	100-FSV136 <sup>(1)</sup>	
		137...277V AC, 181...250V DC	100-FSV277 <sup>(1)</sup>	
		278...575V AC	100-FSV575 <sup>(1)</sup>	
		12...250V DC	100-FSD250 <sup>(1)</sup>	
Bulletin 509 Motor Starter Size 0 - 5	12...120V AC	599-K04	MOV	
	240...264V AC	599-KA04		

**Recommended Surge Suppressors**

Device	Coil Voltage	Suppressor Catalog Number	Type <sup>(4)</sup>
Bulletin 509 Motor Starter Size 6	12...120V AC	199-FSMA1 <sup>(2)</sup>	RC
	12...120V AC	199-GSMA1 <sup>(3)</sup>	MOV
Bulletin 700 R/RM Relay	AC coil	Not Required	
	24...48V DC	199-FSMA9	MOV
	50...120V DC	199-FSMA10	
	130...250V DC	199-FSMA11	
Bulletin 700 Type N, P, PK or PH Relay	6...150V AC/DC	700-N24	RC
	24...48V AC/DC	199-FSMA9	MOV
	50...120V AC/DC	199-FSMA10	
	130...250V AC/DC	199-FSMA11	
	6...300V DC	199-FSMZ-1	Diode
Miscellaneous electromagnetic devices limited to 35 sealed VA	6...150V AC/DC	700-N24	RC

(1) Catalog numbers for screwless terminals include the string 'CR' after '100-'. For example: Cat. No. 100-FSC48 becomes Cat. No. 100-**CR**FSC48; Cat. No. 100-FSV55 becomes 100-**CR**FSV55; and so on.

(2) For use on the interposing relay.

(3) For use on the contactor or starter.

(4) RC Type not to be used with Triac outputs. Varistor is not recommended for use on the relay outputs.


**Grounding the Controller**

**WARNING:** All devices connected to the RS-232/485 communication port must be referenced to controller ground, or be floating (not referenced to a potential other than ground). Failure to follow this procedure may result in property damage or personal injury.

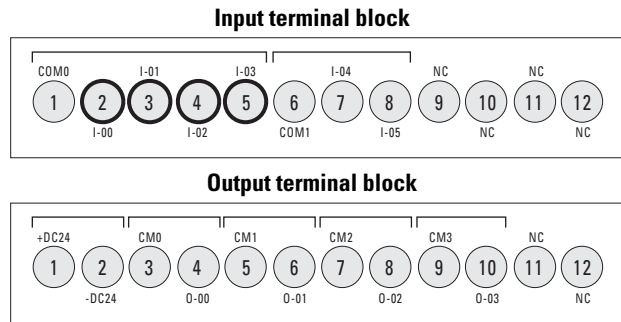
This product is intended to be mounted to a well grounded mounting surface such as a metal panel. Refer to the Industrial Automation Wiring and Grounding Guidelines, publication [1770-4.1](#), for additional information.

## Wiring Diagrams

The following illustrations show the wiring diagrams for the Micro800 controllers. Controllers with DC inputs can be wired as either sinking or sourcing inputs. Sinking and sourcing does not apply to AC inputs.

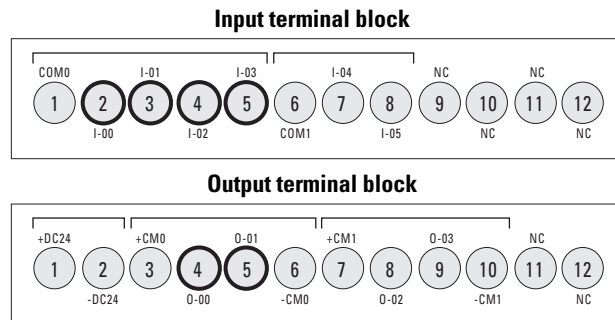
High-speed inputs and outputs are indicated by .

### 2080-LC30-10QWB



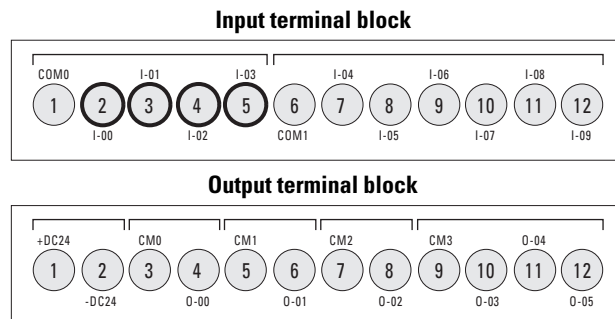
45033

### 2080-LC30-10QVB



45034

### 2080-LC30-16AWB / 2080-LC30-16QWB

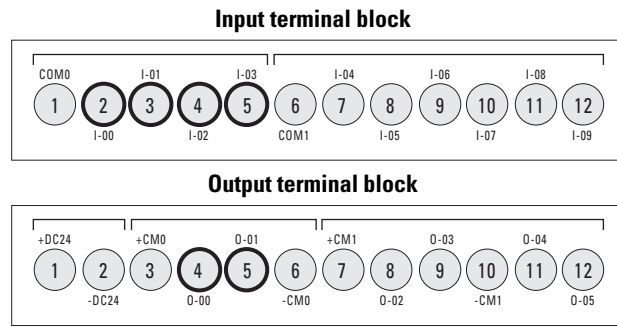


45028

**TIP** 2080-LC30-16AWB has no high-speed inputs.

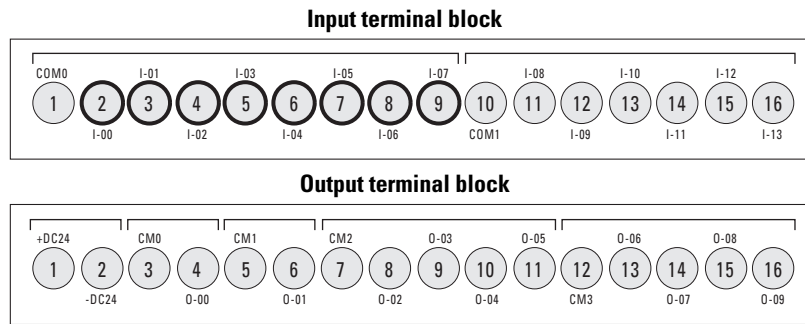


*2080-LC30-16QVB*



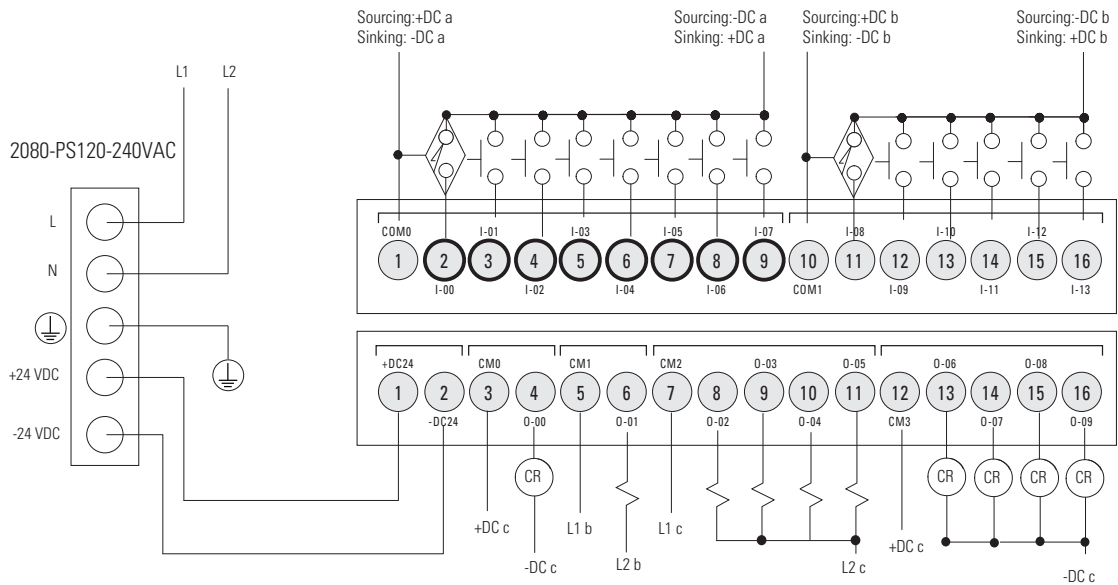
45029

*2080-LC30-24QWB / 2080-LC50-24AWB / 2080-LC50-24QWB /  
2080-LC70-24AWB / 2080-LC70-24QWB / 2080-LC70-24QWBK*



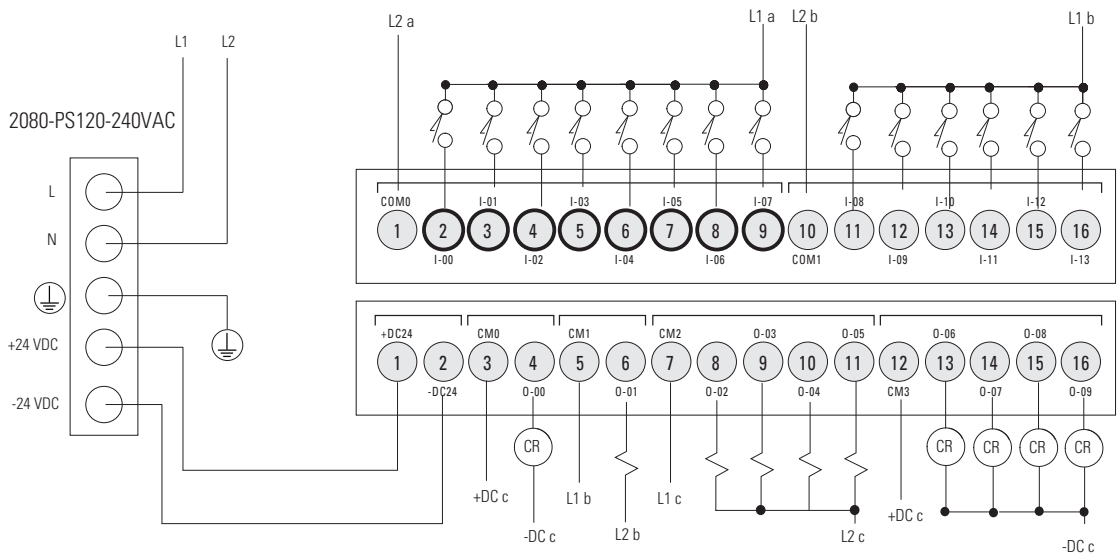
45019

**2080-LC30-24QWB, 2080-LC50-24QWB, 2080-LC70-24QWB, 2080-LC70-24QWBK, DC Input Configuration**



- IMPORTANT**
- Do not connect –DC24 (Output terminal 2) to Earth/Chassis Ground.
  - In Micro870 systems that use more than four Micro800 Expansion I/O modules, we recommend to use a 1601-XLP60EQ power supply instead of a 2080-PS120-240VAC power supply. Make sure to wire both the Micro870 controller and 2085-EP24VDC expansion power supply to the same 1601-XLP60EQ power supply.

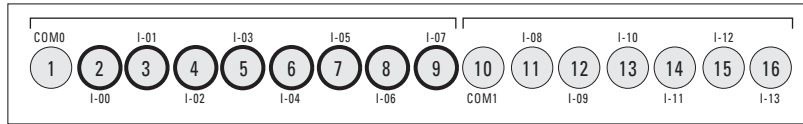
**2080-LC50-24AWB, 2080-LC70-24AWB, DC Input Configuration**



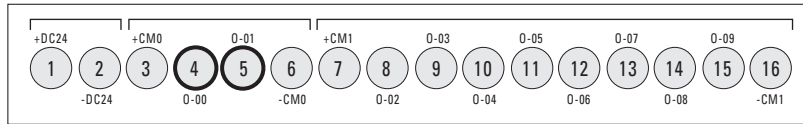
- IMPORTANT** Do not connect –DC24 (Output terminal 2) to Earth/Chassis Ground.

2080-LC30-24QVB / 2080-LC30-24QBB / 2080-LC50-24QVB /  
 2080-LC50-24QBB / 2080-LC70-24QBB / 2080-LC70-24QBBK

**Input terminal block**

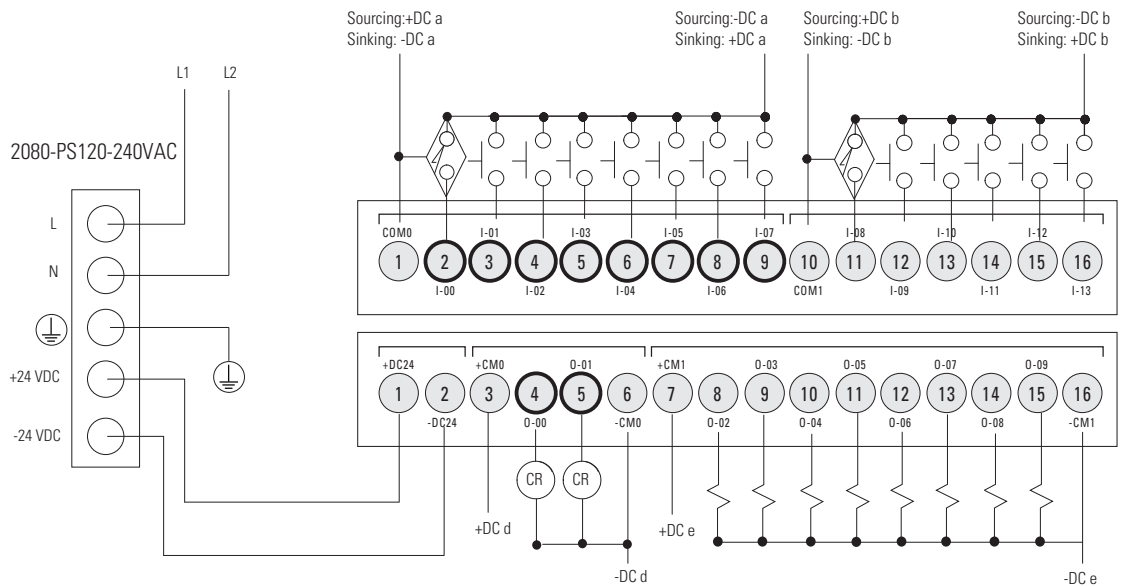


**Output terminal block**



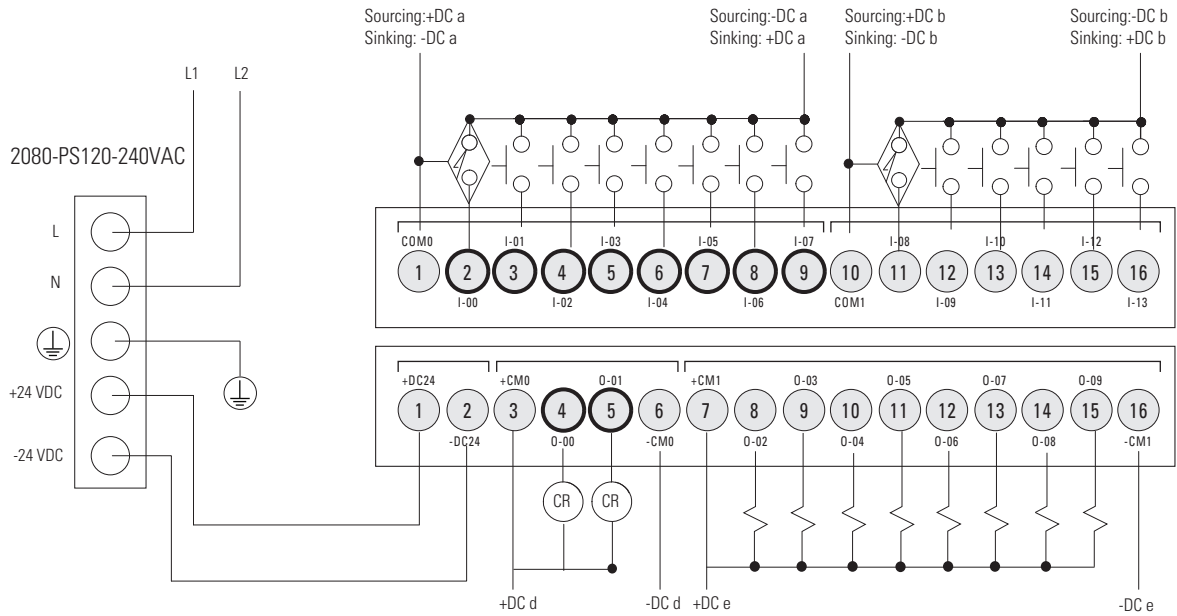
45020

**2080-LC30-24QBB, 2080-LC50-24QBB, 2080-LC70-24QBB, 2080-LC70-24QBBK, DC Input Configuration**



- IMPORTANT**
- Do not connect -DC24 (Output terminal 2) to Earth/Chassis Ground.
  - In Micro870 systems that use more than four Micro800 Expansion I/O modules, we recommend to use a 1601-XLP60EQ power supply instead of a 2080-PS120-240VAC power supply. Make sure to wire both the Micro870 controller and 2085-EP24VDC expansion power supply to the same 1601-XLP60EQ power supply.

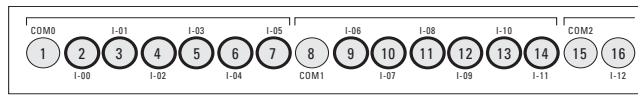
**2080-LC30-24QVB, 2080-LC50-24QVB, DC Input Configuration**



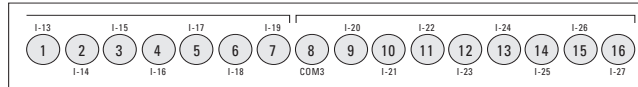
**IMPORTANT** Do not connect –DC24 (Output terminal 2) to Earth/Chassis Ground.

*2080-LC30-48AWB / 2080-LC30-48QWB / 2080-LC50-48AWB / 2080-LC50-48QWB*

**Input terminal blocks**

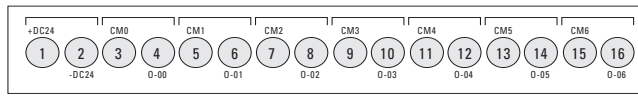


TERMINAL BLOCK 1

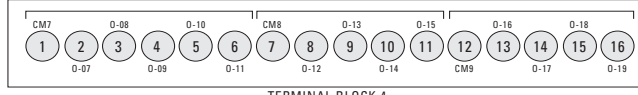


TERMINAL BLOCK 3

**Output terminal blocks**



TERMINAL BLOCK 2



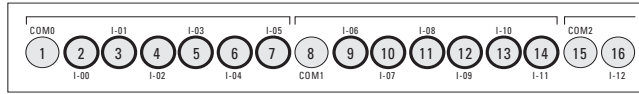
TERMINAL BLOCK 4

45039

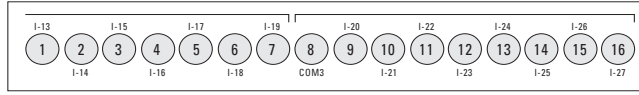
**TIP** 2080-LC30-48AWB has no high-speed inputs.

*2080-LC30-48QVB / 2080-LC30-48QBB / 2080-LC50-48QVB /  
2080-LC50-48QBB*

**Input terminal blocks**

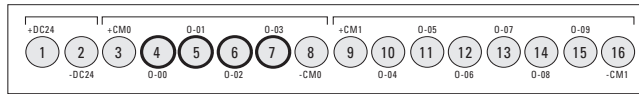


TERMINAL BLOCK 1

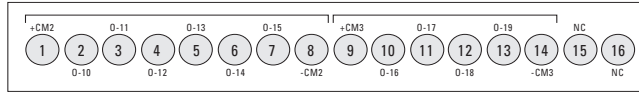


TERMINAL BLOCK 3

**Output terminal blocks**



TERMINAL BLOCK 2



TERMINAL BLOCK 4

45040

## Controller I/O Wiring

This section contains some relevant information about minimizing electrical noise and also includes some wiring examples.

### Minimize Electrical Noise

Because of the variety of applications and environments where controllers are installed and operating, it is impossible to ensure that all environmental noise will be removed by input filters. To help reduce the effects of environmental noise, install the Micro800 system in a properly rated (for example, NEMA) enclosure. Make sure that the Micro800 system is properly grounded.

A system may malfunction due to a change in the operating environment after a period of time. We recommend periodically checking system operation, particularly when new machinery or other noise sources are installed near the Micro800 system.

### Analog Channel Wiring Guidelines

Consider the following when wiring your analog channels:

- The analog common (COM) is not electrically isolated from the system, and is connected to the power supply common.
- Analog channels are not isolated from each other.
- Use Belden cable #8761, or equivalent, shielded wire.
- Under normal conditions, the drain wire (shield) should be connected to the metal mounting panel (earth ground). Keep the shield connection to earth ground as short as possible.
- To ensure optimum accuracy for voltage type inputs, limit overall cable impedance by keeping all analog cables as short as possible. Locate the I/O system as close to your voltage type sensors or actuators as possible.

### Minimize Electrical Noise on Analog Channels

Inputs on analog channels employ digital high-frequency filters that significantly reduce the effects of electrical noise on input signals. However, because of the variety of applications and environments where analog controllers are installed and operated, it is impossible to ensure that all environmental noise will be removed by the input filters.

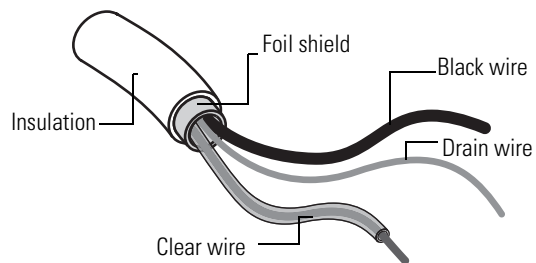
Several specific steps can be taken to help reduce the effects of environmental noise on analog signals:

- install the Micro800 system in a properly rated enclosure, for example, NEMA. Make sure that the shield is properly grounded.

- use Belden cable #8761 for wiring the analog channels, making sure that the drain wire and foil shield are properly earth grounded.
- route the Belden cable separately from any AC wiring. Additional noise immunity can be obtained by routing the cables in grounded conduit.

## Grounding Your Analog Cable

Use shielded communication cable (Belden #8761). The Belden cable has two signal wires (black and clear), one drain wire, and a foil shield. The drain wire and foil shield must be grounded at one end of the cable.



44531

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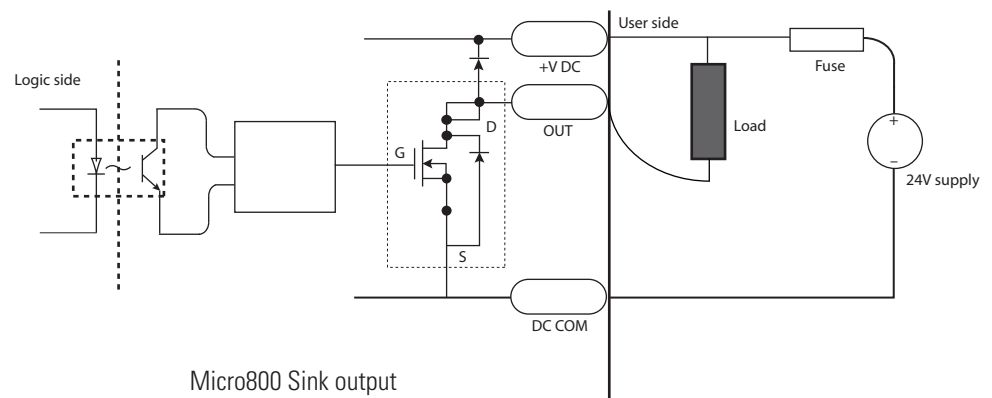
**IMPORTANT** Do not ground the drain wire and foil shield at both ends of the cable.

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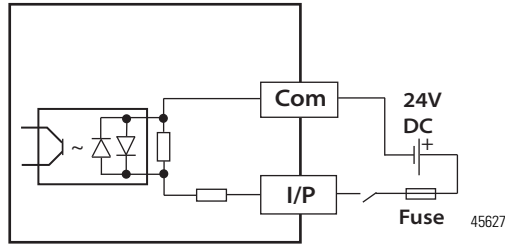
## Wiring Examples

Examples of sink/source, input/output wiring are shown below.

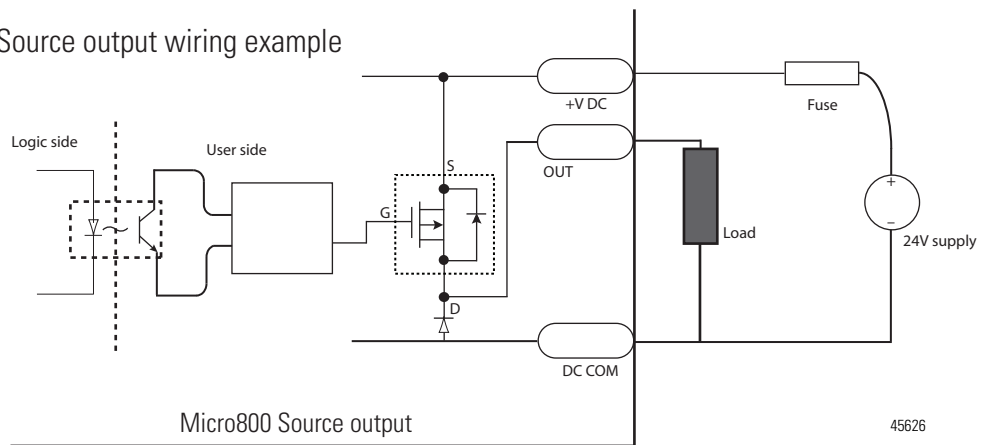
### Sink output wiring example



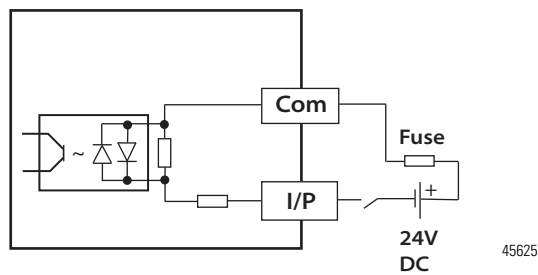
Sink input wiring example



Source output wiring example



Source input wiring example





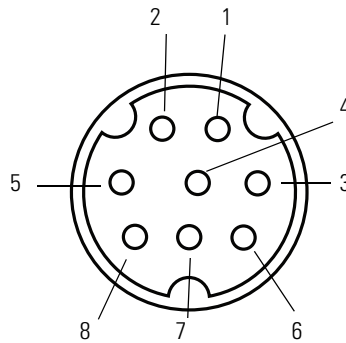
## Embedded Serial Port Wiring

The embedded serial port is a non-isolated RS232/RS485 serial port which is targeted to be used for short distances (<3 m) to devices such as HMIs.

See [Embedded Serial Port Cables on page 8](#) for a list of cables that can be used with the embedded serial port 8-pin Mini DIN connector.

For example the 1761-CBL-PM02 cable is typically used to connect the embedded serial port to PanelView Component HMI using RS232.

### Embedded Serial Port



### Pinout table

Pin	Definition	RS-485 Example	RS-232 Example
1	RS-485+	B(+)	(not used)
2	GND	GND	GND
3	RS-232 RTS	(not used)	RTS
4	RS-232 RxD	(not used)	RxD
5	RS-232 DCD	(not used)	DCD
6	RS-232 CTS	(not used)	CTS
7	RS-232 TxD	(not used)	TxD
8	RS-485-	A(-)	(not used)

- IMPORTANT**
- Do not connect the GND pin of the serial port to Earth/Chassis Ground. The GND pin of the serial port is the DC common for the Serial Port Communication signals and is not intended for Shield Ground.
  - If the length of the serial cable is more than 3 meters, use an isolated serial port, catalog number 2080-SERIALISOL.

**Notes:**

## Communication Connections

### Overview

This chapter describes how to communicate with your control system and configure communication settings. The method you use and cabling required to connect your controller depends on what type of system you are employing. This chapter also describes how the controller establishes communication with the appropriate network. Topics include:

Topic	Page
Supported Communication Protocols	57
Use Modems with Micro800 Controllers	64
Configure Serial Port	65
Configure Ethernet Settings	70
OPC Support Using RSLinx Enterprise	73

The Micro830, Micro850, and Micro870 controllers have the following embedded communication channels:

- a non-isolated RS-232/RS-485 combo port
- a non-isolated USB programming port

In addition, the Micro850 and Micro870 controllers have an RJ-45 Ethernet port.

### Supported Communication Protocols

Micro830, Micro850, and Micro870 controllers support communication through the embedded RS-232/RS-485 serial port as well as any installed serial port plug-in modules. In addition, Micro850 and Micro870 controllers also support communication through the embedded Ethernet port, and can be connected to a local area network for various devices providing 10 Mbps/100 Mbps transfer rate.

These are the communication protocols supported by Micro830/Micro850/Micro870 controllers:

- Modbus RTU Master and Slave
- CIP Serial Client/Server (RS-232 only)
- CIP Symbolic Client/Server
- ASCII

These are the communication protocols supported by Micro850 and Micro870 controllers only:

- EtherNet/IP Client/Server
- Modbus TCP Client/Server
- DHCP Client
- Sockets Client/Server TCP/UDP

**Connection Limits for Micro830/Micro850/Micro870 Controllers**

Description		Micro830	Micro850/ Micro870
<b>CIP Connections</b>			
Total number of client plus server connections for all ports		16	24
Maximum number of client connections for all ports		15	16
Maximum number of server connections for all ports		16	24
Maximum number of EtherNet/IP connections	Client	–	16
	Server		23
Maximum number of USB connections	Client	–	–
	Server	15	23
Maximum number of Serial connections	Client	15	16
	Server	15	23
<b>TCP Connections</b>			
Total number of client plus server connections		–	64
Maximum number for EtherNet/IP	Client		16
	Server		16
Maximum number for Modbus TCP	Client		16
	Server		16
Maximum number for User Programmable Sockets			8
<b>User Programmable Sockets</b>			
Total number of User Programmable Sockets (any combination of UDP plus TCP Client/Server)		–	8

**IMPORTANT** If all client/server connections are fully loaded, performance may be affected, such as data loss and intermittent delays during communication.

Here are some configuration examples based on the limits described in the table above:

1. The maximum number of drives that can be controlled over EtherNet/IP is 16. This is due to the maximum limit of TCP Client connections is 16, and the maximum limit of EtherNet/IP Client connections is also 16.
2. If you have 10 devices controlled over EtherNet/IP, the maximum number of devices that can be controlled over Serial is six. This is due to the maximum limit of Client connections is 16.

3. The total number of UDP sockets plus TCP Client/Server sockets has a maximum limit of eight.

## Modbus RTU

Modbus is a half-duplex, master-slave communications protocol. The Modbus network master reads and writes bits and registers. Modbus protocol allows a single master to communicate with a maximum of 247 slave devices. Micro800 controllers support Modbus RTU Master and Modbus RTU Slave protocol. For more information on configuring your Micro800 controller for Modbus protocol, refer to the Connected Components Workbench Online Help. For more information about the Modbus protocol, refer to the Modbus Protocol Specifications (available from <http://www.modbus.org>).

See [Modbus Mapping for Micro800 on page 241](#) for information on Modbus mapping. To configure the Serial port as Modbus RTU, see [Configure Modbus RTU on page 67](#).

**TIP** Use MSG\_MODBUS instruction to send Modbus messages over serial port.

## CIP Serial Client/Server (RS-232 only)

CIP Serial Client/Server allows CIP protocol to be used over an RS-232 serial port. It is typically used with modems. The advantage over non-CIP serial protocols is that since the protocol is CIP, program downloads are supported including CIP pass-through from the serial port to Ethernet.

## ASCII

ASCII provides connection to other ASCII devices, such as bar code readers, weigh scales, serial printers, and other intelligent devices. You can use ASCII by configuring the embedded or any plug-in serial RS232/RS485 port for the ASCII driver. Refer to the Connected Components Workbench Online Help for more information.

To configure the serial port for ASCII, see [Configure ASCII on page 68](#).

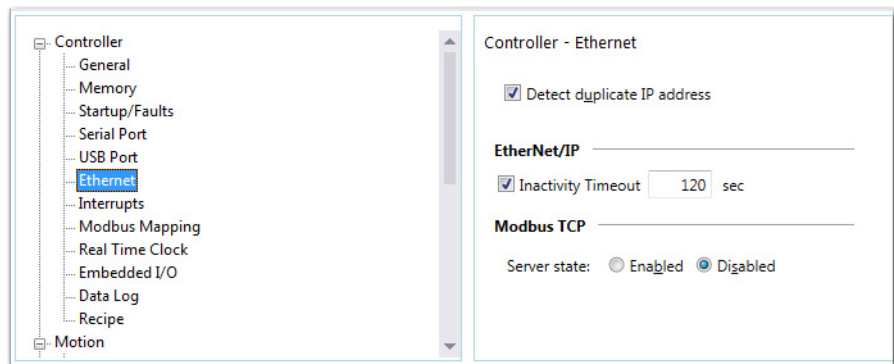
## Modbus TCP Client/Server

The Modbus TCP Client/Server communication protocol uses the same Modbus mapping features as Modbus RTU, but instead of the Serial port, it is supported over Ethernet. Modbus TCP Server takes on Modbus Slave features on Ethernet.

No protocol configuration is required other than configuring the Modbus mapping table. For information on Modbus mapping, see [Modbus Mapping for Micro800 on page 241](#).

**TIP** Use MSG\_MODBUS2 instruction to send Modbus TCP message over Ethernet port.

With Connected Components Workbench software version 12 or later, the Modbus TCP Server is disabled by default. If you want to use Modbus TCP, you can enable it from the Ethernet settings.



## CIP Symbolic Client/Server

CIP Symbolic is supported by any CIP compliant interface including Ethernet (EtherNet/IP) and Serial Port (CIP Serial). This protocol allows HMIs to easily connect to the Micro830/Micro850/Micro870 controller.

Micro850 and Micro870 controllers support up to 16 simultaneous EtherNet/IP Client connections and 23 simultaneous EtherNet/IP Server connections.

CIP Serial, supported on Micro830, Micro850, and Micro870 controllers, makes use of DF1 Full Duplex protocol, which provides point-to-point connection between two devices.

The Micro800 controllers support the protocol through RS-232 connection to external devices, such as computers running RSLinx® Classic software, PanelView Component terminals (firmware revisions 1.70 and above), PanelView 800 terminals or other controllers that support CIP Serial over DF1 Full-Duplex, such as ControlLogix® and CompactLogix™ controllers that have embedded serial ports.

EtherNet/IP, supported on the Micro850 and Micro870 controller, makes use of the standard Ethernet TCP/IP protocol.

The Micro850 and Micro870 controller supports up to 23 simultaneous EtherNet/IP Server connections.

To configure CIP Serial, see [Configure CIP Serial Driver on page 65](#).

To configure for EtherNet/IP, see [Configure Ethernet Settings on page 70](#).

### *CIP Symbolic Addressing*

Users may access any global variables through CIP Symbolic addressing except for system and reserved variables.

One- or two-dimension arrays for simple data types are supported (for example, ARRAY OF INT[1..10, 1..10]) are supported but arrays of arrays (for example, ARRAY OF ARRAY) are not supported. Array of strings are also supported.

### **Supported Data Types in CIP Symbolic**

<b>Data Type<sup>(1)</sup></b>	<b>Description</b>
BOOL	Logical Boolean with values TRUE(1) and FALSE(0) (Uses up 8 bits of memory)
SINT	Signed 8-bit integer value
INT	Signed 16-bit integer value
DINT	Signed 32-bit integer value
LINT <sup>(2)</sup>	Signed 64-bit integer value
USINT	Unsigned 8-bit integer value
UINT	Unsigned 16-bit integer value
UDINT	Unsigned 32-bit integer value
ULINT <sup>(2)</sup>	Unsigned 64-bit integer value
REAL	32-bit floating point value
LREAL <sup>(2)</sup>	64-bit floating point value
STRING	character string (1 byte per character)
DATE <sup>(3)</sup>	Unsigned 32-bit integer value
TIME <sup>(3)</sup>	Unsigned 32-bit integer value

<sup>(1)</sup> Logix MSG instruction can read/write SINT, INT, DINT, LINT and REAL data types using “CIP Data Table Read” and “CIP Data Table Write” message types. BOOL, USINT, UINT, UDINT, ULINT, LREAL, STRING, SHORT\_STRING, DATE, and TIME data types are not accessible with the Logix MSG instruction.

<sup>(2)</sup> Not supported in PanelView Component or PanelView 800.

<sup>(3)</sup> Can be used by sending data to UDINT, mainly for use with PanelView Plus and PanelView 800 HMI terminals.

## CIP Client Messaging

CIP Generic and CIP Symbolic messages are supported on Micro800 controllers through the Ethernet and serial ports. These client messaging features are enabled by the MSG\_CIPSYMBOLIC and MSG\_CIPGENERIC function blocks.

See Micro800 Programmable Controllers: Getting Started with CIP Client Messaging, publication [2080-QS002](#), for more information and sample quickstart projects to help you use the CIP Client Messaging feature.

## Sockets Client/Server TCP/UDP

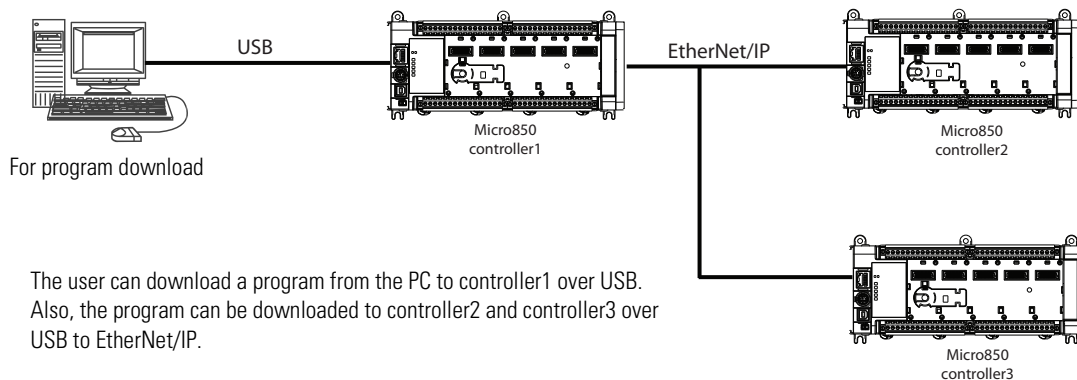
Sockets protocol is used for Ethernet communications to devices which do not support Modbus TCP and Ethernet/IP. Sockets support client and server, and TCP and UDP. Typical applications include communicating to printers, barcode readers, and PCs.

## CIP Communications Pass-thru

The Micro830, Micro850, and Micro870 controllers support pass-thru on any communications port that supports Common Industrial Protocol (CIP) for applications such as program download. It does not support applications that require dedicated connections such as HMI. Micro830, Micro850, and Micro870 controllers support a maximum of one hop. A hop is defined to be an intermediate connection or communications link between two devices – in Micro800, this is through EtherNet/IP or CIP Serial or CIP USB.

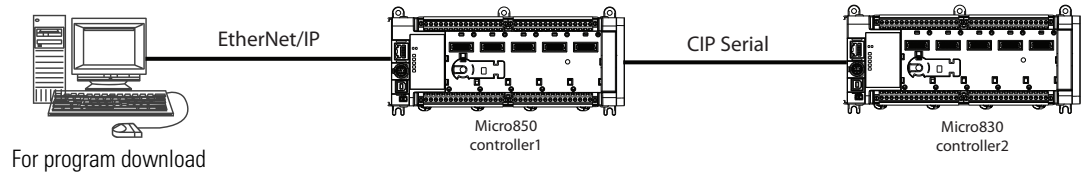
## Examples of Supported Architectures

### USB to EtherNet/IP

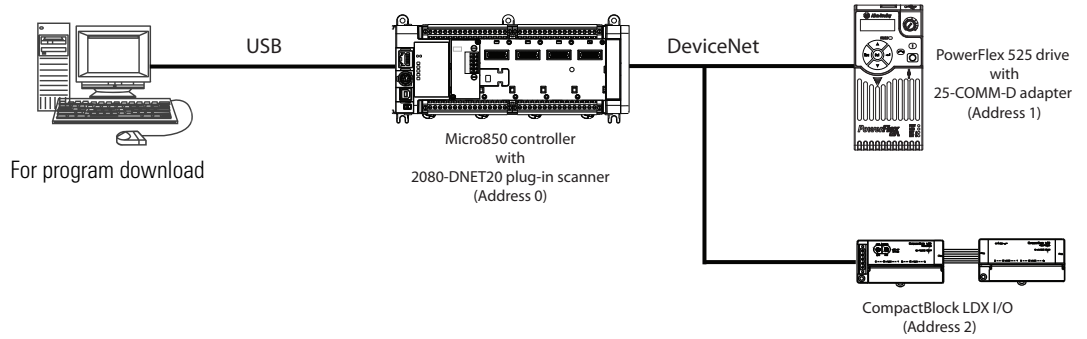




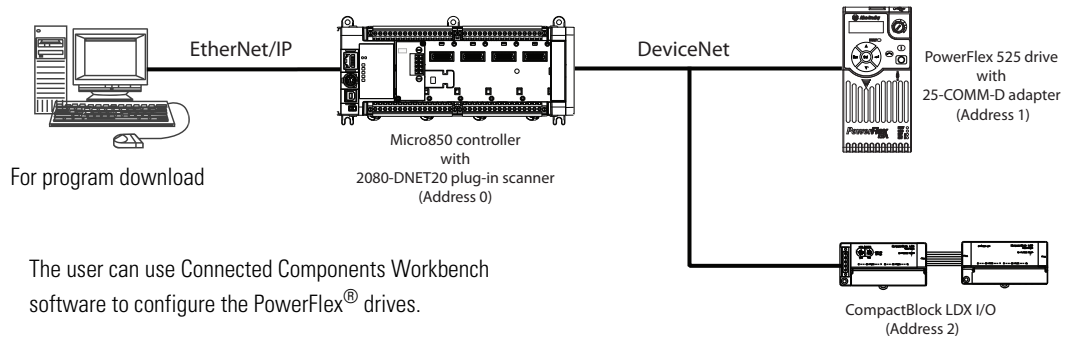
*EtherNet/IP to CIP Serial*



*USB to DeviceNet*



*EtherNet/IP to DeviceNet*




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**IMPORTANT** Micro800 controllers do not support more than one hop (for example, from EtherNet/IP → CIP Serial → EtherNet/IP).

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## Use Modems with Micro800 Controllers

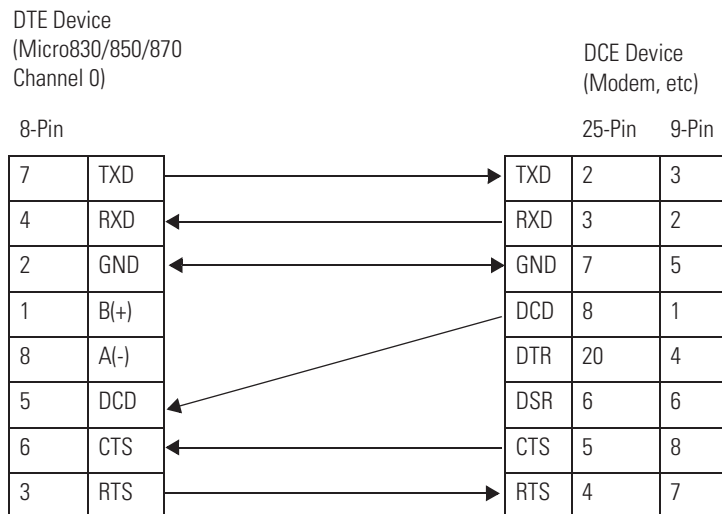
Serial modems can be used with the Micro830, Micro850, and Micro870 controllers.

### Making a DF1 Point-to-Point Connection

You can connect the Micro830, Micro850, and Micro870 programmable controller to your serial modem using an Allen-Bradley null modem serial cable (1761-CBL-PM02) to the controller's embedded serial port together with a 9-pin null modem adapter – a null modem with a null modem adapter is equivalent to a modem cable. The recommended protocol for this configuration is CIP Serial.

### Construct Your Own Modem Cable

If you construct your own modem cable, the maximum cable length is 15.24 m (50 ft) with a 25-pin or 9-pin connector. Refer to the following typical pinout for constructing a straight-through cable:

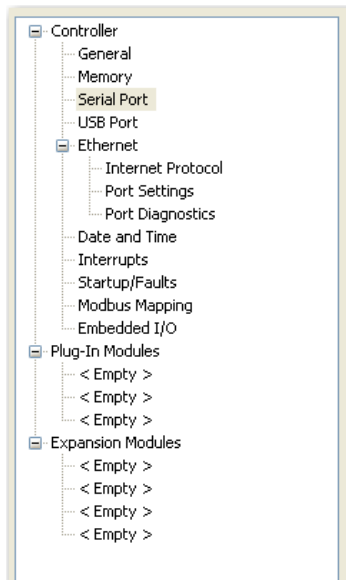


## Configure Serial Port

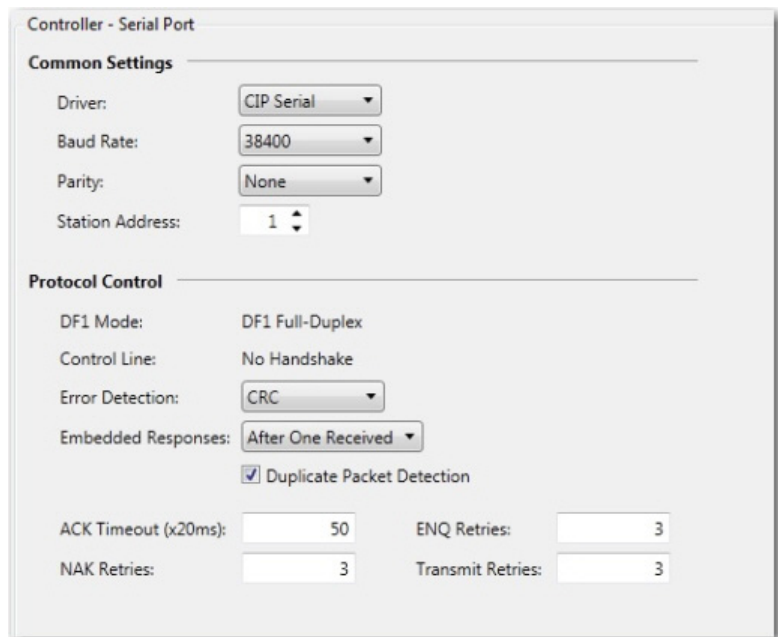
You can configure the Serial Port driver as CIP Serial, Modbus RTU, ASCII or Shutdown through the Device Configuration tree in Connected Components Workbench.

### Configure CIP Serial Driver

1. Open your Connected Components Workbench project. On the device configuration tree, go to the Controller properties. Click Serial Port.



2. Select CIP Serial from the Driver field.



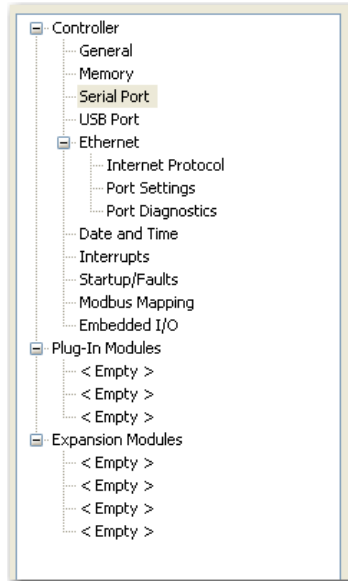
3. Specify a baud rate. Select a communication rate that all devices in your system support. Configure all devices in the system for the same communication rate. Default baud rate is set at 38400 bps.
4. In most cases, parity and station address should be left at default settings.
5. Click Advanced Settings and set Advanced parameters.  
Refer to the table [CIP Serial Driver Parameters on page 66](#) for a description of the CIP Serial parameters.

**CIP Serial Driver Parameters**

Parameter	Options	Default
Baud rate	Toggles between the communication rate of 1200, 2400, 4800, 9600, 19200, and 38400.	38400
Parity	Specifies the parity setting for the serial port. Parity provides additional message-packet error detection. Select Even, Odd, or None.	None
Station Address	The station address for the serial port on the DF1 master. The only valid address is 1.	1
DF1 Mode	DF1 Full Duplex (read only)	Configured as full-duplex by default.
Control Line	No Handshake (read only)	Configured as no handshake by default.
Duplicate Packet Detection	Detects and eliminates duplicate responses to a message. Duplicate packets may be sent under noisy communication conditions when the sender's retries are not set to 0. Toggles between Enabled and Disabled.	Enabled
Error Detection	Toggles between CRC and BCC.	CRC
Embedded Responses	To use embedded responses, choose Enabled Unconditionally. If you want the controller to use embedded responses only when it detects embedded responses from another device, choose After One Received.  If you are communicating with another Allen-Bradley device, choose Enabled Unconditionally. Embedded responses increase network traffic efficiency.	After One Received
NAK Retries	The number of times the controller will resend a message packet because the processor received a NAK response to the previous message packet transmission.	3
ENQ Retries	The number of enquiries (ENQs) that you want the controller to send after an ACK timeout occurs.	3
Transmit Retries	Specifies the number of times a message is retried after the first attempt before being declared undeliverable. Enter a value from 0...127.	3
ACK Timeout (x20 ms)	Specifies the amount of time after a packet is transmitted that an ACK is expected.	50

## Configure Modbus RTU

1. Open your Connected Components Workbench project. On the device configuration tree, go to the Controller properties. Click Serial Port.



2. Select Modbus RTU on the Driver field.

The image shows the 'Controller - Serial Port' configuration window. The 'Driver' field is set to 'Modbus RTU'. The 'Baud Rate' is set to '19200', 'Parity' is 'None', and 'Modbus Role' is 'Modbus RTU Master'. The 'Advanced Settings' section is expanded, showing the 'Protocol Control' settings:

Media:	RS232	RTS Pre-Delay:	0
Data Bits:	8	RTS Post-Delay:	0
Stop Bits:	1		
Response Timer:	200		
Broadcast Pause:	200		
Inter-Char Timeout:	0		

3. Specify the following parameters:

- Baud rate
- Parity
- Unit address
- Modbus Role (Master, Slave, Auto)

**Modbus RTU Parameters**

Parameter	Options	Default
Baud Rate	1200, 2400, 4800, 9600, 19200, 38400	19200
Parity	None, Odd, Even	None
Modbus Role	Master, Slave, Auto	Master

4. Click Advanced Settings to set advanced parameters. Refer to the table for available options and default configuration for advanced parameters.

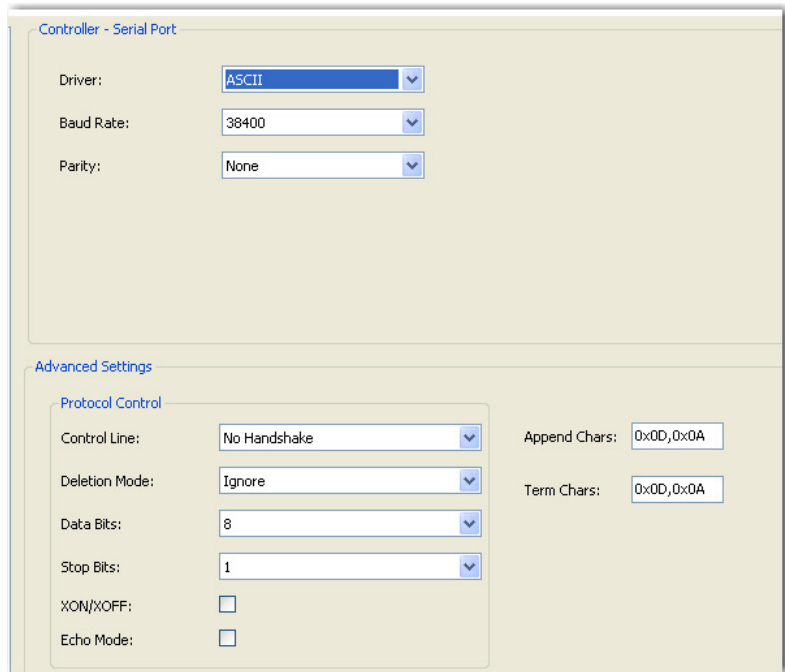
**Modbus RTU Advanced Parameters**

Parameter	Options	Default
Media	RS-232, RS-232 RTS/CTS, RS-485	RS-232
Data bits	Always 8	8
Stop bits	1, 2	1
Response timer	0...999,999,999 milliseconds	200
Broadcast Pause	0...999,999,999 milliseconds	200
Inter-char timeout	0...999,999,999 microseconds	0
RTS Pre-delay	0...999,999,999 microseconds	0
RTS Post-delay	0...999,999,999 microseconds	0

**Configure ASCII**

1. Open your Connected Components Workbench project. On the device configuration tree, go to Controller properties. Click Serial Port.

2. Select ASCII on the Driver field.



3. Specify baud rate and parity.

### ASCII Parameters

Parameter	Options	Default
Baud Rate	1200, 2400, 4800, 9600, 19200, 38400	19200
Parity	None, Odd, Even	None

4. Click Advanced Settings to configure advanced parameters.

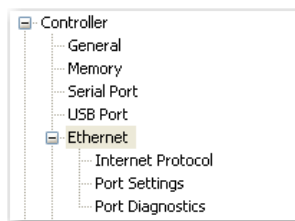


### ASCII Advanced Parameters

Parameter	Options	Default
Control Line	Full Duplex Half-duplex with continuous carrier Half-duplex without continuous carrier No Handshake	No Handshake
Deletion Mode	CRT Ignore Printer	Ignore
Data bits	7, 8	8
Stop bits	1, 2	1
XON/XOFF	Enabled or Disabled	Disabled
Echo Mode	Enabled or Disabled	Disabled
Append Chars	0x0D,0x0A or user-specified value	0x0D,0x0A
Term Chars	0x0D,0x0A or user-specified value	0x0D,0x0A

## Configure Ethernet Settings

1. Open your Connected Components Workbench project (for example, Micro850). On the device configuration tree, go to Controller properties. Click Ethernet.





- Under Ethernet, click Internet Protocol.  
Configure Internet Protocol (IP) settings. Specify whether to obtain the IP address automatically using DHCP or manually configure IP address, subnet mask, and gateway address.

- TIP** The Ethernet port defaults to the following out-of-the box settings:
- DHCP (dynamic IP address)
  - Address Duplicate Detection: On

---

**IMPORTANT** When a DHCP server fails, the Micro800 controller allocates IP addresses in the private range 169.254.0.1 to 169.254.255.254. The Micro800 controller verifies its address is unique on the network using ARP. When the DHCP server is again able to service requests, the Micro800 controller updates its address automatically.

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- Click the checkbox Detect duplicate IP address to enable detection of duplicate address.
- Under Ethernet, click Port Settings.

- Set Port State as Enabled or Disabled.
- To manually set connection speed and duplexity, uncheck the option box Auto-Negotiate speed and duplexity. Then, set Speed (10 or 100 Mbps) and Duplexity (Half or Full) values.
- Click Save Settings to Controller if you would like to save the settings to your controller.

8. On the device configuration tree, under Ethernet, click Port Diagnostics to monitor Interface and Media counters. The counters are available and updated when the controller is in Debug mode.

## Validate IP Address

Modules must validate the incoming IP address configuration, whether it is obtained through explicit configuration or through DHCP.

The following rules must be obeyed when configuring the IP address:

- The IP address for the module cannot be set to zero, a multicast address, a broadcast address, or an address on the Class A loopback network (127.x.x.x).
- The IP address should not start with zero, and the IP address network ID should be not zero.
- The Network mask cannot be set to 255.255.255.255.
- The Gateway address must be on the same subnet as the IP address that is being configured.
- The Name Server address cannot be set to zero, a multicast address, a broadcast address, or an address on the Class A loopback network (127.x.x.x).

The valid range of static IPv4 IP address exclude:

- Broadcast or zero IP (255.255.255.255 or 0.0.0.0)
- IP address starting with 0 or 127 (0.xxx.xxx.xxx or 127.xxx.xxx.xxx)
- IP address ending with 0 or 255 (xxx.xxx.xxx.0 or xxx.xxx.xxx.255)
- IP addresses in range 169.254.xxx.xxx (169.254.0.0 to 169.254.255.255)
- IP addresses in range 224.0.0.0 to 255.255.255.255

## Ethernet Host Name

Micro800 controllers implement unique host names for each controller, to be used to identify the controller on the network. The default host name is comprised of two parts: product type and MAC address, separated by a hyphen. For example: 2080LC50-xxxxxxxxxxxx, where xxxxxxxxxxxx is the MAC address.

The user can change the host name using the CIP Service Set Attribute Single when the controller is in Program/Remote Program mode.

## Configure CIP Serial Driver

1. Open your Connected Components Workbench project. On the device configuration tree, go to the Controller properties. Click Serial port.
2. Select CIP Serial from the Driver field.
3. Specify a baud rate. Select a communication rate that all devices in your system support. Configure all devices in the system for the same communication rate. Default baud rate is set @ 38400 bps.
4. In most cases, parity and station address should be left at default settings.
5. Click Advanced Settings and set Advanced parameters.

## OPC Support Using RSLinx Enterprise

Support for Open Platform Communications (OPC) using CIP symbolic has been added from firmware release 7.0 onwards. This can be used in place of Modbus addressing.

RSLinx Enterprise version 5.70 (CPR9 SR7) or later and FactoryTalk Gateway version 3.70 (CPR9 SR7) or later are required.

**Notes:**

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## Program Execution in Micro800

This section provides a brief overview of running or executing programs with a Micro800 controller.

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**IMPORTANT** This section generally describes program execution in Micro800 controllers. Certain elements may not be applicable or true for certain models (for example, Micro820 does not support PTO motion control).

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For detailed information regarding ladder diagrams, instructions, function blocks and so on, see the Micro800 Programmable Controllers Instruction Manual, publication [2080-RM001](#).

### Overview of Program Execution

A Micro800 cycle or scan consists of reading inputs, executing programs in sequential order, updating outputs and performing housekeeping (data log, recipe, communications).

Program names must begin with a letter or underscore, followed by up to 127 letters, digits or single underscores. Use programming languages such as ladder logic, function block diagrams and structured text.

Up to 256 programs may be included in a project, depending on available controller memory. By default, the programs are cyclic (executed once per cycle or scan). As each new program is added to a project, it is assigned the next consecutive order number. When you start up the Project Organizer in Connected Components Workbench, it displays the program icons based on this order. You can view and modify an order number for a program from the program's properties. However, the Project Organizer does not show the new order until the next time the project is opened.

The Micro800 controller supports jumps within a program. Call a subroutine of code within a program by encapsulating that code as a User Defined Function (UDF) or User Defined Function Block (UDFB). A UDF is similar to a traditional subroutine and uses less memory than a UDFB, while a UDFB can have multiple instances. Although a UDFB can be executed within another UDFB, a maximum nesting depth of five is supported. A compilation error occurs if this is exceeded. This also applies to UDFs.

Alternatively, you can assign a program to an available interrupt and have it executed only when the interrupt is triggered. A program assigned to the User Fault Routine runs once just prior to the controller going into Fault mode.

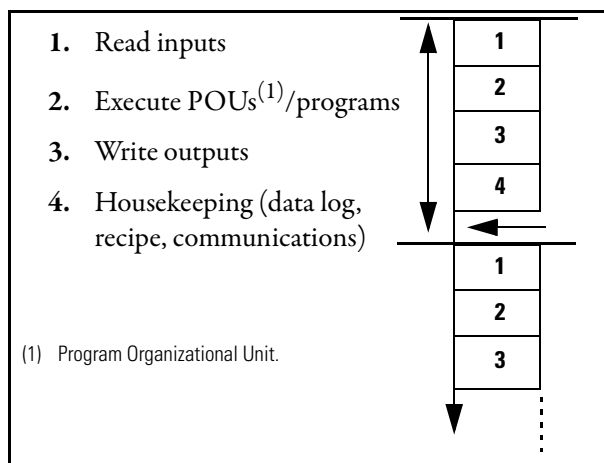
In addition to the User Fault Routine, Micro800 controllers also support two Selectable Timed Interrupts (STI). STIs execute assigned programs once every set point interval (1...65535 ms).

The Global System Variables associated with cycles/scans are:

- `__SYSVA_CYCLECNT` – Cycle counter
- `__SYSVA_TCYCURRENT` – Current cycle time
- `__SYSVA_TCYMAXIMUM` – Maximum cycle time since last start.

### Execution Rules

This section illustrates the execution of a program. The execution follows four main steps within a loop. The loop duration is a cycle time for a program.



When a cycle time is specified, a resource waits until this time has elapsed before starting the execution of a new cycle. The POU's execution time varies depending on the number of active instructions. When a cycle exceeds the specified time, the loop continues to execute the cycle but sets an overrun flag. In such a case, the application no longer runs in real time.

When a cycle time is not specified, a resource performs all steps in the loop then restarts a new cycle without waiting.

### Optional Module

Normally before the read inputs step, the controller will verify the presence of any configured plug-in and expansion I/O modules. If a plug-in or expansion I/O module is missing, the controller will fault. In Connected Components Workbench software release 10 or later, an Optional Module configuration option is added to prevent a missing plug-in I/O or expansion I/O module from faulting the controller if enabled. This option can be enabled separately for each plug-in I/O or expansion I/O module.



**ATTENTION:** If the optional module feature is enabled, use the MODULE\_INFO instruction to verify that the module is present because the controller will not fault if the module is missing.

## Controller Load and Performance Considerations

Within one program scan cycle, the execution of the main steps (as indicated in the Execution Rules diagram) could be interrupted by other controller activities which have higher priority than the main steps. Such activities include,

1. User Interrupt events, including STI, EII, and HSC interrupts (when applicable);
2. Communication data packet receiving and transmitting;
3. PTO Motion engine periodical execution (if supported by the controller).

When one or several of these activities occupy a significant percentage of the Micro800 controller execution time, the program scan cycle time will be prolonged. The Watchdog timeout fault (0xD011) could be reported if the impact of these activities is underestimated, and the Watchdog timeout is set marginally. The Watchdog setting defaults to 2 s and generally never needs to be changed.

## Periodic Execution of Programs

For applications where periodic execution of programs with precise timing is required, such as for PID, it is recommended that STI (Selectable Timed Interrupt) be used to execute the program. STI provides precise time intervals.

It is not recommended that the system variable `__SYSVA_TCYCYCTIME` be used to periodically execute all programs as this also causes all communication to execute at this rate.



**WARNING:** Communication timeouts may occur if programmed cycle time is set too slow (for example, 200 ms) to maintain communications.

### System Variable for Programmed Cycle Time

Variable	Type	Description
<code>__SYSVA_TCYCYCTIME</code>	TIME	Programmed cycle time. <b>Note:</b> Programmed cycle time only accepts values in multiples of 10 ms. If the entered value is not a multiple of 10, it will be rounded up to the next multiple of 10.

## Power Up and First Scan

In Program mode, all analog and digital input variables hold their last state, and the LEDs are always updated. Also all analog and digital output variables hold their last state, but only the analog outputs hold their last state while the digital outputs are off.

When transitioning from Program mode to Run mode, all analog output variables hold their last state but all digital output variables are cleared.

Two system variables are also available from revision 2 and later.

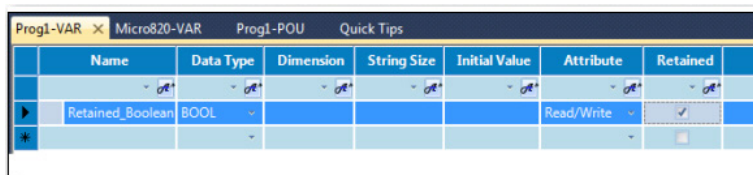
### System Variables for Scan and Powerup on Firmware Release 2 and later

Variable	Type	Description
_SYSVA_FIRST_SCAN	BOOL	First scan bit. Can be used to initialize or reset variables immediately after every transition from Program to Run mode. <b>Note:</b> True only on first scan. After that, it is false.
_SYSVA_POWER_UP_BIT	BOOL	Powerup bit. Can be used to initialize or reset variables immediately after download from Connected Components Workbench or immediately after being loaded from memory backup module (for example, microSD card). <b>Note:</b> True only on the first scan after a powerup, or running a new ladder for the first time.

## Variable Retention

After a power cycle, all variables inside instances of instructions are cleared. Micro830 and Micro850 controllers retain all user-created variables. Micro810® and Micro820 controllers can only retain a maximum of 400 bytes of user-created variable values. Micro870 controllers can only retain a maximum of 128 kilobytes of user-created variable values.

For example: A user-created variable called My\_Timer of Time data type will be retained after a power cycle but the elapsed time (ET) within a user-created timer TON instruction will be cleared. This means that after a power cycle, global variables are cleared or set to initial value, and depending on the controller, some or all user-created variable values are retained. You can choose which variables to retain by selecting them on the global variable page.





## Memory Allocation

Depending on base size, available memory on Micro800 controllers are shown in the table below.

### Memory Allocation for Micro800 Controllers

Attribute	10/16-point (Micro830)	20-point (Micro820)	24- and 48-points (Micro830, Micro850)	24-point (Micro870)
Program steps <sup>(1)</sup>	4 K	10 K	10 K	20 K
Data bytes	8 KB	20 KB	20 KB	40 KB

(1) Estimated Program and Data size are “typical” – program steps and variables are created dynamically.  
1 Program Step = 12 data bytes.

These specifications for instruction and data size are typical numbers. When a project is created for Micro800, memory is dynamically allocated as either program or data memory at build time. This means that program size can exceed the published specifications if data size is sacrificed and vice versa. This flexibility allows maximum usage of execution memory. In addition to the user defined variables, data memory also includes any constants and temporary variables generated by the compiler at build time.

If your project is larger, it affects the power up time. Typical power up time is 10...15 seconds for all controllers. However, if your project has a lot of initial and project values, it may cause the power up time to exceed 30 seconds. After boot up, Ethernet/IP connections may take up to 60 seconds to establish.

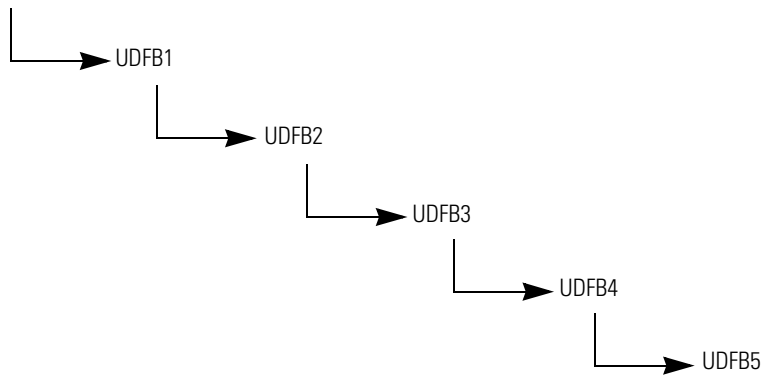
The Micro800 controllers also have project memory, which stores a copy of the entire downloaded project (including comments), as well as configuration memory for storing plug-in setup information, and so on.

## Guidelines and Limitations for Advanced Users

Here are some guidelines and limitations to consider when programming a Micro800 controller using Connected Components Workbench software:

- Each program/POU can use up to 64 Kb of internal address space. For all controllers except Micro870, it is recommended that you split large programs into smaller programs to improve code readability, simplify debugging and maintenance tasks.
- A User Defined Function (UDF) uses significantly less memory than a User Defined Function Block (UDFB). For example, 30% less for a typical sized program compared to a UDFB with one instance. The savings increases as the number of UDFB instances increases.
- A User Defined Function Block (UDFB) can be executed within another UDFB, with a limit of five nested UDFBs. Avoid creating UDFBs with references to other UDFBs, as executing these UDFBs too many times may result in a compile error. This also applies to UDFs.

### Example of Five Nested UDFBs



- Structured Text (ST) is much more efficient and easier to use than Ladder Logic, when used for equations. If you are used to using the RSLogix 500® CPT Compute instruction, a great alternative is to use ST combined with either UDF or UDFB.

As an example, for an Astronomical Clock Calculation, Structured Text uses 40% less Instructions.

Display\_Output LD:

Memory Usage (Code) : 3148 steps

Memory Usage (Data) : 3456 bytes

Display\_Output ST:

Memory Usage (Code) : 1824 steps

Memory Usage (Data) : 3456 bytes

- You may encounter an Insufficient Reserved Memory error while downloading and compiling a program over a certain size. One workaround is to use arrays, especially if there are many variables.

## Motion Control

Generally two types of motion control are used in Micro800 controller motion applications which have Kinetix 3 servo drives.

- Indexed Motion – Micro800 controller issues position indexes to the servo drive using Modbus RTU communications or discrete I/O. Used for simple positioning. See publication [CC-QS025](#) for building block example.
- PTO Motion – Micro800 controller uses pulse and direction outputs to the servo drive for precise control of position and velocity with Modbus RTU communications or discrete I/O for feedback. Micro800 motion configuration and instructions makes programming easy. See publication [CC-QS033](#) for building block example.

### PTO Motion Control

Certain Micro830, Micro850, and Micro870 controllers (see table below) support motion control through high speed pulse-train outputs (PTO). PTO functionality refers to the ability of a controller to accurately generate a specific number of pulses at a specified frequency. These pulses are sent to a motion device, such as a servo drive, which in turn controls the number of rotations (position) of a servo motor. Each PTO is exactly mapped to one axis, to allow for control of simple positioning in stepper motors and servo drives with pulse/direction input.

As the duty cycle of the PTO can be changed dynamically, the PTO can also be used as a pulse width modulation (PWM) output.

PTO/PWM and motion axes support on the Micro830, Micro850, and Micro870 controllers are summarized below.

**PTO/PWM<sup>(1)</sup> and Motion Axis Support on Micro830, Micro850, and Micro870**

Controller	PTO (built-in)	Number of Axes Supported
<b>10/16 Points<sup>(2)</sup></b> 2080-LC30-10QVB 2080-LC30-16QVB	1	1
<b>24 Points</b> 2080-LC30-24QVB <sup>(1)</sup> 2080-LC30-24QBB <sup>(1)</sup> 2080-LC50-24QVB 2080-LC50-24QBB 2080-LC70-24QBB 2080-LC70-24QBBK	2	2
<b>48 Points</b> 2080-LC30-48QVB <sup>(1)</sup> 2080-LC30-48QBB <sup>(1)</sup> 2080-LC50-48QVB 2080-LC50-48QBB	3	3

<sup>(1)</sup> PWM outputs are only supported on firmware revision 6 and later.

<sup>(2)</sup> For Micro830 catalogs, Pulse Train Output functionality is only supported from firmware revision 2 and later.



**ATTENTION:** To use the Micro800 Motion feature effectively, users need to have a basic understanding of the following:

- PTO components and parameters  
See [Use the Micro800 Motion Control Feature on page 83](#) for a general overview of Motion components and their relationships.
- Programming and working with elements in the Connected Components Workbench software  
The user needs to have a working knowledge of ladder diagram, structured text, or function block diagram programming to be able to work with motion function blocks, variables, and axis configuration parameters.



**ATTENTION:** To learn more about Connected Components Workbench and detailed descriptions of the variables for the Motion Function Blocks, you can refer to Connected Components Workbench Online Help that comes with your Connected Components Workbench installation.

**IMPORTANT** The PTO function can only be used with the controller’s embedded I/O. It cannot be used with expansion I/O modules.

## Use the Micro800 Motion Control Feature

The Micro800 motion control feature has the following elements. New users need to have a basic understanding of the function of each element to effectively use the feature.

### Components of Motion Control

Element	Description	Page
Pulse Train Outputs	Consists of one pulse output and one direction output. A standard interface to control a servo or stepper drive.	<ul style="list-style-type: none"> <li>• <a href="#">Input and Output Signals on page 84</a></li> </ul>
Axis	From a system point of view, an axis is a mechanical apparatus that is driven by a motor and drive combination. The drive receives position commands through the Micro800 pulse train outputs interface based upon the PLC execution of motion function blocks. On the Micro800 controller, it is a pulse train output and a set of inputs, outputs, and configuration.	<ul style="list-style-type: none"> <li>• <a href="#">Motion Axis and Parameters on page 97</a></li> <li>• <a href="#">Motion Axis Configuration in Connected Components Workbench on page 109</a></li> </ul>
Motion Function Blocks	A set of instructions that configure or act upon an axis of motion.	<ul style="list-style-type: none"> <li>• Connected Components Workbench Online Help</li> <li>• <a href="#">Motion Control Function Blocks on page 87</a></li> <li>• <a href="#">Axis Ref Data Type on page 104</a></li> <li>• <a href="#">Function Block and Axis Status Error Codes on page 106</a></li> <li>• <a href="#">Homing Function Block on page 122</a></li> </ul>
Jerk	Rate of change of acceleration. The Jerk component is mainly of interest at the start and end of motion. Too high of a Jerk may induce vibrations.	<ul style="list-style-type: none"> <li>• See <a href="#">Acceleration, Deceleration, and Jerk Inputs on page 89</a>.</li> </ul>

To use the Micro800 motion feature, you need to:

1. Configure the Axis Properties  
See [Motion Axis Configuration in Connected Components Workbench on page 109](#) for instructions.
2. Write your motion program through the Connected Components Workbench software  
For instructions on how to use the Micro800 motion control feature, see the quickstart instructions, Use the Motion Control Feature on Micro800 Controllers, publication [2080-QS001](#).
3. Wire the Controller
  - a. refer to [Input and Output Signals on page 84](#) for fixed and configurable inputs/outputs

- b. See [Sample Motion Wiring Configuration on 2080-LC30-xxQVB / 2080-LC50-xxQVB / 2080-LC70-xxQVB on page 86](#) for reference

The next sections provide a more detailed description of the motion components. You can also refer to the Connected Components Workbench Online Help for more information about each motion function block and their variable inputs and outputs.

## Input and Output Signals

Multiple input/output control signals are required for each motion axis, as described in the next tables. PTO Pulse and PTO Direction are required for an axis. The rest of the input/outputs can be disabled and re-used as regular I/O.

### Fixed PTO Input/Output

Motion Signals	PTO0 (EM_00)		PTO1 (EM_01)		PTO2 (EM_02)	
	Logical Name in Software	Name on Terminal Block	Logical Name in Software	Name on Terminal Block	Logical Name in Software	Name on Terminal Block
PTO pulse	_IO_EM_DO_00	O-00	_IO_EM_DO_01	O-01	IO_EM_DO_02	O-02
PTO direction	_IO_EM_DO_03	O-03	_IO_EM_DO_04	O-04	IO_EM_DO_05	O-05
Lower (Negative) Limit switch	_IO_EM_DI_00	I-00	_IO_EM_DI_04	I-04	IO_EM_DI_08	I-08
Upper (Positive) Limit switch	_IO_EM_DI_01	I-01	_IO_EM_DI_05	I-05	IO_EM_DI_09	I-09
Absolute Home switch	_IO_EM_DI_02	I-02	_IO_EM_DI_06	I-06	IO_EM_DI_10	I-10
Touch Probe Input switch	_IO_EM_DI_03	I-03	_IO_EM_DI_07	I-07	IO_EM_DI_11	I-11

### Configurable input/output

Motion Signals	Input/Output	Notes
Servo/Drive On	OUTPUT	Can be configured as any embedded output.
Servo/Drive Ready	INPUT	Can be configured as any embedded input.
In-Position signal (from Servo/motor)	INPUT	Can be configured as any embedded input.
Home Marker	INPUT	Can be configured as any embedded input, from input 0...15.

These I/O can be configured through the axis configuration feature in Connected Components Workbench. Any outputs assigned for motion should not be controlled in the user program.

See [Motion Axis Configuration in Connected Components Workbench on page 109](#).

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**IMPORTANT** If an output is configured for motion, then that output can no longer be controlled or monitored by the user program and cannot be forced. For example, when a PTO Pulse output is generating pulses, the corresponding logical variable IO\_EM\_DO\_xx will not toggle its value and will not display the pulses in the Variable Monitor but the physical LED will give an indication.

If an input is configured for motion, then forcing the input only affects the user program logic and not motion. For example, if the input Drive Ready is false, then the user cannot force Drive Ready to true by forcing the corresponding logical variable IO\_EM\_DI\_xx to be true.

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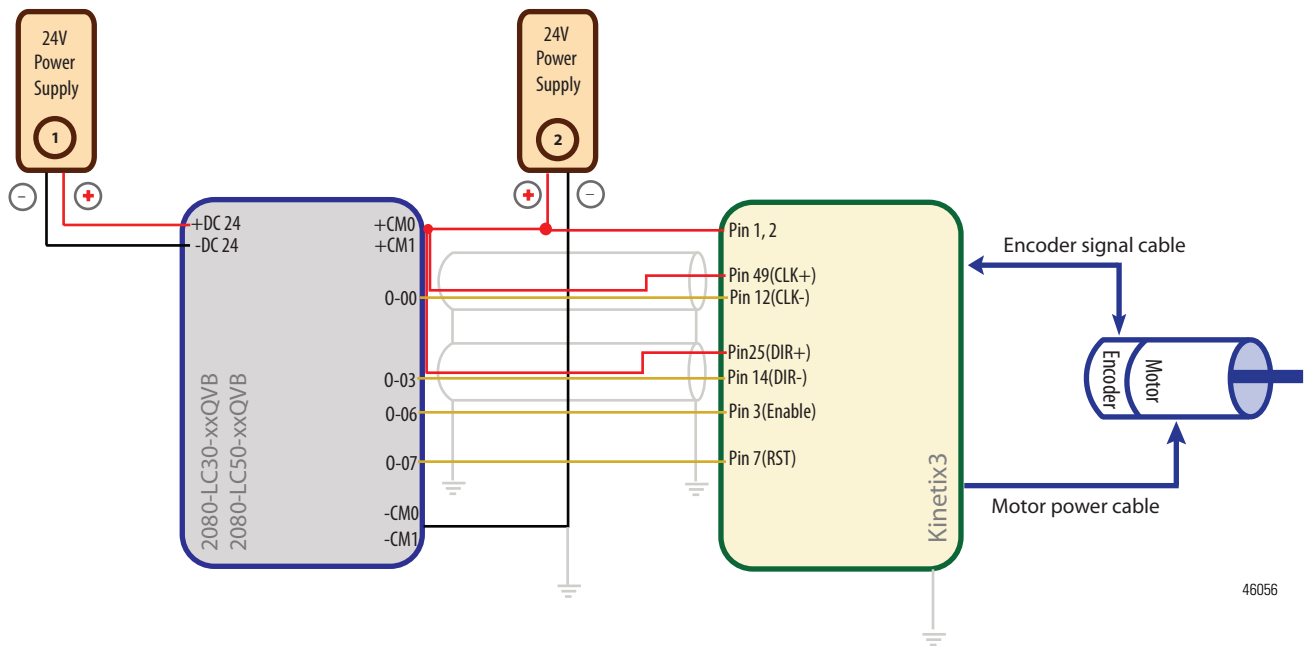
### Motion Wiring Input/Output Description

Motion Signals	Input/Output	Description	Uniqueness
PTO pulse	OUTPUT	PTO pulse from the embedded fast output, to be connected to Drive PTO input.	Not Shared
PTO direction	OUTPUT	PTO pulse direction indication, to be connected to Drive Direction input.	Not Shared
Servo/Drive On	OUTPUT	The control signal used to activate/deactivate Servo/Drive. This signal becomes Active when MC_Power (on) is commanded.	Can be shared with more than one drive
Lower (Negative) Limit switch	INPUT	The input for hardware negative limit switch, to be connected to mechanical/electrical negative limit sensor.	Not Shared
Upper (Positive) Limit switch	INPUT	The input for hardware positive limit switch, to be connected to mechanical/electrical positive limit sensor.	Not Shared
Absolute Home switch	INPUT	The input for hardware home switch (sensor), to be connected to mechanical/electrical home sensor.	Not Shared
Touch Probe Input switch	INPUT	The input for hardware touch probe signal, to be used with Motion MC_TouchProbe and MC_AbortTrigger function blocks to capture axis commanded position during the motion path.	Not Shared

### Motion Wiring Input/Output Description

Motion Signals	Input/Output	Description	Uniqueness
Servo/Drive Ready	INPUT	The input signal that indicates Servo/Drive is ready to receive PTO pulse and direction signal from controller. No moving function blocks can be issued to an axis before the axis has this signal ready if this signal is Enabled in the motion axis configuration or axis properties page.	Can be shared with more than one drive
In-Position signal (from Servo/motor)	INPUT	The input signal that indicates the moving part is in the commanded position. This signal has to be Active after the moving part reaches the commanded position for MoveAbsolute and MoveRelative function blocks. For MoveAbsolute and MoveRelative function blocks, when In_Position is enabled, the controller will report an error (EP_MC_MECHAN_ERR) if the signal is not active within five seconds when the last PTO pulse sent out.	Not Shared
Home Marker	INPUT	This signal is the zero pulse signal from the motor encoder. This signal can be used for fine homing sequence to improve the homing accuracy.	Not Shared

### Sample Motion Wiring Configuration on 2080-LC30-xxQVB / 2080-LC50-xxQVB / 2080-LC70-xxQVB



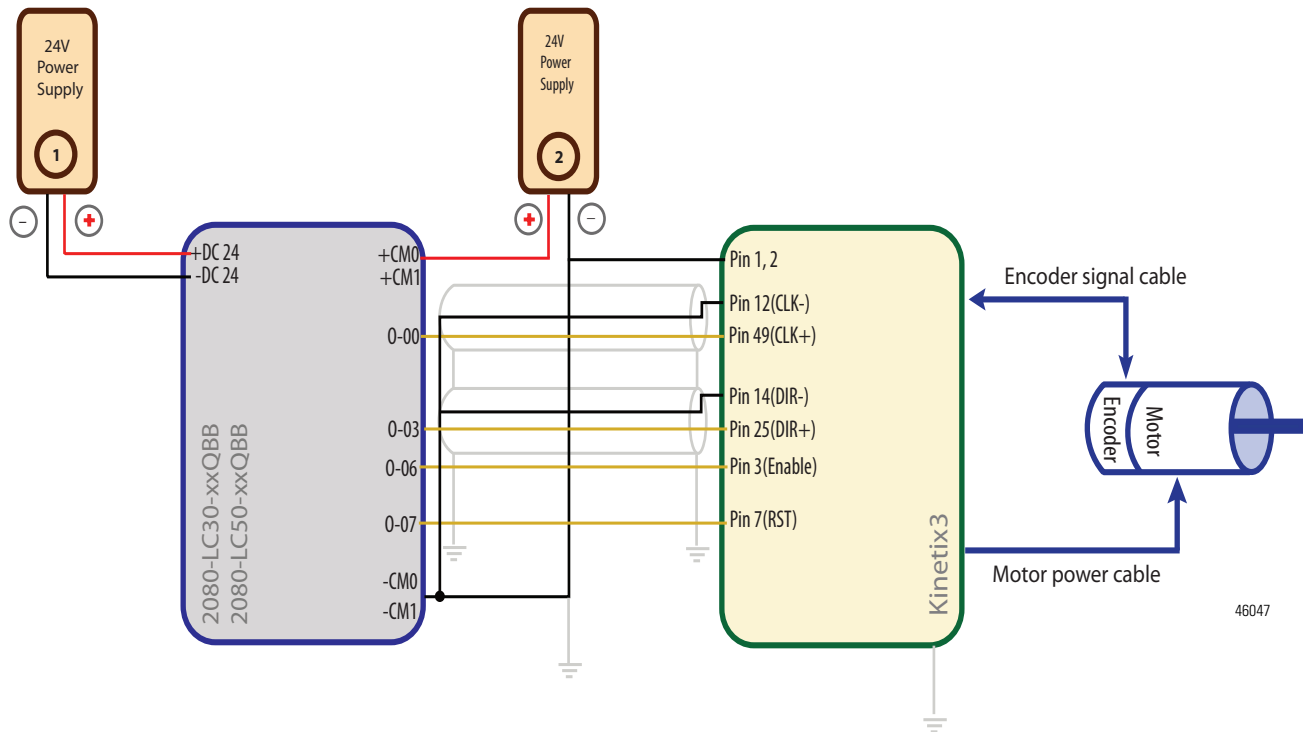
**Notes:**

- (1) Drive Enable (Pin 3) and Reset Drive (Pin 7) will be operating as sourcing inputs when (Pin1,2) connected to ⊖ of the Power Supply 2.
- (2) To help you configure Kinetix3 drive parameters so the drive can communicate and be controlled by a Micro830/Micro850/Micro870 controller, see publication [CC-0S033](#). The parameter Command Type must be set to "Step/Direction.Positive Logic", and the parameter Controller Output Type must be set to "Open Collector Input".

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**Sample Motion Wiring Configuration on 2080-LC30-xxQBB / 2080-LC50-xxQBB / 2080-LC70-xxQBB**



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**Notes:**

- (1) Drive Enable (Pin 3) and Reset Drive (Pin 7) will be operating as sinking inputs when (Pin 1,2) connected to + of the Power Supply 2.
- (2) To help you configure Kinetix3 drive parameters so the drive can communicate and be controlled by a Micro830/Micro850/Micro870 controller, see publication [CC-0S033](#). The parameter Command Type must be set to "Step/Direction.Positive Logic", and the parameter Controller Output Type must be set to "Open Collector Input".

## Motion Control Function Blocks

Motion control function blocks instruct an axis to a specified position, distance, velocity, and state.

Function Blocks are categorized as Movement (driving motion) and Administrative.

### Administrative Function Blocks

Function Block Name	Function Block Name
MC_Power	MC_ReadAxisError
MC_Reset	MC_ReadParameter
MC_TouchProbe	MC_ReadBoolParameter
MC_AbortTrigger	MC_WriteParameter
MC_ReadStatus	MC_WriteBoolParameter
MC_SetPosition	



**WARNING:** During Run Mode Change (RMC), the MC\_Power function block should be disabled, which will power down the axis. Otherwise the axis will remain powered even if the function block is deleted.

Take note of the following:

- If a new instance of MC\_Power accesses the axis, the axis will enter the error stop state.
- If MC\_Power is inside a UDFB and any edit is made to the UDFB that changes the UDFB template (for example, adding a local variable), the axis will enter the error stop state.

### Movement Function Blocks

Function Block Name	Description	Correct Axis State for issuing Function Block
MC_MoveAbsolute	This function block commands an axis to a specified absolute position.	Standstill, Discrete Motion, Continuous Motion
MC_MoveRelative	This function block commands an axis of a specified distance relative to the actual position at the time of execution.	Standstill, Discrete Motion, Continuous Motion
MC_MoveVelocity	This function block commands a never ending axis move at a specified velocity.	Standstill, Discrete Motion, Continuous Motion
MC_Home	This function block commands the axis to perform the "search home" sequence. The "Position" input is used to set the absolute position when reference signal is detected, and configured Home offset is reached. This function block completes at "StandStill" if the homing sequence is successful.	Standstill
MC_Stop	This function block commands an axis stop and transfers the axis to the state "Stopping". It aborts any ongoing function block execution. While the axis is in state Stopping, no other function block can perform any motion on the same axis. After the axis has reached velocity zero, the Done output is set to TRUE immediately. The axis remains in the state "Stopping" as long as Execute is still TRUE or velocity zero is not yet reached. As soon as "Done" is SET and "Execute" is FALSE the axis goes to state "StandStill".	Standstill, Discrete Motion, Continuous Motion, Homing
MC_Halt	This function block commands an axis to a controlled motion stop. The axis is moved to the state "DiscreteMotion", until the velocity is zero. With the Done output set, the state is transferred to "StandStill".	Standstill, Discrete Motion, Continuous Motion



**ATTENTION:** During Run Mode Change, the Movement Function Blocks can only be deleted when that Function Block has been done or aborted. Otherwise unintended axis and Function Block behavior may occur.



**ATTENTION:** Each motion function block has a set of variable inputs and outputs that allows you to control a specific motion instruction. Refer to the Connected Components Workbench Online Help for a description of these variable inputs and outputs.

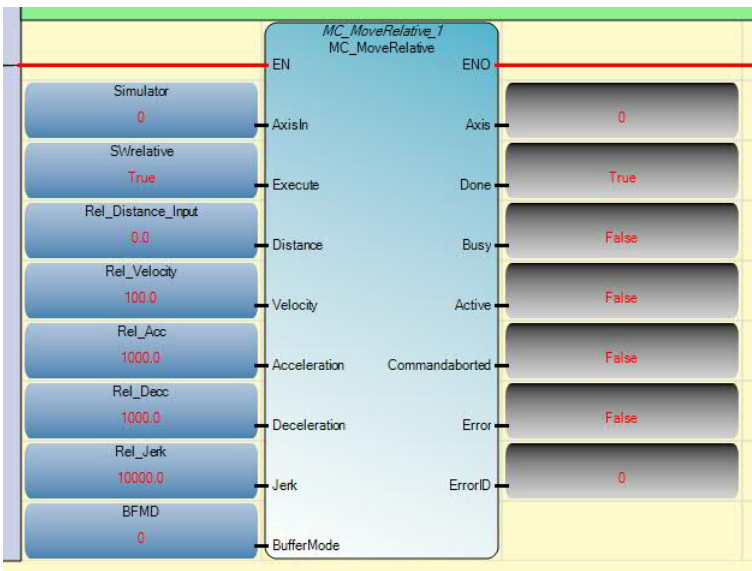
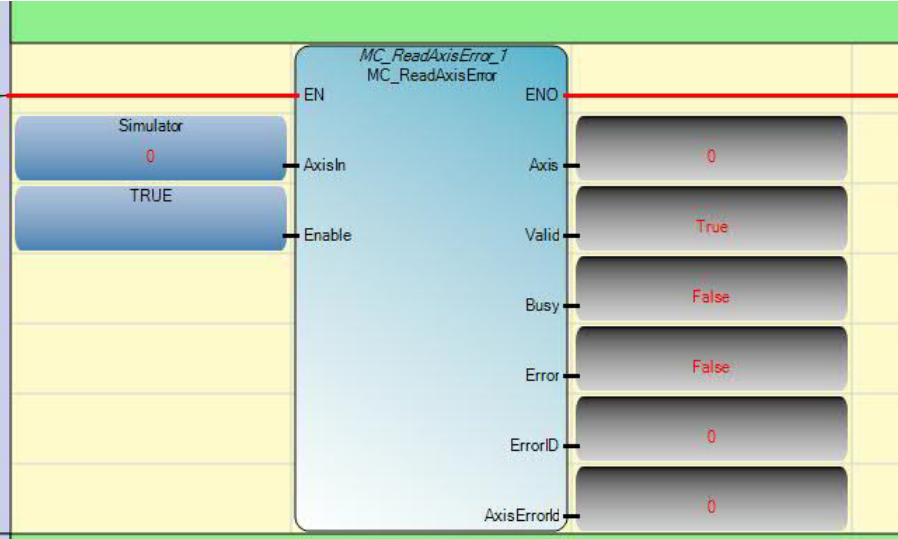
## General Rules for the Motion Control Function Blocks

To work with motion control function blocks, users need to be familiar with the following general rules.

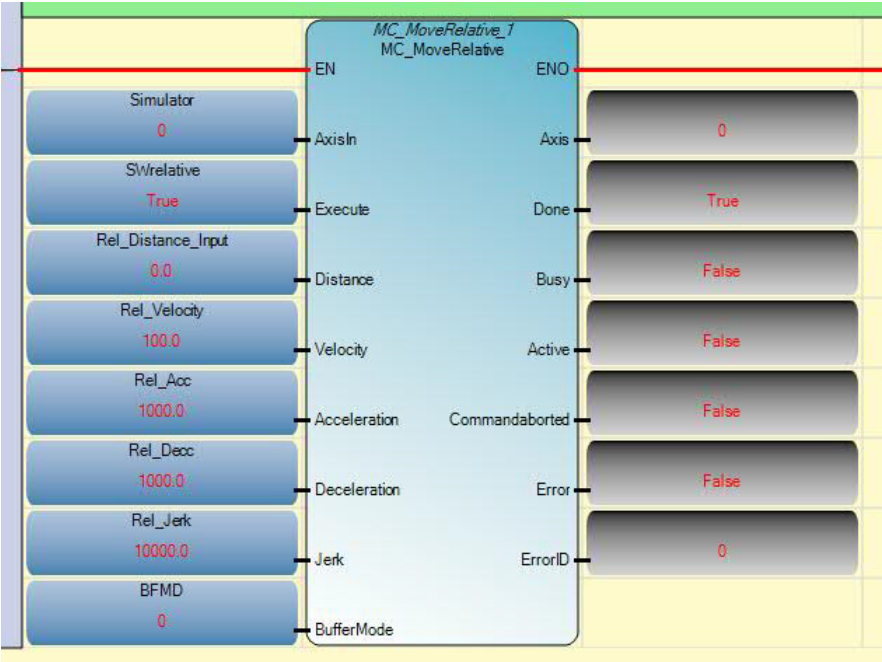
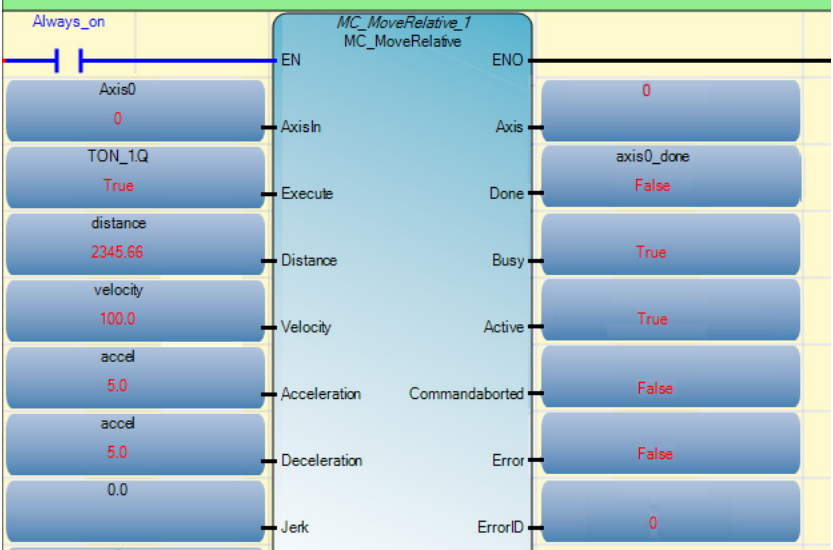
### General Rules for the Motion Function Block

Parameter	General Rules
Input parameters	<p><b>When Execute is True:</b> The parameters are used with the rising edge of the Execute input. To modify any parameter, it is necessary to change the input parameter(s) and to trigger motion again.</p> <p><b>When Enable is True:</b> The parameters are used with the rising edge of the Enable input and can be modified continuously.</p>
Inputs exceeding application limits	If a function block is configured with parameters that result in a violation of application limits, the instance of the function block generates an error. The Error output will be flagged On, and error information will be indicated by the output ErrorID. The controller, in most cases, will remain in Run mode, and no motion error will be reported as a major controller fault.
Position/Distance Input	For MC_MoveAbsolute function block, the position input is the absolute location commanded to the axis. For MC_MoveRelative, the distance input is the relative location (considering current axis position is 0) from current position.
Velocity Input	Velocity can be a signed value. Users are advised to use positive velocity. Direction input for the MC_MoveVelocity function block can be used to define the direction of the move (that is, negative velocity x negative direction = positive velocity). For MC_MoveRelative and MC_MoveAbsolute function blocks the absolute value of the velocity is used. Velocity input does not need to be reached if Jerk input is equal to 0.
Direction Input	For MC_MoveAbsolute, direction input is ignored. (This is reserved for future use.) For MC_MoveVelocity, direction input value can be 1 (positive direction), 0 (current direction) or -1 (negative direction). For any other value, only the sign is taken into consideration. For example, -3 denotes negative direction, +2 denotes positive direction, and so on. For MC_MoveVelocity, the resulting sign of the product value derived from $velocity \times direction$ decides the motion direction, if the value is not 0. For example, if $velocity \times direction = +300$ , then direction is positive.
Acceleration, Deceleration, and Jerk Inputs	<ul style="list-style-type: none"> <li>Deceleration or Acceleration inputs should have a positive value. If Deceleration or Acceleration is set to be a non-positive value, an error will be reported (Error ID: MC_FB_ERR_RANGE).</li> <li>The Jerk input should have a non-negative value. If Jerk is set to be a negative value, error will be reported. (Error ID: MC_FB_ERR_RANGE).</li> <li>If maximum Jerk is configured as zero in Connected Components Workbench motion configuration, all jerk parameters for the motion function block has to be configured as zero. Otherwise, the function block reports an error (Error ID: MC_FB_ERR_RANGE).</li> <li>If Jerk is set as a non-zero value, S-Curve profile is generated. If Jerk is set as zero, trapezoidal profile is generated.</li> <li>If the motion engine fails to generate the motion profile prescribed by the dynamic input parameters, the function block reports an error (Error ID: MC_FB_ERR_PROFILE).</li> </ul> <p>See <a href="#">Function Block and Axis Status Error Codes on page 106</a> for more information about error codes.</p>

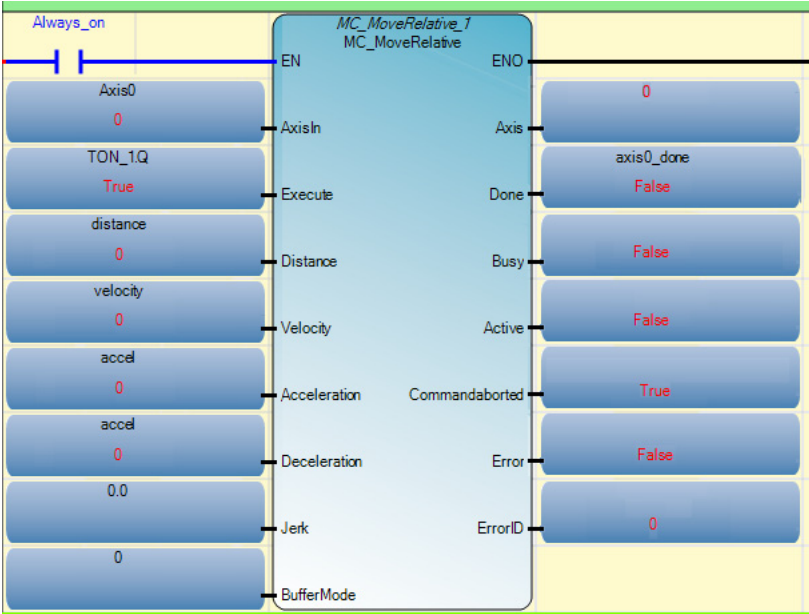
**General Rules for the Motion Function Block**

Parameter	General Rules
Output Exclusivity	<p><b>With Execute:</b> The outputs Busy, Done, Error, and CommandAborted indicate the state of the function block and are mutually exclusive – only one of them can be true on one function block. If execute is true, one of these outputs has to be true.</p> <p>The outputs Done, Busy, Error, ErrorID, and CommandAborted are reset with the falling edge of Execute. However, the falling edge of Execute does not stop or even influence the execution of the actual function block. Even if Execute is reset before the function block completes, the corresponding outputs are set for at least one cycle.</p> <p>If an instance of a function block receives a new Execute command before it completes (as a series of commands on the same instance), the new Execute command is ignored, and the previously issued instruction continues with execution.</p>  <p><b>With Enable:</b> The outputs Valid and Error indicate whether a read function block executes successfully. They are mutually exclusive: only one of them can be true on one function block for MC_ReadBool, MC_ReadParameter, MC_ReadStatus.</p> <p>The Valid, Enabled, Busy, Error, and ErrorID outputs are reset with the falling edge of Enable as soon as possible.</p> 
Axis output	<p>When used in Function Block Diagram, you can connect the axis output parameter to the Axis input parameter of another motion function block for convenience (for example, MC_POWER to MC_HOME).</p> <p>When used in a Ladder Diagram, you cannot assign a variable to the Axis output parameter of another motion function block because it is read-only.</p>

**General Rules for the Motion Function Block**

Parameter	General Rules
Behavior of Done Output	<p>The output Done is set when the commanded action has completed successfully.</p> <p>With multiple function blocks working on the same axis in a sequence, the following rule applies:</p> <p>When one movement on an axis is aborted with another movement on the same axis without having reached the final goal, output Done will not be set on the first function block.</p> 
Behavior of Busy Output	<p>Every function block has a Busy output, indicating that the function block is not yet finished (for function blocks with an Execute input), and new output values are pending (for function blocks with Enable input).</p> <p>Busy is set at the rising edge of Execute and reset when one of the outputs Done, Aborted, or Error is set, or it is set at the rising edge of Enable and reset when one of the outputs Valid or Error is set.</p> <p>It is recommended that the function block continue executing in the program scan for as long as Busy is true, because the outputs will only be updated when the instruction is executing. For example, in ladder diagram, if the rung becomes false before the instruction finishes executing, the Busy output will stay true forever even though the function block has finished executing.</p> 

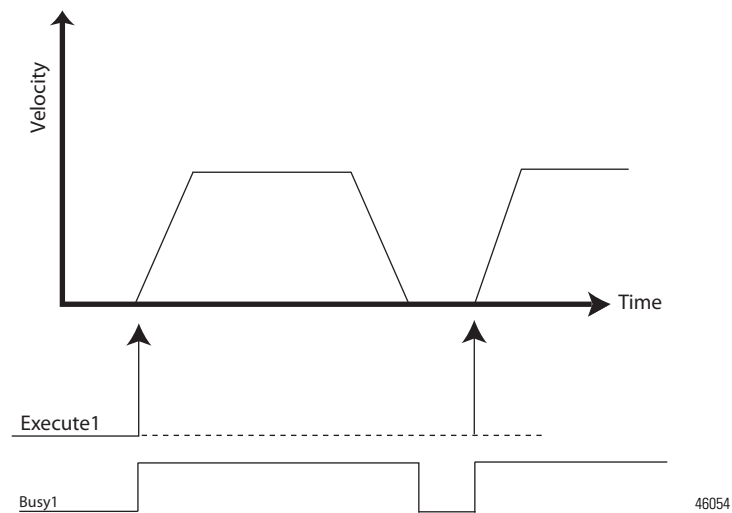
**General Rules for the Motion Function Block**

Parameter	General Rules
Output Active	In current implementation, buffered moves are not supported. Consequently, Busy and Active outputs have the same behavior.
Behavior of CommandAborted Output	<p>CommandAborted is set when a commanded motion is aborted by another motion command. When CommandAborted occurs, other output signals such as InVelocity are reset.</p> 
Enable and Valid Status	<p>The Enable input for read function blocks is level-sensitive. On every program scan with the Enable input as true, the function block will perform a read and update its outputs. The Valid output parameter shows that a valid set of outputs is available.</p> <p>The Valid output is true as long as valid output values are available and the Enable input is true. The relevant output values will be refreshed as long as the input Enable is true.</p> <p>If there is a function block error, and the relevant output values are not valid, then the valid output is set to false. When the error condition no longer exists, the values will be updated and the Valid output will be set again.</p>
Relative Move versus Absolute Move	<p>Relative move does not require the axis to be homed. It simply refers to a move in a specified direction and distance. Absolute move requires that the axis be homed. It is a move to a known position within the coordinate system, regardless of distance and direction. Position can be negative or positive value.</p>
Buffered Mode	<p>For all motion control function blocks, BufferMode input parameter is ignored. Only aborted moves are supported for this release.</p>
Error Handling	<p>All blocks have two outputs which deal with errors that can occur during execution. These outputs are defined as follows:</p> <ul style="list-style-type: none"> <li>• <b>Error</b> – Rising edge of “Error” informs that an error occurred during the execution of the function block, where the function block cannot successfully complete.</li> <li>• <b>ErrorID</b> – Error number.</li> </ul> <p><b>Types of errors:</b></p> <ul style="list-style-type: none"> <li>• Function block logic (such as parameters out of range, state machine violation attempted)</li> <li>• hard limits or soft limits reached</li> <li>• Drive failure (Drive Ready is false)</li> </ul> <p>For more information about function block error, see <a href="#">Motion Function Block and Axis status Error ID on page 107</a>.</p>

### Simultaneous Execution of Two Movement Function Blocks (Busy Output = True)

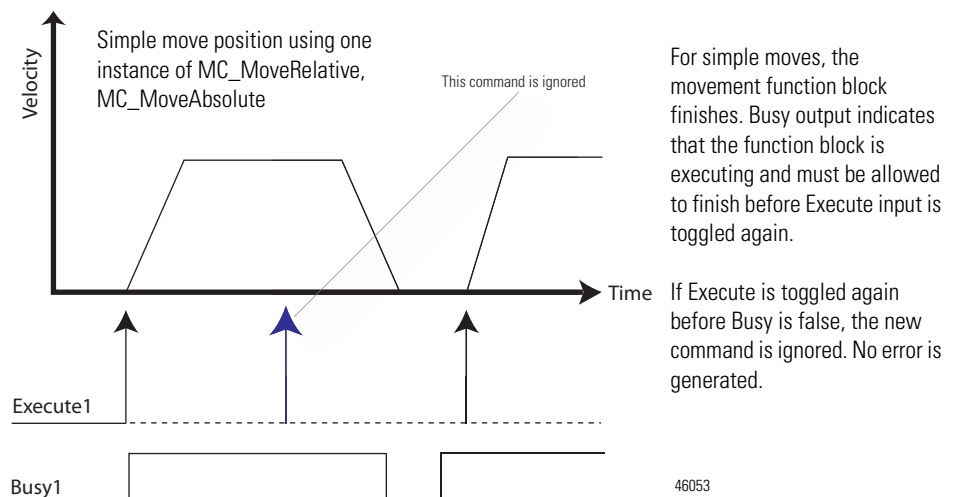
The general rule is that when a movement function block is busy, then a function block **with the same instance** (for example, MC\_MoveRelative2) cannot be executed again until the function block status is not busy.

**TIP** MC\_MoveRelative, MC\_MoveAbsolute will be busy until final position is reached. MC\_MoveVelocity, MC\_Halt, and MC\_Stop will be busy until final velocity is reached.

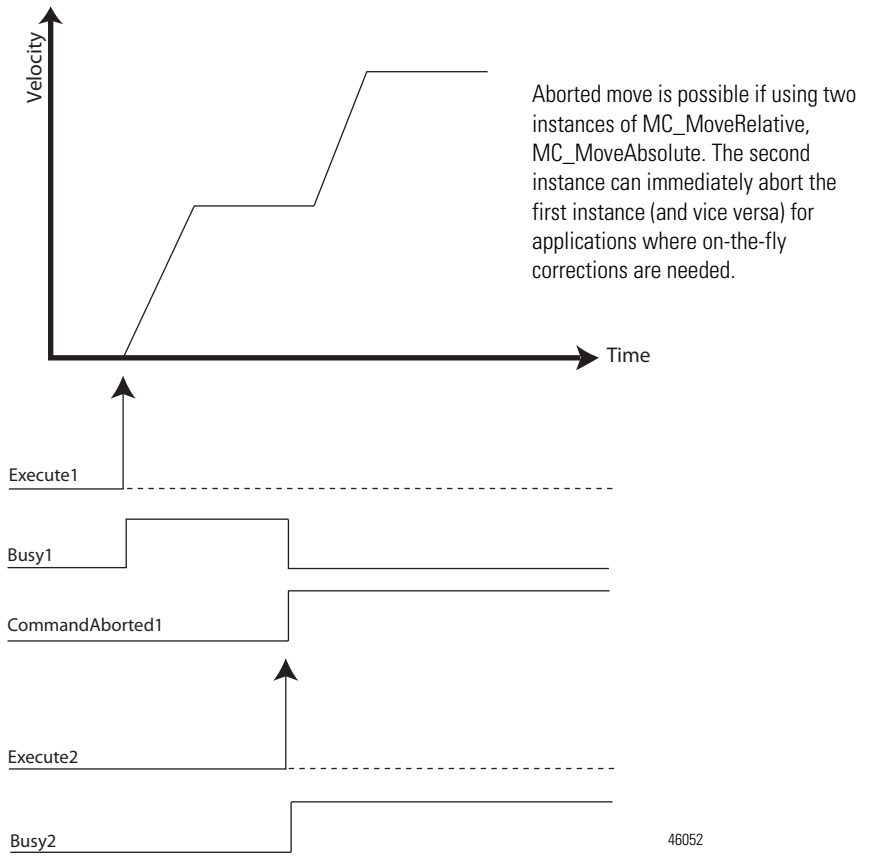


When a movement function block is busy, a function block **with a different instance** (for example, MC\_MoveRelative1 and MC\_MoveAbsolute1 on the same axis) can abort the currently executing function block. This is mostly useful for on-the-fly adjustments to position, velocity, or to halt after a specific distance.

### Example: Move to Position Ignored Due to Busy



*Example: Successful Aborted Move*

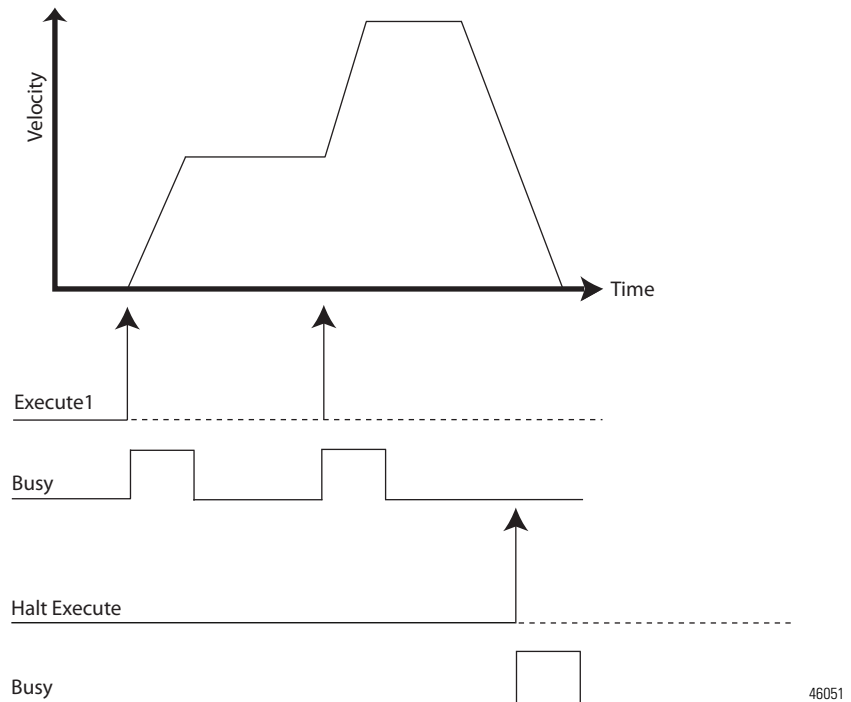


*Example: Changing Velocity With No Abort*

When changing velocity, generally, an aborted move is not necessary since the function block is only Busy during acceleration (or deceleration). Only a single instance of the function block is required.

To bring the axis to a standstill, use MC\_Halt.



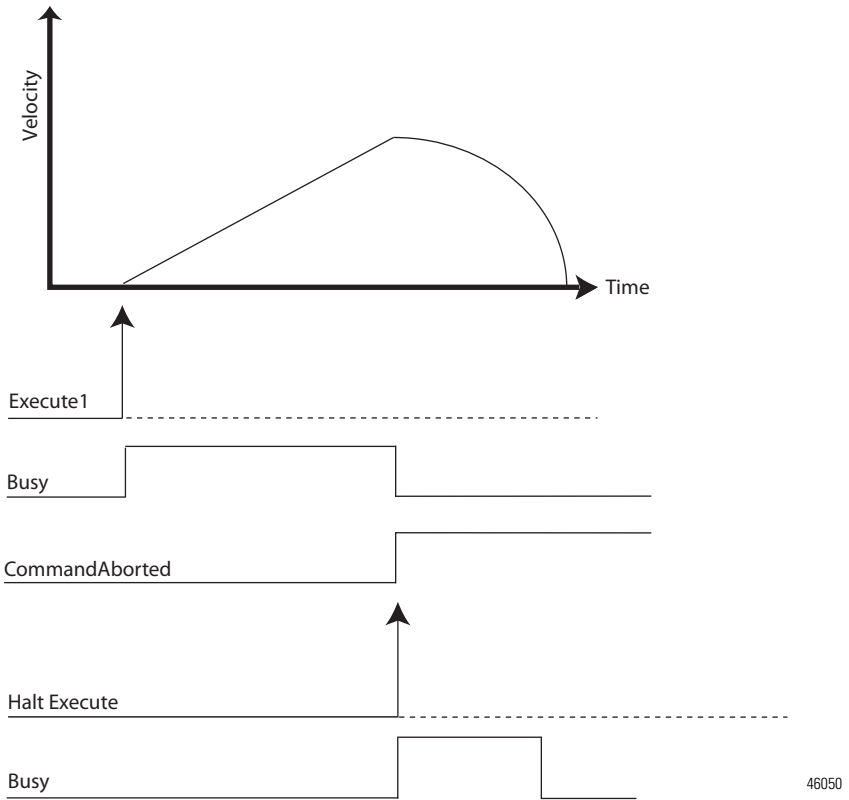


It is possible for the movement function blocks and MC\_Halt to abort another motion function block during acceleration/deceleration. This is not recommended as the resulting motion profile may not be consistent.



**ATTENTION:** If MC\_Halt aborts another motion function block during acceleration and the MC\_Halt Jerk input parameter is less than the Jerk of the currently executing function block, the Jerk of the currently executing function block is used to prevent an excessively long deceleration.

*Example: Aborted Movement Function Block During Acceleration/Deceleration*

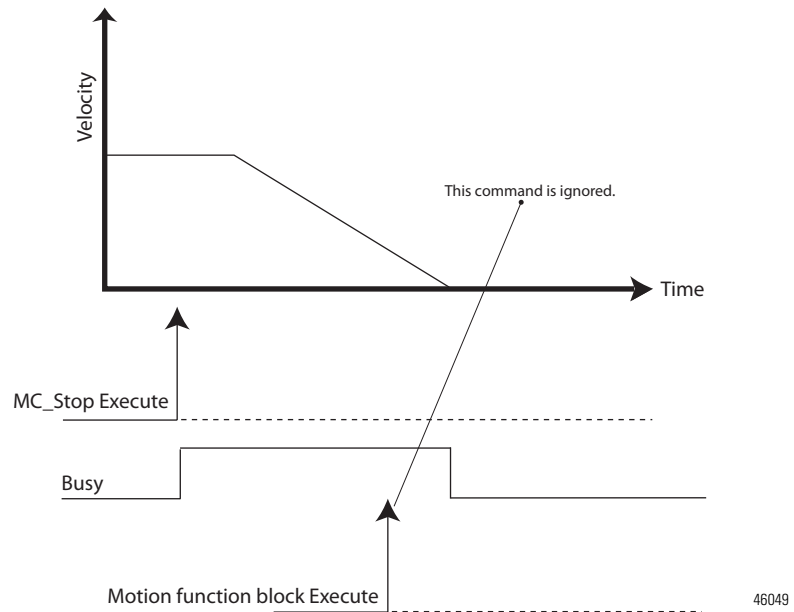



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**IMPORTANT** If MC\_Halt aborts another movement function block during acceleration and the MC\_Halt Jerk input parameter is less than the Jerk of the currently executing FB, the Jerk of the currently executing function block is used to prevent excessively long deceleration.

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*Example: Error Stop using MC\_Stop cannot be Aborted*



MC\_Halt and MC\_Stop are both used to bring an axis to a Standstill but MC\_Stop is used when an abnormal situation occurs.

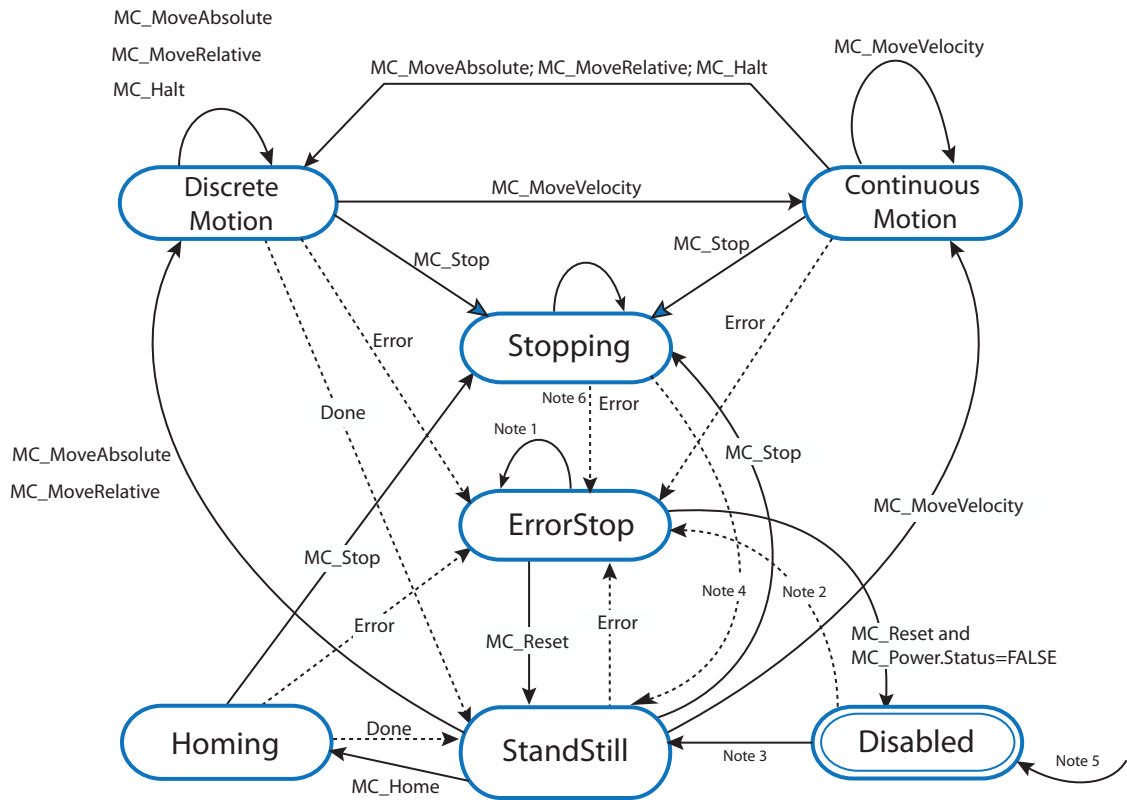
- TIP** MC\_Stop can abort other motion function blocks but can never be aborted itself.
- TIP** MC\_Stop goes to the Stopping state and normal operation cannot resume.

## Motion Axis and Parameters

The following state diagram illustrates the behavior of the axis at a high level when multiple motion control function blocks are activated. The basic rule is that motion commands are always taken sequentially, even if the controller has the capability of real parallel processing. These commands act on the axis' state diagram.

The axis is always in one of the defined states (see diagram below). Any motion command is a transition that changes the state of the axis and, as a consequence, modifies the way the current motion is computed.

### Motion Axis State Diagram



**NOTES:**

- (1) In the ErrorStop and Stopping states, all function blocks (except MC\_Reset), can be called although they will not be executed. MC\_Reset generates a transition to the Standstill state. If an error occurs while the state machine is in the Stopping state, a transition to the ErrorStop state is generated. Axis position still updates even if the Axis state is ErrorStop. Also, the MC\_TouchProbe function block is still active if it was executed before the ErrorStop state.
- (2) Power.Enable = TRUE and there is an error in the Axis.
- (3) Power.Enable = TRUE and there is no error in the Axis.
- (4) MC\_Stop.Done AND NOT MC\_Stop.Execute.
- (5) When MC\_Power is called with Enable = False, the axis goes to the Disabled state for every state including ErrorStop.
- (6) If an error occurs while the state machine is in Stopping state, a transition to the ErrorStop state is generated.

## Axis States

The axis state can be determined from one of the following predefined states. Axis state can be monitored through the Axis Monitor feature of the Connected Components Workbench software when in debug mode.

### Motion States

State value	State Name
0x00	Disabled
0x01	Standstill
0x02	Discrete Motion
0x03	Continuous Motion
0x04	Homing
0x06	Stopping
0x07	Stop Error

### Axis State Update

On motion execution, although the motion profile is controlled by Motion Engine as a background task, which is independent from POU scan, axis state update is still dependent on when the relevant motion function block is called by the POU scan.

For example, on a moving axis on a Ladder POU (state of a rung=true), an MC\_MoveRelative function block in the rung is scanned and the axis starts to move. Before MC\_MoveRelative completes, the state of the rung becomes False, and MC\_MoveRelative is no longer scanned. In this case, the state of this axis cannot switch from Discrete Motion to StandStill, even after the axis fully stops, and the velocity comes to 0.

The screenshot displays a ladder logic rung with an 'Always\_on' contact and an 'MC\_MoveRelative' function block. The function block is configured with the following parameters:

- Axis0: 0
- TON\_1.Q: True
- distance: 2345.66
- velocity: 100.0
- accel: 5.0
- accel: 5.0
- 0.0
- 0

The function block outputs are shown on the right:

- Axis: 0
- axis0\_done: False
- Busy: True
- Active: True
- Commandaborted: False
- Error: False
- ErrorID: 0

The Variable Monitoring window on the right shows the following data for Axis0:

Name	Logical Value
Axis0.ErrorFlag	
Axis0.AxisHomed	
Axis0.ConstVel	
Axis0.AccelFlag	
Axis0.DecelFlag	
Axis0.AxisState	2
Axis0.ErrorID	0
Axis0.ExtraData	0
Axis0.T.targetPos	2355.66
Axis0.CommandPos	2355.66
Axis0.T.targetVel	100.0
Axis0.CommandVel	0.0

## Limits

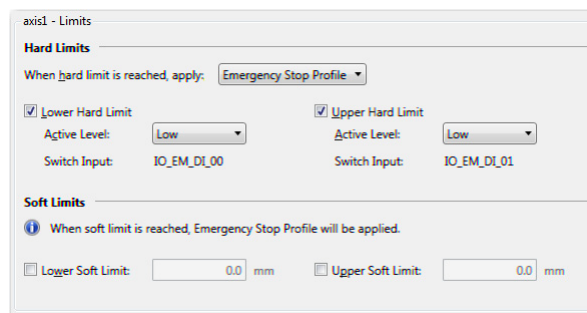
The Limits parameter sets a boundary point for the axis, and works in conjunction with the Stop parameter to define a boundary condition for the axis on the type of stop to apply when certain configured limits are reached.

There are three types of motion position limits.

- Hard Limits
- Soft Limits
- PTO Pulse Limits

**TIP** See [Motion Axis Configuration in Connected Components Workbench on page 109](#) for information on how to configure limits and stop profiles and the acceptable value range for each.

If any one of these limits is reached on a moving axis (except on homing), an over travel limit error will be reported and the axis will be stopped based on configured behavior.



**Sample Limits configuration in Connected Components Workbench**

### Hard Limits

Hard limits refer to the input signals received from physical hardware devices such as limit switches and proximity sensors. These input signals detect the presence of the load at the maximum upper and minimum lower extents of allowable motion of the load or movable structure that carries the load, such as a load tray on a transfer shuttle.

Hardware limits are mapped to discrete inputs that are associated with data tags/variables.

When a hard limit switch is enabled, the axis comes to a stop when the limit switch is detected during motion. If hard stop on hard limit switch is configured as ON and the limit is detected, motion is stopped immediately (that is, PTO pulse is stopped immediately by the hardware). Alternatively, if hard stop on hard limit switch is configured as OFF, motion will be stopped using Emergency Stop parameters.

When any hard limit switch is enabled, the input variable connecting to this physical input can still be used in User Application.

When a hard limit switch is enabled, it will be used automatically for MC\_Home function block, if the switch is in the Homing direction configured in the Connected Components Workbench software (Mode: MC\_HOME\_ABS\_SWITCH or MC\_HOME\_REF\_WITH\_ABS). See [Homing Function Block on page 122](#).

### *Soft Limits*

Soft limits refer to data values that are managed by the motion controller. Unlike hardware limits which detect the presence of the physical load at specific points in the allowable motion of the load, soft limits are based on the stepper commands and the motor and load parameters.

Soft limits are displayed in user defined units. The user can enable individual soft limits. For non-enabled soft limits (whether upper or lower), an infinite value is assumed.

Soft Limits are activated only when the corresponding axis is homed. Users can enable or disable soft limits, and configure an upper and lower limit setting through the Connected Components Workbench software.

### **Soft Limits Checking on the Function Blocks**

<b>Function Block</b>	<b>Limits Checking</b>
MC_MoveAbsolute	The target position will be checked against the soft limits before motion starts.
MC_MoveRelative	
MC_MoveVelocity	The soft limits will be checked dynamically during motion.

When a soft limit is enabled, the axis comes to a stop when the limit is detected during motion. The motion is stopped using emergency stop parameters.

If both hard and soft limits are configured as enabled, for two limits in the same direction (upper or lower), the limits should be configured such that the soft limit is triggered before the hard limit.

### *PTO Pulse Limits*

This limit parameter is not configurable by the user and is the physical limitation of the embedded PTO. The limits are set at 0x7FFF0000 and -0x7FFF0000 pulses, for upper and lower limits, respectively.

PTO pulse limits are checked by the controller unconditionally — that is, the checking is always ON.

On a non-continuous motion, to prevent a moving axis going to ErrorStop status with Motion PTO Pulse limits detected, user needs to prevent current position value going beyond PTO Pulse limit.

On a continuous motion (driven by MC\_MoveVelocity function block), when the current position value goes beyond PTO pulse limit, PTO pulse current position will automatically roll over to 0 (or the opposite soft limit, if it is activated), and the continuous motion continues.

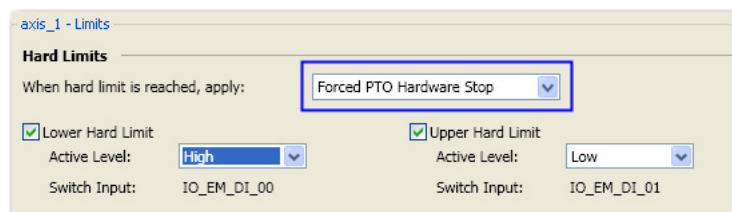
For a continuous motion, if the axis is homed, and the soft limit in the motion direction is enabled, soft limit will be detected before PTO pulse limit being detected.

## Motion Stop

There are three types of stops that can be configured for an axis.

### *Immediate Hardware Stop*

This type of Immediate Stop is controlled by the hardware. If a Hard Stop on a Hard Limit switch is enabled, and the Hard Limit has been reached, the PTO pulse for the axis will be cut off immediately by the controller. The stop response has no delay (less than 1  $\mu$ s).



### *Immediate Soft Stop*

The maximum possible response delay for this type of stop could be as much as the Motion Engine Execution time interval. This type of stop is applicable in the following scenarios:

- During motion, when axis PTO Pulse Limit is reached;
- One Hard Limit is enabled for an axis, but Hard Stop on Hard Limit switch is configured as Off. If the Emergency Stop is configured as Immediate Software Stop, during motion, when the Hard Limit switch is detected;
- One Soft Limit is enabled for an axis and the axis has been homed. If the emergency stop is configured as Immediate Soft Stop, during motion, when the Soft Limit reach is detected;



- The Emergency Stop is configured as Immediate Soft Stop. During motion, MC\_Stop function block is issued with Deceleration parameter equal to 0.

### *Decelerating Soft Stop*

Decelerating soft stop could be delayed as much as Motion Engine Execution Time interval. This type of stop is applied in the following scenarios:

- One Hard Limit is enabled for an axis, but Hard Stop on Hard Limit switch is configured as Off. If the emergency stop is configured as decelerating stop, during motion, when the Hard Limit switch is detected;
- One Soft Limit is enabled for an axis and the axis has been homed. If the emergency stop is configured as decelerating stop, during motion, when the soft limit reach is detected by firmware;
- The Emergency Stop is configured as Decelerating Stop. During motion, the MC\_Stop function block is issued with deceleration parameter set to 0.
- During motion, MC\_Stop function block is issued with Deceleration parameter not set to 0.

## **Motion Direction**

For distance (position) motion, with the target position defined (absolute or relative), the direction input is ignored.

For velocity motion, direction input value can be positive (1), current (0) or negative (-1). For any other value, only the sign (whether positive or negative) is considered and defines whether the direction is positive or negative. This means that if the product of velocity and direction is -3, then direction type is negative.

### **MC\_MoveVelocity Supported Direction Types**

<b>Direction Type</b>	<b>Value used<sup>(1)</sup></b>	<b>Direction description</b>
Positive direction	1	Specific for motion/rotation direction. Also called clockwise direction for rotation motion.
Current direction	0	Current direction instructs the axis to continue its motion with new input parameters, without direction change. The direction type is valid only when the axis is moving and the MC_MoveVelocity is called.
Negative direction	-1	Specific for motion/rotation direction. Also referred to as counter-clockwise direction for rotation motion.

<sup>(1)</sup> Data type: short integer.

## Axis Elements and Data Types

### *Axis\_Ref Data Type*

Axis\_Ref is a data structure that contains information on a motion axis. It is used as an input and output variable in all motion function blocks. One axis\_ref instance is created automatically in the Connected Components Workbench software when the user adds one motion axis to the configuration.

The user can monitor this variable in controller debug mode through the software when the motion engine is active, or in the user application as part of user logic. It can also be monitored remotely through various communication channels.

### Data Elements for Axis\_Ref

Element name	Data Type	Description
Axis_ID	UINT8	The logic axis ID automatically assigned by the Connected Components Workbench software. This parameter cannot be edited or viewed by user.
ErrorFlag	UINT8	Indicates whether an error is present in the axis.
AxisHomed	UINT8	Indicates whether homing operation is successfully executed for the axis or not. When the user tries to redo homing for an axis with AxisHomed already set (homing performed successfully), and the result is not successful, the AxisHomed status will be cleared.
ConsVelFlag	UINT8	Indicates whether the axis is in constant velocity movement or not. Stationary axis is not considered to be in constant velocity.
AccFlag	UINT8	Indicates whether the axis is in an accelerating movement or not.
DecFlag	UINT8	Indicates whether the axis is in a decelerating movement or not.
AxisState	UINT8	Indicates the current state of the axis. For more information, see <a href="#">Axis States on page 99</a> .
ErrorID	UINT16	Indicates the cause for axis error when error is indicated by ErrorFlag. This error usually results from motion function block execution failure. See <a href="#">Motion Function Block and Axis status Error ID on page 107</a> .
ExtraData	UINT16	Reserved.
TargetPos	REAL (float) <sup>(1)</sup>	Indicates the final target position of the axis for MoveAbsolute and MoveRelative function blocks. For MoveVelocity, Stop, and Halt function blocks, TargetPos is 0 except when the TargetPos set by previous position function blocks is not cleared.

**Data Elements for Axis\_Ref**

Element name	Data Type	Description
CommandPos	REAL (float) <sup>(1)</sup>	On a moving axis, this is the current position the controller commands the axis to go to.
TargetVel	REAL (float) <sup>(1)</sup>	The maximum target velocity issued to the axis by a move function block. The value of TargetVel is same as the velocity setting in current function block, or smaller, depending on other parameters in the same function block. This element is a signed value indicating direction information. See <a href="#">PTO Pulse Accuracy on page 120</a> for more information.
CommandVel	REAL (float) <sup>(1)</sup>	During motion, this element refers to the velocity the controller commands the axis to use. This element is a signed value indicating direction information.

<sup>(1)</sup> See [Real Data Resolution on page 118](#) for more information on REAL data conversion and rounding.

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**IMPORTANT** Once an axis is flagged with error, and the error ID is not zero, the user needs to reset the axis (using MC\_Reset) before issuing any other movement function block.

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**IMPORTANT** The update for axis status is performed at the end of one program scan cycle, and the update is aligned with the update of Motion Axis status.

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**Axis Error Scenarios**

In most cases, when a movement function block instruction issued to an axis results in a function block error, the axis is also usually flagged as being in Error state. The corresponding ErrorID element is set on the axis\_ref data for the axis. However, there are exception scenarios where an axis error is not flagged. The exception can be, but not limited to, the following scenarios:

- A movement function block instructs an axis, but the axis is in a state where the function block could not be executed properly. For example, the axis has no power, or is in Homing sequence, or in Error Stop state.
- A movement function block instructs an axis, but the axis is still controlled by another movement function block. The axis cannot allow the motion to be controlled by the new function block without going to a full stop. For example, the new function block commands the axis to change motion direction.
- When one movement function block tries to control an axis, but the axis is still controlled by another movement function block, and the newly-defined motion profile cannot be realized by the controller. For example, User Application issues an S-Curve MC\_MoveAbsolute function block to an axis with too short a distance given when the axis is moving.
- When one movement function block is issued to an axis, and the axis is in the Stopping or Error Stopping sequence.

For the above exceptions, it is still possible for the user application to issue a successful movement function block to the axis after the axis state changes.

## MC\_Engine\_Diag Data Type

The MC\_Engine\_Diag data type contains diagnostic information on the embedded motion engine. It can be monitored in debug mode through the Connected Components Workbench software when the motion engine is active, or through the user application as part of user logic. It can also be monitored remotely through various communication channels.

One MC\_Engine\_Diag instance is created automatically in the Connected Components Workbench software when the user adds the first motion axis in the motion configuration. This instance is shared by all user-configured motion axes.

### Data Elements for MC\_Engine\_Diag

Element name	Data Type
MCEngState	UINT16
CurrScantime <sup>(1)</sup>	UINT16
MaxScantime <sup>(1)</sup>	UINT16
CurrEngineInterval <sup>(1)</sup>	UINT16
MaxEngineInterval <sup>(1)</sup>	UINT16
ExtraData	UINT16

<sup>(1)</sup> The time unit for this element is microsecond. This diagnostic information can be used to optimize motion configuration and user application logic adjustment.

### MCEngstate States

State name	State	Description
MCEng_Idle	0x01	MC engine exists (at least one axis defined), but the engine is idle as there is no axis is moving. The Engine diagnostic data is not being updated.
MCEng_Running	0x02	MC engine exists (at least one axis defined) and the engine is running. The diagnostic data is being updated.
MCEng_Faulted	0x03	MC engine exists, but the engine is faulted.

## Function Block and Axis Status Error Codes

All motion control function blocks share the same ErrorID definition.

Axis error and function block error share the same Error ID, but error descriptions are different, as described in the table below.

**TIP** Error code 128 is warning information to indicate the motion profile has been changed and velocity has been adjusted to a lower value but the function block can execute successfully.

**Motion Function Block and Axis status Error ID**

Error ID	Error ID MACRO	Error description for Function Block	Error description for Axis Status <sup>(1)</sup>
00	MC_FB_ERR_NO	Function block execution is successful.	The axis is in operational state.
01	MC_FB_ERR_WRONG_STATE	The function block cannot execute because the axis is not in the correct state. Check the axis state.	The axis is not operational due to incorrect axis state detected during a function block execution. Reset the state of the axis using the MC_Reset function block.
02	MC_FB_ERR_RANGE	The function block cannot execute because there is invalid axis dynamic parameter(s) (velocity, acceleration, deceleration, or jerk) set in the function block. Correct the setting for the dynamic parameters in the function block against Axis Dynamics configuration page.	The axis is not operational due to invalid axis dynamic parameter(s) (velocity, acceleration, deceleration, or jerk) set in a function block. Reset the state of the axis using the MC_Reset function block. Correct the setting for the dynamic parameters in the function block against Axis Dynamics configuration page.
03	MC_FB_ERR_PARAM	The function block cannot execute because there is invalid parameter other than velocity, acceleration, deceleration, or jerk, set in the function block. Correct the setting for the parameters (for example, mode or position) for the function block.	The axis is not operational due to invalid parameter(s) other than velocity, acceleration, deceleration, or jerk, set in a function block. Reset the state of the axis using the MC_Reset function block. Correct the setting for the parameters (for example, mode or position) for the function block.
04	MC_FB_ERR_AXISNUM	The function block cannot execute because the axis does not exist, the axis configuration data is corrupted, or the axis is not correctly configured.	Motion internal Fault, Error ID = 0x04. Call Tech support.
05	MC_FB_ERR_MECHAN	The function block cannot execute because the axis is faulty due to drive or mechanical issues. Check the connection between the drive and the controller (Drive Ready and In-Position signals), and ensure the drive is operating normally.	The axis is not operational due to drive or mechanical issues. Check the connection between the drive and the controller (Drive Ready and In-Position signals), and ensure the drive is operating normally. Reset the state of the axis using the MC_Reset function block.
06	MC_FB_ERR_NOPOWER	The function block cannot execute because the axis is not powered on. Power on the axis using MC_Power function block.	The axis is not powered on. Power on the axis using MC_Power function block. Reset the state of the axis using the MC_Reset function block.
07	MC_FB_ERR_RESOURCE	The function block cannot execute because the resource required by the function block is controlled by some other function block or not available. Ensure the resource required by the function block available for use. Some examples: <ul style="list-style-type: none"> <li>• MC_power function block attempts to control the same axis.</li> <li>• MC_Stop function block is executed against the same axis at the same time.</li> <li>• Two or more MC_TouchProbe function blocks are executed against the same axis at the same time.</li> </ul>	The axis is not operational due to the resource required by a function block is under the control of other function block, or not available. Ensure the resource required by the function block available for use. Reset the state of the axis using the MC_Reset function block.
08	MC_FB_ERR_PROFILE	The function block cannot execute because the motion profile defined in the function block cannot be achieved. Correct the profile in the function block.	The axis is not operational due to motion profile defined in a function block cannot be achieved. Reset the state of the axis using the MC_Reset function block. Correct the profile in the function block.

**Motion Function Block and Axis status Error ID**

Error ID	Error ID MACRO	Error description for Function Block	Error description for Axis Status <sup>(1)</sup>
09	MC_FB_ERR_VELOCITY	<p>The function block cannot execute because the motion profile requested in the function block cannot be achieved due to current axis velocity. Some examples:</p> <ul style="list-style-type: none"> <li>• The function block requests the axis to reverse the direction while the axis is moving.</li> <li>• The required motion profile cannot be achieved due to current velocity too low or too high.</li> </ul> <p>Check the motion profile setting in the function block, and correct the profile, or re-execute the function block when the axis velocity is compatible with the requested motion profile.</p>	<p>The axis is not operational. The motion profile requested in the function block cannot be achieved because of current axis velocity. Some examples:</p> <ul style="list-style-type: none"> <li>• The function block requests the axis to reverse the direction while the axis is moving.</li> <li>• The required motion profile cannot be achieved due to current velocity too low or too high.</li> </ul> <p>Reset the state of the axis using the MC_Reset function block. Correct the motion profile in the function block, or re-execute the function block when the axis velocity is compatible with the requested motion profile.</p>
10	MC_FB_ERR_SOFT_LIMIT	<p>This function block cannot execute as it will end up moving beyond the soft limit, or the function block is aborted as the soft limit has been reached. Check the velocity or target position settings in the function block, or adjust soft limit setting.</p>	<p>The axis is not operational due to soft limit error detected, or due to expected soft limit error in a function block. Reset the state of the axis using the MC_Reset function block. Check the velocity or target position settings for the function block, or adjust Soft Limit setting.</p>
11	MC_FB_ERR_HARD_LIMIT	<p>This function block is aborted as the Hard Limit switch active state has been detected during axis movement, or aborted as the Hard Limit switch active state has been detected before axis movement starts. Move the axis away from the hard limit switch in the opposite direction.</p>	<p>The axis is not operational due to hard limit error detected. Reset the state of the axis using the MC_Reset function block, and then move the axis away from the hard limit switch in the opposite direction.</p>
12	MC_FB_ERR_LOG_LIMIT	<p>This function block cannot execute as it will end up moving beyond the PTO Accumulator logic limit, or the function block is aborted as the PTO Accumulator logic limit has been reached. Check the velocity or target position settings for the function block. Or, use MC_SetPosition function block to adjust the axis coordinate system.</p>	<p>The axis is not operational due to PTO Accumulator logic limit error detected, or due to expected PTO accumulator logic limit error in a function block. Reset the state of the axis using the MC_Reset function block. Check the velocity or target position settings for the function block. Or, use MC_SetPosition function block to adjust the axis coordinate system.</p>
13	MC_FB_ERR_ENGINE	<p>A motion engine execution error is detected during the execution of this function block. Power cycle the whole motion setup, including controller, drives and actuators, and re-download the User Application. If the fault is persistent, call Tech support.</p>	<p>The axis is not operational due to a motion engine execution error. Power cycle the whole motion setup, including controller, drives and actuators, and re-download the User Application. If the fault is persistent, contact your local Rockwell Automation technical support representative. For contact information, see: <a href="http://support.rockwellautomation.com/MySupport.asp">http://support.rockwellautomation.com/MySupport.asp</a>.</p>
16	MC_FB_ERR_NOT_HOMED	<p>The Function Block cannot execute because the axis needs to be homed first. Execute homing against the axis using MC_Home Function Block.</p>	<p>The axis is not operational because the axis is not homed. Reset the state of the axis using the MC_Reset Function Block.</p>
128	MC_FB_PARAM_MODIFIED	<p><b>Warning:</b> The requested motion parameter for the axis has been adjusted. The function block executes successfully.</p>	<p>Motion internal Fault, Error ID = 0x80. Contact your local Rockwell Automation technical support representative. For contact information, see: <a href="http://support.rockwellautomation.com/MySupport.asp">http://support.rockwellautomation.com/MySupport.asp</a>.</p>

<sup>(1)</sup> You can view axis status through the Axis Monitor feature of the Connected Components Workbench software.

When a motion control function block ends with an error, and the axis is in ErrorStop state, in most cases, MC\_Reset function block (or, MC\_Power Off/On and MC\_Reset) can be used to have the axis to be recovered. With this, the axis can get back to normal motion operation without stopping the controller operation.

## Major Fault Handling

In case the controller encounters issues where recovery is not possible through the Stop, Reset, or Power function blocks, controller operation will be stopped and a major fault will be reported.

The following motion-related major fault codes are defined for Micro830, Micro850, and Micro870 controllers.

### Major Fault Error Codes and Description

Major Fault Value	Fault ID MACRO	Major Fault description
0xF100	EP_MC_CONFIG_GEN_ERR	There is general configuration error detected in the motion configuration downloaded from Connected Components Workbench, such as Num of Axis, or Motion execution interval being configured out of range. When this major fault is reported, there could be no axis in ErrorStop state.
0xF110	EP_MC_RESOURCE_MISSING	Motion configuration has mismatch issues with motion resource downloaded to the controller. There are some motion resources missing. When this major fault is reported, there could be no axis in ErrorStop state.
0xF12x	EP_MC_CONFIG_AXS_ERR	Motion configuration for axis cannot be supported by this catalog, or the configuration has some resource conflict with some other motion axis, which has been configured earlier. The possible reason could be maximum velocity, max acceleration is configured out of supported range. x = the logic Axis ID (0...3).
0xF15x	EP_MC_ENGINE_ERR	There is a motion engine logic error (firmware logic issue or memory crash) for one axis detected during motion engine cyclic operation. One possible reason can be motion engine data/memory crash. (This is motion engine operation error, and should not happen in normal condition.) x = the logic Axis ID (0...3).

## Motion Axis Configuration in Connected Components Workbench

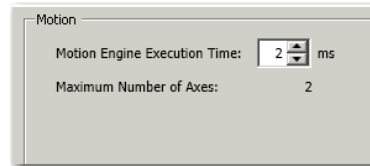
A maximum of three motion axes can be configured through the Connected Components Workbench software. To add, configure, update, delete, and monitor an axis in Connected Components Workbench, refer to the next sections.

**TIP** Configuration changes must be compiled and downloaded to the controller to take effect.

**TIP** Values for the different motion axis parameters are validated based on a set of relationships and pre-determined absolute range. See [Motion Axis Parameter Validation on page 121](#) for a description of the relationships between parameters.

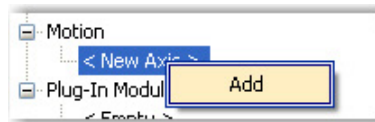
## Add New Axis

**IMPORTANT** Motion Engine Execution Time



When an axis is added to the configuration, the Motion Engine Execution Time can be configured from 1...10 ms (default: 1 ms). This global parameter applies to all motion axis configurations.

1. On the Device Configuration tree, right-click <New Axis>. Click Add.



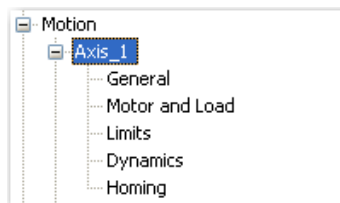
2. Provide an axis name. Click Enter.

**TIP** Name must begin with a letter or underscore character, followed by a letter or single underscore characters.

**TIP** You can also press F2 to edit axis name.

3. Expand the newly created Axis to see the following configuration categories:

- General
- Motor and Load
- Limits
- Dynamics
- Homing



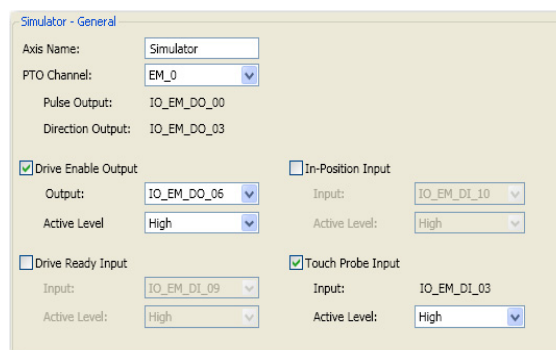


**TIP** To help you edit these motion properties, see [Edit Axis Configuration on page 111](#). You can also learn more about axis configuration parameters.

## Edit Axis Configuration

### General Parameters

1. On the axis configuration tree, click General. The <Axis Name> - General properties tab appears.



2. Edit General parameters. You can refer to the table for a description of the general configuration parameters for a motion axis.

**IMPORTANT** To edit these general parameters, you can refer to [Input and Output Signals on page 84](#) for more information about fixed and configurable outputs.

### General Parameters

Parameter	Description and Values
Axis Name	User defined. Provides a name for the motion axis.
PTO Channel	Shows the list of available PTO channels.
Pulse output	Presents the logical variable name of the Direction Output channel based on the PTO channel value that has been assigned.
Direction output	Presents the logical variable name of the Direction Output channel based on the PTO channel value that has been assigned.
Drive Enable Output	Servo On Output Enable flag. Check the option box to enable.
- Output	The list of available digital output variables that can be assigned as servo/drive output.
- Active Level	Set as High (default) or Low.
In-position Input	Check the option box to enable in-position input monitoring.
- Input	List of digital input variables for in-position input monitoring. Select an input.

**General Parameters**

Parameter	Description and Values
- Active Level	Set as High (default) or Low.
Drive ready input	Servo Ready Input Enable flag. Check the option box to enable the input.
- Input	The list of digital input variables. Select an input.
- Active Level	Set as High (default) or Low.
Touch probe input	Configure whether an input for touch probe is used. Check the option box to enable touch probe input.
- Input	List of digital input variables. Select an input
- Active Level	Set the active level for touch probe input as High (default) or Low.

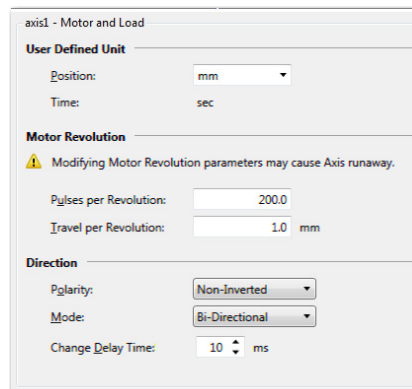
*PTO Channel Naming*

Names of embedded PTO channels have the prefix EM (embedded) and each available PTO channel is enumerated starting from 0. For example, a controller that supports three axes will have the following PTO channels available:

- EM\_0
- EM\_1
- EM\_2

*Motor and Load*

Edit the Motor Load properties as defined in the table.



**IMPORTANT** Certain parameters for Motor and Load are Real values. For more information, see [Real Data Resolution on page 118](#)

**Motor and Load Parameters**

Parameter	Description and Values
<b>User-defined unit</b>	Defines user unit scaling that matches your mechanical system values. These units shall be carried forward into all command and monitor axis in user unit values throughout programming, configuration and monitoring functions.
Position	Select from any of the following options: <ul style="list-style-type: none"> <li>- mm</li> <li>- cm</li> <li>- inches</li> <li>- revs</li> <li>- custom unit (ASCII format of up to 7 characters long)</li> </ul>
Time	Read only. Predefined in seconds.
<b>Motor revolution</b>	Defines pulse per revolution and travel per revolution values.
Pulse per revolution <sup>(1)</sup>	Defines the number of pulses needed to obtain one revolution of the drive motor. <i>Range:</i> 0.0001...8388607 <i>Default:</i> 200.0
Travel per revolution <sup>(1)</sup>	Travel per revolution defines the distance, either linear or rotational, that the load moves per revolution of the motor. <i>Range:</i> 0.0001...8388607. <i>Default:</i> 1.0 user unit.
<b>Direction</b>	Defines polarity, mode, and change of delay time values.
Polarity	Direction polarity determines whether the direction signal received by the controller as a discrete input should be interpreted on the input as received by the motion controller, (that is, the non-inverted case), or whether the signal should be inverted prior to interpretation by the motion control logic. Set as Inverted or Non-inverted (default).
Mode	Set as Bi-directional (default), Positive (clockwise), or Negative (counter-clockwise) direction.
Change delay time	Configure from 0...100 ms. Default value is 10 ms.

<sup>(1)</sup> The parameter is set as REAL (float) value in Connected Components Workbench. To learn more about conversions and rounding of REAL values, see [Real Data Resolution on page 118](#).

**TIP**

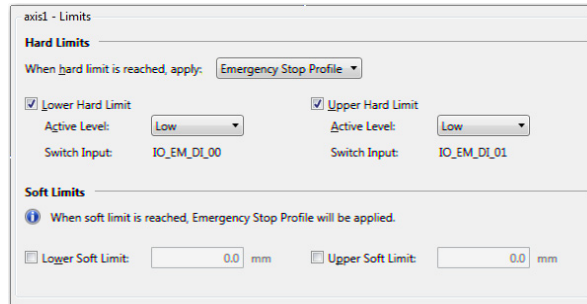
A red border on an input field indicates that an invalid value has been entered. Scroll over the field to see tooltip message that will let you know the valid value range for the parameter. Supply the valid value.



**ATTENTION:** Modifying Motor Revolution parameters may cause axis runaway.

## Limits

Edit the Limits parameters based on the table below.



**ATTENTION:** To learn more about the different types of Limits, see [Limits on page 100](#).

### Limits Parameters

Parameter <sup>(1)</sup>	Value
<b>Hard Limits</b>	Defines upper and lower hard limits for the axis.
When hard limits is reached, apply	Configure whether to perform a forced PTO hardware stop (immediately turn off pulse output) or whether to decelerate (leave pulse output on and use deceleration values as defined on the Emergency Stop profile). Set as any of the following: <ul style="list-style-type: none"> <li>Forced PTO Hardware Stop</li> <li>Emergency Stop Profile</li> </ul>
Lower Hard Limit	Click checkbox to enable a lower hard limit.
Active Level (for Lower Hard Limit)	High or Low.
Upper Hard Limit	Click checkbox to enable.
Active Level (for Upper Hard Limit)	High or Low.
<b>Soft Limits</b>	Defines upper and lower soft limits values.
Lower Soft Limit <sup>(2)</sup>	Lower soft limit should be less than upper soft limit. 1. Click checkbox to enable an lower/upper soft limit. 2. Specify a value (in mm).
Upper Soft Limit <sup>(2)</sup>	

<sup>(1)</sup> To convert from user units to pulse:

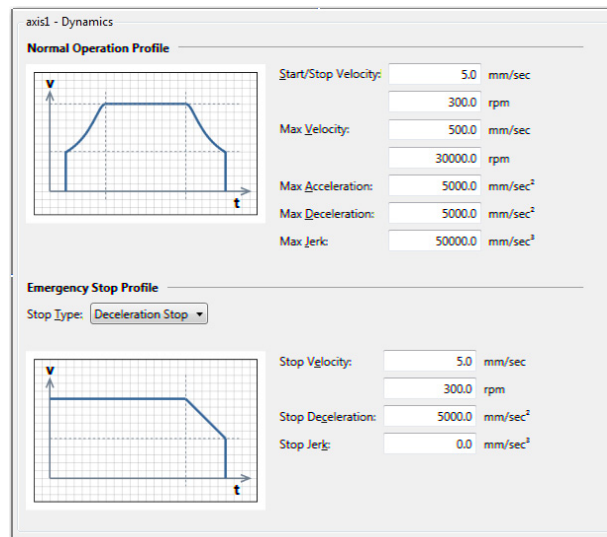
$$\text{Value in user unit} = \text{Value in pulse} \times \frac{\text{Travel per revolution}}{\text{Pulse per revolution}}$$

<sup>(2)</sup> The parameter is set as REAL (float) value in Connected Components Workbench. To learn more about conversions and rounding of REAL values, see [Real Data Resolution on page 118](#).

### TIP

A red border on an input field indicates that an invalid value has been entered. Scroll over the field to see tooltip message that will let you know the valid value range for the parameter. Supply the valid value.

- Click Dynamics. The <Axis Name> - Dynamics tab appears. Edit the Dynamics parameters based on the table below.



### Dynamics Parameters

Parameter	Values
Start/Stop Velocity <sup>(1) (2)</sup>	The range is based on Motor and Load parameters (See <a href="#">Motor and Load Parameters on page 113</a> ) using:
Start/Stop Velocity in rpm <sup>(1) (2)</sup>	<p>Range 1 ... 100,000 pulse/sec            Default: 300 rpm</p> <p>For example, you can configure the value from 0.005...500 mm/s for 200 pulses per revolution and units of 1 mm per revolution.<sup>(3)</sup></p> <p>Rpm value is automatically populated when a value in user units is specified, but the user can also initially enter an rpm value.</p> <p>Start/stop velocity should not be greater than maximum velocity.</p>
Max Velocity <sup>(1) (2)</sup>	The range is based on Motor and Load parameters (See <a href="#">Motor and Load Parameters on page 113</a> ) using: Range: 1 ... 10,000,000 pulse/sec. Default: 100,000.0 pulse/sec
Max Acceleration <sup>(1)</sup>	The range is based on Motor and Load parameters (See <a href="#">Motor and Load Parameters on page 113</a> ) using: Range: 1 ... 10,000,000 pulse/sec <sup>2</sup> Default: 10,000,000 pulse/sec <sup>2</sup>
Max Deceleration <sup>(1)</sup>	The range is based on Motor and Load parameters (See <a href="#">Motor and Load Parameters on page 113</a> ) using: Range: 1 ... 100,000 pulse/sec <sup>2</sup> Default: 10,000,000 pulse/sec <sup>2</sup>
Max Jerk <sup>(1)</sup>	The range is based on Motor and Load parameters (See <a href="#">Motor and Load Parameters on page 113</a> ) using: Range: 0 ... 10,000,000 pulse/sec <sup>3</sup> Default: 10,000,000 pulse/sec <sup>3</sup>
<b>Emergency Stop Profile</b>	Defines stop type, velocity, deceleration and jerk values.
Stop Type	Set as Deceleration Stop (default) or Immediate Stop.

### Dynamics Parameters

Parameter	Values
Stop Velocity <sup>(1)</sup>	The range is based on Motor and Load parameters (See <a href="#">Motor and Load Parameters on page 113</a> ) using: <i>Range:</i> 1...100,000 pulse/sec <i>Default:</i> 300 rpm
Stop Deceleration <sup>(1)</sup>	The range is based on Motor and Load parameters (See <a href="#">Motor and Load Parameters on page 113</a> ) using: <i>Range:</i> 1...10,000,000 pulse/sec <i>Default:</i> 300.0 rpm <sup>2</sup>
Stop Jerk <sup>(1)</sup>	The range is based on Motor and Load parameters (See <a href="#">Motor and Load Parameters on page 113</a> ) using: <i>Range:</i> 0...10,000,000 pulse/sec <sup>3</sup> <i>Default:</i> 0.0 rpm <sup>3</sup> (Disabled)

<sup>(1)</sup> The parameter is set as REAL (float) value in Connected Components Workbench. To learn more about conversions and rounding of REAL values, see [Real Data Resolution on page 118](#).

<sup>(2)</sup> The formula for deriving rpm to user unit, and vice versa:

$$v \text{ (in rpm)} = \frac{v \text{ (in user unit/sec)} \times 60 \text{ s}}{\text{travel per revolution (in user unit)}}$$

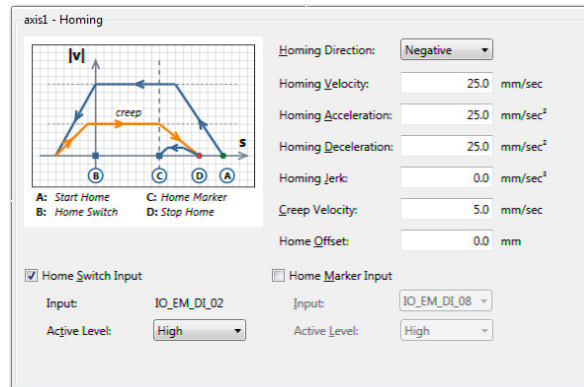
<sup>(3)</sup> To convert from parameter value from pulse to user units:

$$\text{Value in user unit} = \text{Value in pulse} \times \frac{\text{Travel per revolution}}{\text{Pulse per revolution}}$$

**TIP**

A red border on an input field indicates that an invalid value has been entered. Scroll over the field to see tooltip message that will let you know the valid value range for the parameter. Supply the valid value.

## 4. Set Homing parameters based on the description below. Click Homing.

**Homing Parameters**

Parameter	Value range
Homing Direction	Positive (clockwise) or negative (counterclockwise).
Homing Velocity <sup>(1)</sup>	<i>Range:</i> 1...100,000 pulse/sec <i>Default:</i> 5,000.0 pulse/sec (25.0 mm/sec) <b>NOTE:</b> Homing Velocity should not be greater than the maximum velocity.
Homing Acceleration <sup>(1)</sup>	<i>Range:</i> 1...10,000,000 pulse/sec <sup>2</sup> <i>Default:</i> 5000.0 pulse/sec <sup>2</sup> (25.0 mm/sec <sup>2</sup> ) <b>NOTE:</b> Homing Acceleration should not be greater than Maximum Acceleration.
Homing Deceleration <sup>(1)</sup>	<i>Range:</i> 1...10,000,000 pulse/sec <sup>2</sup> <i>Default:</i> 5000.0 pulse/sec <sup>2</sup> (25.0 mm/sec <sup>2</sup> ) <b>NOTE:</b> Homing Deceleration should not be greater than Maximum Deceleration.
Homing Jerk <sup>(1)</sup>	<i>Range:</i> 0...10,000,000 pulse/sec <sup>3</sup> <i>Default:</i> 0.0 pulse/sec <sup>3</sup> (0.0 mm/sec <sup>3</sup> ) <b>NOTE:</b> Homing Jerk should not be greater than Maximum Jerk.
Creep Velocity <sup>(1)</sup>	<i>Range:</i> 1...5,000 pulse/sec <i>Default:</i> 1000.0 pulse/sec (5.0 mm/sec) <b>NOTE:</b> Homing Creep Velocity should not be greater than Maximum Velocity.
Homing Offset <sup>(1)</sup>	<i>Range:</i> -1073741824...1073741824 pulse <i>Default:</i> 0.0 pulse (0.0 mm)
Home Switch Input	Enable home switch input by clicking the checkbox.
- Input	Read only value specifying the input variable for home switch input.
- Active Level	High (default) or Low.
Home Marker Input	Enable the setting of a digital input variable by clicking the checkbox.
- Input	Specify digital input variable for home marker input.
- Active Level	Set the active level for the home switch input as High (default) or Low.

<sup>(1)</sup> The parameter is set as REAL (float) value in Connected Components Workbench. To learn more about conversions and rounding of REAL values, see [Real Data Resolution on page 118](#).

## Axis Start/Stop Velocity

Start/Stop velocity is the initial velocity when an axis starts to move, and the last velocity before the axis stops moving. Generally, Start/Stop velocity is configured at some low value, so that it is smaller than most velocity used in the motion function block.

- When the target velocity is smaller than Start/Stop velocity, move the axis immediately at the target velocity;
- When the target velocity is NOT smaller than Start/Stop velocity, move the axis immediately at Start/Stop velocity;

## Real Data Resolution

Certain data elements and axis properties use REAL data format (single-precision floating point format). Real data has seven-digit resolution and digit values entered by the user that are longer than seven digits are converted. See the following examples.

### REAL Data Conversion Examples

User value	Converted to
0.12345678	0.1234568
1234.1234567	1234.123
12345678	1.234568E+07 (exponential format)
0.000012345678	1.234568E-05 (exponential format)
2147418166	2.147418+E09
-0.12345678	-0.1234568

If the number of digits is greater than seven (7) and the eighth digit is greater than or equal to 5, then the 7th digit is rounded up. For example:

21474185 rounded to 2.147419E+07

21474186 rounded to 2.147419E+07

If the eighth digit is <5, no rounding is done and the seventh digit remains the same. For example:

21474181 rounded to 2.147418E+07



Examples for Motion Configuration: <sup>(1)</sup>

Parameter	Actual Value Entered by User	Converted Value in Connected Components Workbench	Tooltip Error Value <sup>(1)</sup>
Pulses per revolution	8388608	8388608 (no conversion)	Pulse per revolution must be in the range of 0.0001 to 8388607 user unit.
Upper Soft Limit	10730175	1.073018E+7	Upper Soft limit must be greater than Lower Soft Limit. The range is from 0 (exclusive) to 1.073217E+07 user unit.
Lower Soft Limit	-10730175	-1.073018E+7	Lower Soft limit must be smaller than Upper Soft Limit. The range is from -1.073217E+07 to 0 (exclusive) user unit.

<sup>(1)</sup> On the axis configuration page in Connected Components Workbench, an input field with a red border indicates that the value that has been entered is invalid. A tooltip message should let you know the expected range of values for the parameter. The range of values presented in the tooltip messages are also presented in REAL data format.

*Variable Monitor Example*

The Variable Monitor displays six significant digits with rounding, although the real data type still contains seven significant digits.

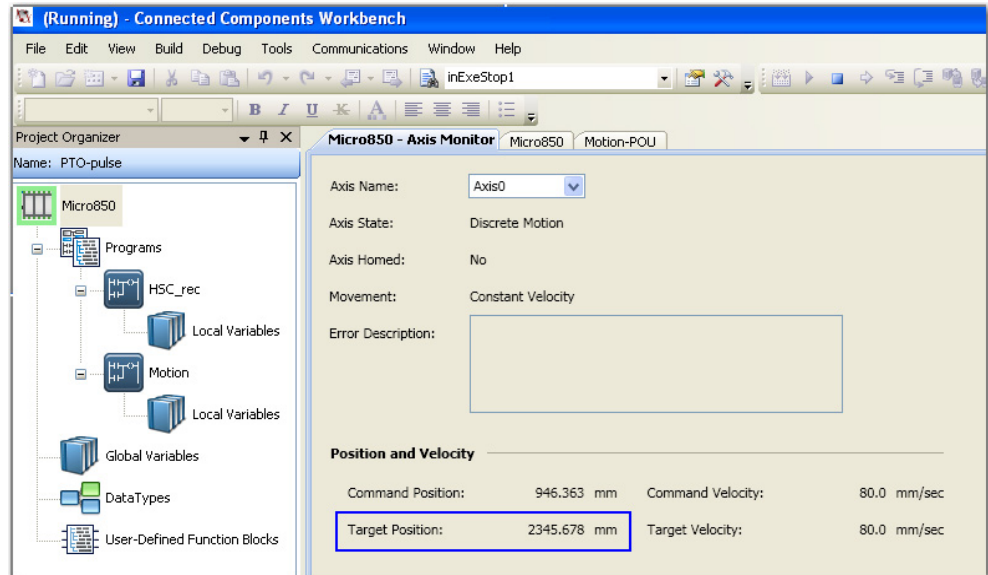
In this example, the user has entered the Target Position value of 2345.678. This value is rounded up to six digits (2345.68) in the Variable Monitoring screen.

The image shows a software interface for variable monitoring. On the left, a table lists parameters for 'MC\_MoveRel' with their current values: Axis0 (0), TON\_TQ (False), distance (2345.68), velocity (80.0), accel (5.0), accel (5.0), 0.0, and 0. On the right, a 'Variable Monitoring' window displays a table with columns for Name, Logical Value, Physical Value, and Lock. The table lists various motion parameters for Axis0 and Axis1. The 'Axis0.TargetPos' and 'Axis0.CommandPos' rows are highlighted with a blue box, showing a Logical Value of 2345.68 and a Physical Value of N/A.

<sup>(1)</sup> For the motion function block parameters, data validation is performed during Run time. The corresponding error will be given if the validation fails.

### Axis Monitor Example

The Axis Monitor displays seven significant digits with rounding.

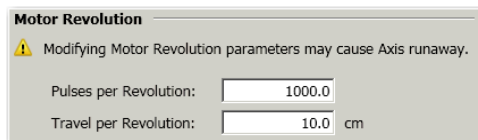


**ATTENTION:** See [Motion Axis Configuration in Connected Components Workbench on page 109](#) to learn more about the different axis configuration parameters.

### PTO Pulse Accuracy

Micro800 motion feature is pulse-based and the value of distance and velocity are designed in such a way that all PTO-related values are integers at the hardware level, when converting to PTO pulse.

For example, if the user configures Motor Pulses per Revolution as 1,000 and Travel per Revolution as 10 cm and the user wants to drive velocity at 4.504 cm/sec. The target velocity is 4.504 cm/sec (that is, 450.4 pulse/sec). In this case, the actual commanded velocity will be 4.5 cm/sec (that is, 450 pulse/sec), and the 0.4 pulse/sec is rounded off.



This rounding scheme also applies to other input parameters such as Position, Distance, Acceleration, Deceleration, and Jerk. For instance, with above motor

revolution configuration, setting Jerk as  $4.504 \text{ cm/sec}^3$  is the same as setting Jerk as  $4.501 \text{ cm/sec}^3$ , as both are rounded off to  $4.5 \text{ cm/sec}^3$ . This rounding applies to both axis configuration input in the Connected Components Workbench software and function block input.

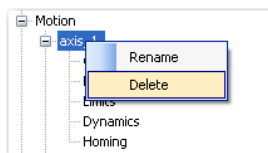
## Motion Axis Parameter Validation

Besides falling within the pre-determined absolute range, motion axis parameters are validated based on relationships with other parameters. These relationships or rules are listed below. Error is flagged whenever there is violation to these relationships.

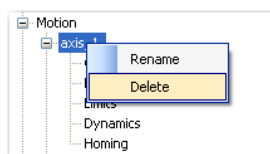
- Lower Soft Limit should be less than the Upper Soft Limit.
- Start/Stop velocity should not be greater than the maximum velocity.
- Emergency Stop velocity should not be greater than the maximum velocity.
- Homing velocity should not be greater than the maximum velocity.
- Homing acceleration should not be greater than maximum acceleration.
- Homing deceleration should not be greater than maximum deceleration.
- Homing jerk should not be greater than maximum jerk.
- Homing creep velocity should not be greater than maximum velocity.

## Delete an Axis

1. On the device configuration tree, and under Motion, right-click the axis name and select Delete.



2. A message box appears asking to confirm deletion. Click Yes.



## Monitor an Axis

To monitor an axis, the Connected Components Workbench software should be connected to the controller and in DEBUG mode.

1. On the device configuration page, click Axis Monitor.

2. The Axis Monitor window appears with the following characteristics available for viewing:
  - axis state
  - axis homed
  - movement
  - error description
  - command position in user unit
  - command velocity in user unit per second
  - target position in user unit
  - target velocity in user unit per second

## Homing Function Block

The homing function block MC\_Home commands the axis to perform the “search home” sequence. The Position input is used to set the absolute position when the reference signal is detected, and configured home offset is reached. This function block completes at StandStill if the homing sequence is successful.

MC\_Home only can be aborted by the function blocks MC\_Stop or MC\_Power. Any abort attempt from other moving function blocks will result in function block failure with Error ID = MC\_FB\_ERR\_STATE. However, homing operation is not interrupted, and can be executed as usual.

If MC\_Home is aborted before it completes, the previously searched home position is considered as invalid, and the axis Homed status is cleared.

After axis power on is done, the axis Homed status is reset to 0 (not homed). On most scenarios, the MC\_Home function block needs to be executed to calibrate the axis position against the axis home configured after MC\_Power (On) is done.

There are five homing modes supported on Micro830, Micro850, and Micro870 controllers.

### Homing Modes

Homing Mode Value	Homing Mode name	Homing Mode Description
0x00	MC_HOME_ABS_SWITCH	Homing process searches for Home Absolute switch.
0x01	MC_HOME_LIMIT_SWITCH	Homing process searches for limit switch.
0x02	MC_HOME_REF_WITH_ABS	Homing process searches for Home Absolute switch plus using encoder reference pulse.
0x03	MC_HOME_REF_PULSE	Homing process searches for limit switch plus using encoder reference pulse.
0x04	MC_HOME_DIRECT	Static homing process with direct forcing a home position from user reference. The function block will set current position the mechanism is in as home position, with its position determined by the input parameter, “Position”.

---

**IMPORTANT** If axis is powered On with only one direction enabled, the MC\_Home function block (in modes 0, 1, 2, 3) will generate an error and only MC\_Home function block (mode 4) can be executed. See MC\_Power function block for more details.

---

## Conditions for Successful Homing

For homing operation to be successful, all configured switches (or sensors) must be properly positioned and wired. The correct position order from the most negative position to the most positive position—that is, from the leftmost to the rightmost in the homing setup diagrams in this section—for the switches are:

1. Lower Limit switch
2. ABS Home switch
3. Upper Limit switch

During MC\_Home function block execution, the home position will be reset, and the soft limits mechanical position will be recalculated. During homing sequence, the motion configuration for the soft limits will be ignored.

The homing motion sequence discussed in this section has the following configuration assumptions:

1. Homing direction is configured as negative direction;
2. The Lower limit switch is configured as enabled and wired;

The different homing modes as defined (see table [Homing Modes on page 122](#)) can have different, but still similar motion sequence. The concept discussed below is applicable to various homing configurations.

## MC\_HOME\_ABS\_SWITCH

---

**IMPORTANT** If home switch is not configured as enabled, MC\_HOME\_ABS\_SWITCH (0) homing fails with MC\_FB\_ERR\_PARAM.

---

MC\_HOME\_ABS\_SWITCH (0) homing procedure performs a homing operation against the home switch. The actual motion sequence is dependent on the home switch, limit switch configuration, and the actual status for the switches before homing starts—that is, when the MC\_Home function block is issued.

*Scenario 1: Moving part at right (positive) side of home switch before homing starts*

The homing motion sequence for this scenario is as follows:

1. Moving part moves to the left side (negative direction);
2. When home switch is detected, the moving part decelerates to stop;
3. Moving part moves back (positive direction) in creep velocity to detect home switch On → Off edge;
4. Once home switch On → Off is detected, record the position as mechanical home position, and decelerate to stop;
5. Move to the configured home position. The mechanical home position recorded during moving back sequence, plus the home offset configured for the axis in the Connected Components Workbench software.

*Scenario 2: Moving part is in between Lower Limit and Home switch before homing starts*

The homing motion sequence for this scenario is as follows:

1. Moving part moves to its left side (negative direction);
2. When lower limit switch is detected, the moving part decelerates to stop, or stop immediately, according to limit switch hard stop configuration;
3. Moving part moves back (in positive direction) in creep velocity to detect home switch On → Off edge;
4. Once home switch On → Off edge is detected, record the position as mechanical home position, and decelerate to stop;
5. Move to the configured home position. The mechanical home position recorded during moving back sequence, plus the home offset configured for the axis in the Connected Components Workbench software.

**TIP** If Lower Limit switch is not configured, or not wired, the homing motion fails, and moves continuously to the left until the drive or moving part fails to move.

*Scenario 3: Moving part on Lower Limit or Home switch before homing starts*

The homing motion sequence for this scenario is as follows:

1. Moving part moves to its right side (in positive direction) in creep velocity to detect home switch On → Off edge;
2. Once home switch On → Off edge is detected, record the position as mechanical home position, and decelerate to stop;

3. Move to the configured home position. The mechanical home position recorded during moving right sequence, plus the home offset configured for the axis in the Connected Components Workbench software.

*Scenario 4: Moving part at left (negative) side of Lower Limit switch before homing starts*

In this case, the homing motion fails and moves continuously to the left until drive or moving part fails to move. User needs to make sure the moving part at the proper location before homing starts.

## MC\_HOME\_LIMIT\_SWITCH

---

**IMPORTANT** If Lower Limit switch is not configured as Enabled, MC\_HOME\_LIMIT\_SWITCH (1) homing will fail (Error ID: MC\_FB\_ERR\_PARAM).

---

For Homing against Lower Limit switch, one positive home offset can be configured; for Homing against Upper Limit switch, one negative home offset can be configured.

MC\_HOME\_LIMIT\_SWITCH (1) homing procedure performs a homing operation against Limit switch. The actual motion sequence is dependent on the limit switch configuration and the actual status for the switch before homing starts—that is, when the MC\_Home function block is issued.

*Scenario 1: Moving part at right (positive) side of Lower Limit switch before homing starts*

The homing motion sequence for this scenario is as follows:

1. Moving part moves to its left side (in negative direction);
2. When Lower Limit switch is detected, the moving part decelerates to stop, or stops immediately, according to Limit Switch Hard Stop configuration;
3. Moving part moves back (in positive direction) in creep velocity to detect Lower Limit switch On → Off edge;
4. Once Lower Limit switch On → Off edge is detected, record the position as mechanical home position, and decelerate to stop;
5. Move to the configured home position. The mechanical home position recorded during moving back sequence, plus the home offset configured for the axis through the Connected Components Workbench software.

*Scenario 2: Moving part on Lower Limit switch before homing starts*

The homing motion sequence for this scenario is as follows:

1. Moving part moves to its right side (in positive direction) in creep velocity to detect Lower Limit switch On → Off edge;
2. Once Lower Limit switch On → Off edge is detected, record the position as mechanical home position, and decelerate to stop;
3. Move to the configured home position. The mechanical home position recorded during moving right sequence, plus the home offset configured for the axis through the software.

*Scenario 3: Moving part at left (negative) side of Lower Limit switch before homing starts*

In this case, the homing motion fails and moves continuously to the left until drive or moving part fails to move. User needs to make sure the moving part is at the proper location before homing starts.

## MC\_HOME\_REF\_WITH\_ABS

---

**IMPORTANT** If Home switch or Ref Pulse is not configured as Enabled, MC\_HOME\_REF\_WITH\_ABS (2) homing fails with Error ID: MC\_FB\_ERR\_PARAM.

---

MC\_HOME\_REF\_WITH\_ABS (2) homing procedure performs a homing operation against Home switch, plus fine Ref Pulse signal. The actual motion sequence is dependent on the home switch, limit switch configuration, and the actual status for the switches before homing starts—that is, when the MC\_Home function block is issued.

*Scenario 1: Moving part at right (positive) side of Home switch before homing starts*

The homing motion sequence for this scenario is as follows:

1. Moving part moves to its left side (in negative direction);
2. When Home Abs switch is detected, the moving part decelerates to stop;
3. Moving part moves back (in positive direction) in creep velocity to detect Home Abs On → Off edge;
4. Once Home Abs switch On → Off is detected, start to detect first Ref Pulse signal coming in;
5. Once the first Ref Pulse signal comes, record the position as mechanical home position, and decelerate to stop;
6. Move to the configured home position. The mechanical home position recorded during moving back sequence, plus the home offset configured for the axis through the Connected Components Workbench software.



*Scenario 2: Moving part between Lower Limit and Home switch before homing starts*

The homing motion sequence for this scenario is as follows:

1. Moving part moves to its left side (in negative direction);
2. When Lower Limit switch is detected, the moving part decelerates to stop, or stops immediately, according to Limit Switch Hard Stop configuration;
3. Moving part moves back (in positive direction) in creep velocity to detect Home switch On → Off edge;
4. Once Home Abs switch On → Off is detected, start to detect first Ref Pulse signal;
5. Once the first Ref Pulse signal comes, record the position as mechanical home position, and decelerate to stop.
6. Move to the configured home position. The mechanical home position recorded during moving back sequence, plus the home offset configured for the axis through the Connected Components Workbench software.

---

**IMPORTANT** In this case, if Lower limit switch is not configured, or not wired, the homing motion will fail and moves continuously to the left until the drive or moving part fails to move.

---

*Scenario 3: Moving part on Lower Limit or Home switch before homing starts*

The homing motion sequence for this scenario is as follows:

1. Moving part moves to its right side (in positive direction) in creep velocity to detect Home switch On → Off edge;
2. Once Home Abs switch On → Off is detected, start to detect first Ref Pulse signal;
3. Once the first Ref Pulse signal comes, record the position as mechanical home position, and decelerate to stop;
4. Move to the configured home position. The mechanical home position recorded during moving right sequence, plus the home offset configured for the axis in the Connected Components Workbench software.

*Scenario 4: Moving part at left (negative) side of Lower Limit switch before homing starts*

In this case, the homing motion fails and moves continuously to the left until drive or moving part fails to move. User needs to make sure the moving part is at the proper location before homing starts.

## MC\_HOME\_REF\_PULSE

---

**IMPORTANT** If Lower Limit switch or Ref Pulse is not configured as Enabled, MC\_HOME\_REF\_PULSE (3) homing fails (ErrorID: MC\_FB\_ERR\_PARAM).

---

For Homing against Lower Limit switch, one positive home offset can be configured; for Homing against Upper Limit switch, one negative home offset can be configured.

MC\_HOME\_REF\_PULSE (3) homing procedure performs a homing operation against Limit switch, plus fine Ref Pulse signal. The actual motion sequence is dependent on the limit switch configuration, and the actual status for the switches before homing starts—that is, when the MC\_Home function block is issued.

*Scenario 1: Moving part at right (positive) side of Lower Limit switch before homing starts*

The homing motion sequence for this scenario is as follows:

1. Moving part moves to its left side (in negative direction);
2. When Lower Limit switch is detected, the moving part decelerates to stop, or stops immediately, according to Limit Switch Hard Stop configuration;
3. Moving part moves back (in positive direction) in creep velocity to detect Lower Limit switch On → Off edge;
4. Once Lower Limit switch On → Off edge is detected, start to detect first Ref Pulse signal;
5. Once the first Ref Pulse signal comes, record the position as the mechanical home position, and decelerate to stop;
6. Move to the configured home position. The mechanical home position recorded during moving back sequence, plus the home offset configured for the axis through the Connected Components Workbench software.

*Scenario 2: Moving part on Lower Limit switch before homing starts*

The homing motion sequence for this scenario is as follows:

1. Moving part moves to its right side (in Positive direction) in creep velocity to detect Lower Limit switch On → Off edge;
2. Once Lower Limit switch On → Off edge is detected, start to detect first Ref Pulse signal;
3. Once the first Ref Pulse signal comes, record the position as the mechanical home position, and decelerate to stop;

4. Move to the configured home position. The mechanical home position recorded during moving back sequence, plus the home offset configured for the axis through the Connected Components Workbench software.

*Scenario 3: Moving part at left (negative) side of Lower Limit switch before homing starts*

In this case, the homing motion fails and moves continuously to the left until drive or moving part fails to move. User needs to make sure the moving part at the proper location before homing starts.

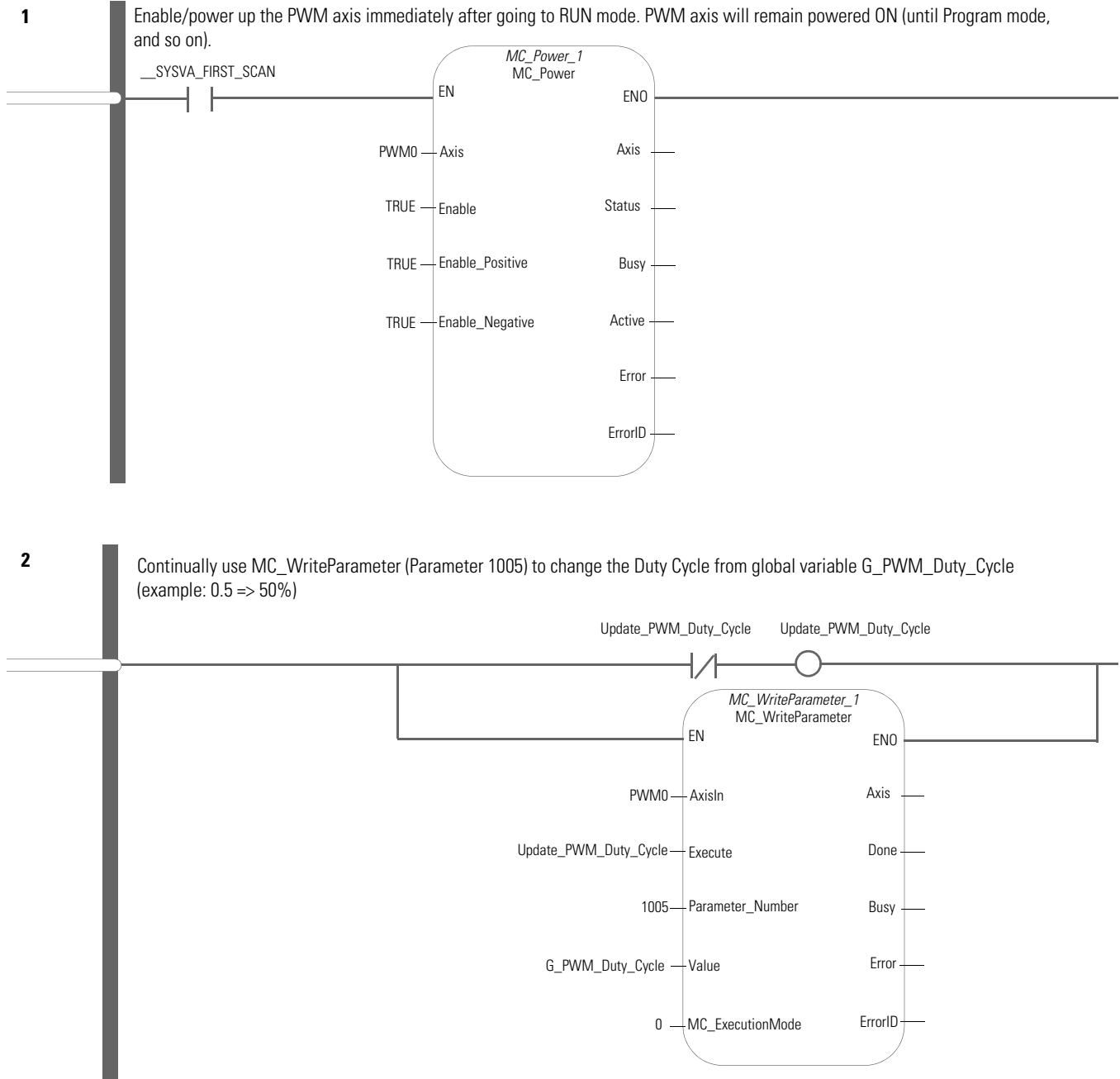
## **MC\_HOME\_DIRECT**

MC\_HOME\_DIRECT (4) homing procedure performs a static homing by directly forcing an actual position. No physical motion is performed in this mode. This is equivalent to a MC\_SetPosition action, except that Axis Homed status will be on once MC\_Home (mode = 4) is performed successfully.

## Use PTO for PWM Control

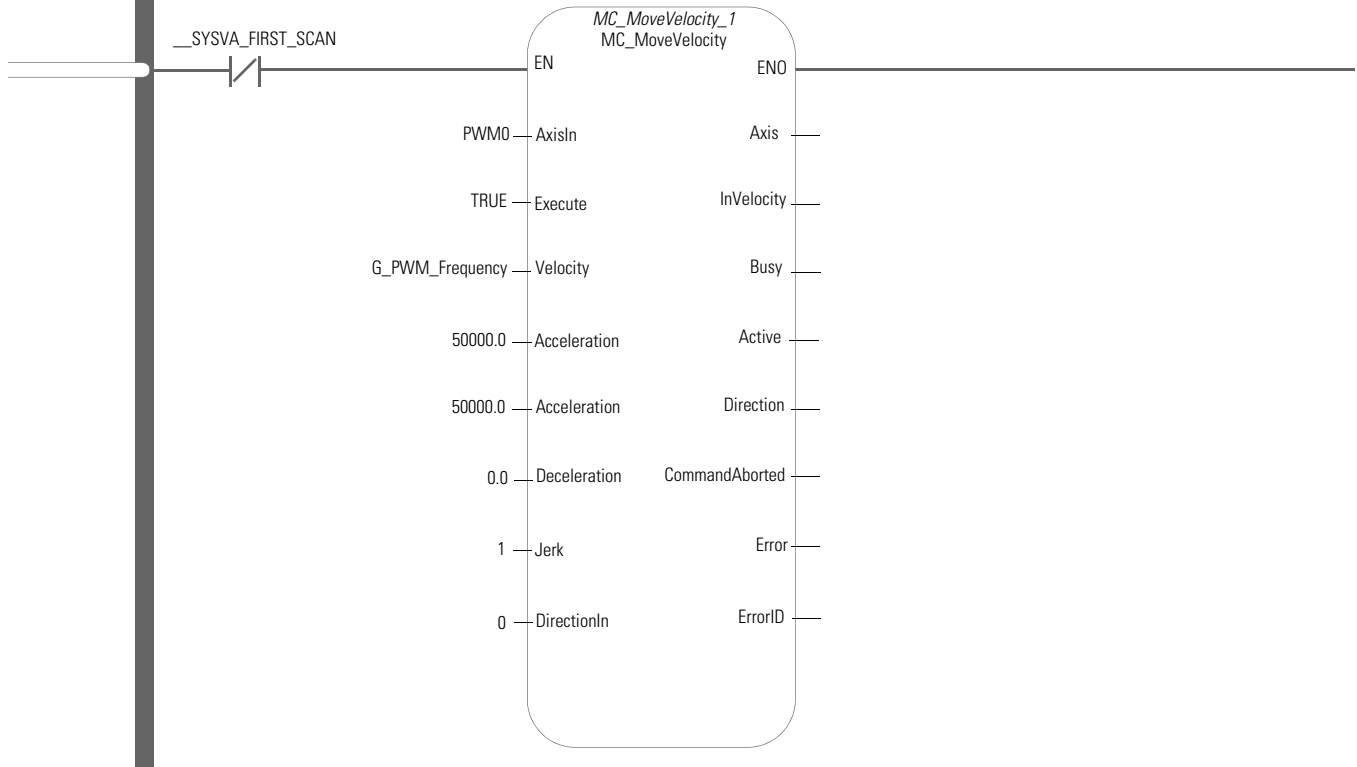
The following example shows you how to use a PTO axis as a PWM.

Launch Connected Components Workbench and create the following ladder program.



3

After first scan, use MC\_MoveVelocity to continually set the PWM frequency (for example: 50,000 => 50 KHz) from global variable G\_PWM\_Frequency. PWM axis will run forever (until Program Mode, MC\_Halt, and so on).



### POU PWM\_Program

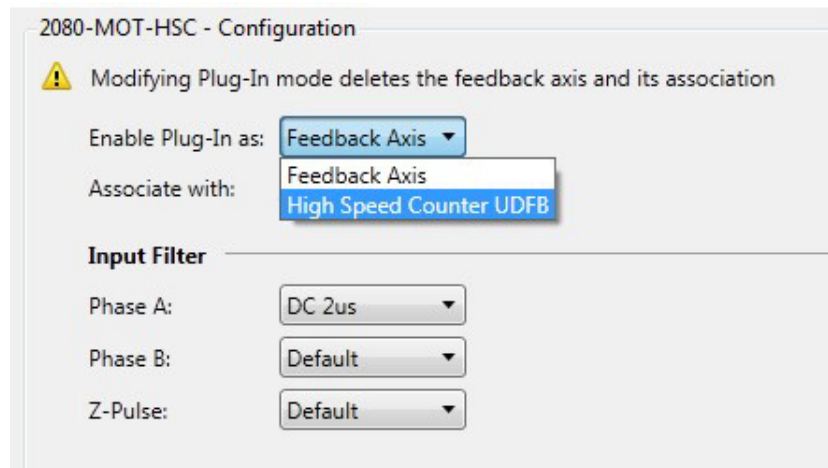
The POU defines four variables.

<p><b>Variable MC_Power_1</b> (* *) Direction: VAR Data Type: MC_Power Attribute: ReadWrite Direct variable (Channel):</p>	<p><b>Variable MC_MoveVelocity_1</b> (* *) Direction: VAR Data Type: MC_MoveVelocity Attribute: ReadWrite Direct variable (Channel):</p>
<p><b>Variable Update_PWM_Duty_Cycle</b> (* *) Direction: Var Data type: BOOL Attribute: ReadWrite Direct variable (Channel):</p>	<p><b>Variable MC_Power_1</b> (* *) Direction: VAR Data Type: MC_Power Attribute: ReadWrite Direct variable (Channel):</p>

## HSC Feedback Axis

From Connected Components Workbench Release 8.0 onwards, support has been added for a HSC (High Speed Counter) Feedback Axis which uses the same instructions as the PTO Motion Axis. UDFBs are still supported (you can use either one but you cannot select both for the same plug-in).

### Example of Selecting Feedback Axis or UDFB with 2080-MOT-HSC Plug-in



The HSC Feedback Axis provides ease-of-use as you no longer need to program the function blocks, and it also uses up less memory on the controller. The HSC Feedback Axis uses only the administrative function blocks from the PTO Motion Axis and they share the same Axis Monitor.

---

**IMPORTANT** The counters are not reset to zero for program download. For example, if using the feedback axis, use the MC\_ResetPosition function block to reset the position to zero.

---



---

**IMPORTANT** If the feedback axis is in the error state because the configured position limits have been exceeded, using the MC\_Reset function block to reset the axis may not clear the error as there may still be pulse detected from the encoder.

---

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## Use the High-Speed Counter and Programmable Limit Switch

### High-Speed Counter Overview

All Micro830, Micro850, and Micro870 controllers, except for 2080-LCxx-AWB, support up to six high speed counters (HSC). The HSC feature in Micro800 consists of two main components: the high-speed counter hardware (embedded inputs in the controller), and high-speed counter instructions in the application program. High-speed counter instructions apply configuration to the high-speed counter hardware and updates the accumulator.



**ATTENTION:** To use the Micro800 HSC feature effectively, you need to have a basic understanding of the following:

- HSC components and data elements.  
The first sections of the chapter provides a detailed description of these components. Quickstart instructions (see page 247) are also available to guide you through setting up a sample HSC project.
- Programming and working with elements in Connected Components Workbench.  
The user needs to have a working knowledge of programming through ladder diagram, structured text, or function block diagram to be able to work with the HSC function block and variables.



**ATTENTION:** Additional information is available on the HSC function block and its elements in the Connected Components Workbench Online Help that comes with your Connected Components Workbench installation.

---

This chapter describes how to use the HSC function and also contains sections on the HSC and HSC\_SET\_STS function blocks, as follows:

- High Speed Counter (HSC) Data Structures
- HSC (High Speed Counter) Function Block
- HSC\_SET\_STS Function Block
- Programmable Limit Switch (PLS) Function
- HSC Interrupts

### Programmable Limit Switch Overview

The Programmable Limit Switch function allows you to configure the High-Speed Counter to operate as a PLS (Programmable Limit Switch) or rotary cam switch. For more information, see [Programmable Limit Switch \(PLS\) Function on page 159](#).

## What is High-Speed Counter?

High-Speed Counter is used to detect narrow (fast) pulses, and its specialized instructions to initiate other control operations based on counts reaching preset values. These control operations include the automatic and immediate execution of the high-speed counter interrupt routine and the immediate update of outputs based on a source and mask pattern you set.

The HSC functions are different than most other controller instructions. Their operation is performed by custom circuitry that runs in parallel with the main system processor. This is necessary because of the high performance requirements of these functions.

### Features and Operation

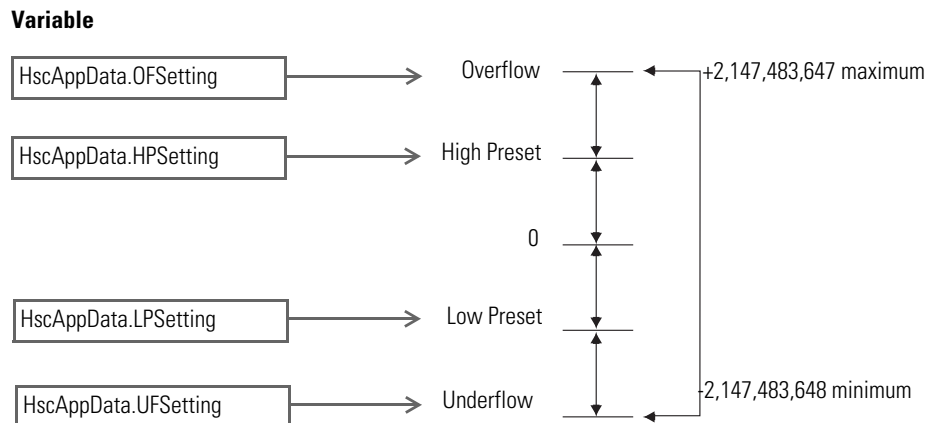
The HSC is extremely versatile; you can select or configure the master HSC for any one of ten (10) modes and the sub HSC for any one of five (5) modes of operation. See [HSC Mode \(HSCAPP.HSCMode\) on page 140](#) for more information.

Some of the enhanced capabilities of the High-Speed Counters are:

- 100 kHz operation
- Direct control of outputs
- 32-bit signed integer data (count range of  $\pm 2,147,483,647$ )
- Programmable High and Low presets, and Overflow and Underflow setpoints
- Automatic Interrupt processing based on accumulated count
- Change parameters on-the-fly (from the user control program)

The High-Speed Counter function operates as described in the following diagram.

#### High Speed Counter Operation





**TIP** You must set a proper value for the variables OFSetting, HPSetting, and UFSetting before triggering Start/Run HSC. Otherwise, the controller will be faulted. (Setting a value for LPSetting is optional for certain counting modes.)

To learn more about HscAppData variable input, see [HSC APP Data Structure on page 139](#).

When using HSC function blocks, it is recommended that you:

- set HSCAppData underflow setting (UFSetting) and low preset setting (LPSetting) to a value less than 0 to avoid possible HSC malfunction when the HSC accumulator is reset to 0.
- set HSCAppData overflow setting (OFSetting) and high preset setting (HPSetting) to a value greater than 0 to avoid possible HSC malfunction when the HSC accumulator is reset to 0.

In some cases, a sub counter will be disabled by master counter mode. See the section HSC Mode (HSCAPP.HSCMode) on page 140.

**TIP** HSC0 is used in this document to define how any HSC works.

---

**IMPORTANT** The HSC function can only be used with the controller's embedded I/O. It cannot be used with expansion I/O modules.

---

## HSC Inputs and Wiring Mapping

All Micro830, Micro850, and Micro870 controllers, except 2080-LCxx-xxAWB, have 100 kHz high-speed counters. Each main high-speed counter has four dedicated inputs and each sub high-speed counter has two dedicated inputs.

### Micro830, Micro850, and Micro870 High Speed Counters

	10/16-point	24-point	48-point
Number of HSC	2	4	6
Main high-speed counters	1 (counter 0)	2 (counter 0,2)	3 (counters 0, 2 and 4)
Sub high-speed counters	1 (counter 1)	2 (counter 1,3)	3 (counters 1, 3 and 5)

High Speed Counter	Inputs used
HSC0	0, 1, 2, 3
HSC1	2, 3
HSC2	4, 5, 6, 7
HSC3	6, 7
HSC4	8, 9, 10, 11
HSC5	10, 11

HSC0's sub counter is HSC1, HSC2's sub counter is HSC3 and HSC4's sub counter is HSC5. Each set of counters share the input. The following table shows the dedicated inputs for the HSCs depending on the mode.

**HSC Input Wiring Mapping**

	Embedded Input											
	0	01	02	03	04	05	06	07	08	09	10	11
HSC0	A/C	B/D	Reset	Hold								
HSC1			A/C	B/D								
HSC2					A/C	B/D	Reset	Hold				
HSC3							A/C	B/D				
HSC4									A/C	B/D	Reset	Hold
HSC5											A/C	B/D

The following tables show the input wiring mapping for the different Micro830, Micro850, and Micro870 controllers.

**Micro830 10 and 16-point Controller HSC Input Wiring Mapping**

Modes of Operation	Input 0 (HSC0) Input 2 (HSC1)	Input 1 (HSC0) Input 3 (HSC1)	Input 2 (HSC0)	Input 3 (HSC0)	Mode Value in User Program (HSCAppData.HSCMode)
Counter with Internal Direction (mode 1a)	Count Up	Not Used			0
Counter with Internal Direction, External Reset and Hold (mode 1b)	Count Up	Not Used	Reset	Hold	1
Counter with External Direction (mode 2a)	Count Up/Down	Direction	Not Used		2
Counter with External Direction, Reset and Hold (mode 2b)	Count	Direction	Reset	Hold	3
Two Input Counter (mode 3a)	Count Up	Count Down	Not Used		4
Two Input Counter with External Reset and Hold (mode 3b)	Count Up	Count Down	Reset	Hold	5
Quadrature Counter (mode 4a)	A Type input	B Type input	Not Used		6
Quadrature Counter with External Reset and Hold (mode 4b)	A Type input	B Type input	Z Type Reset	Hold	7
Quadrature X4 Counter (mode 5a)	A Type input	B Type input	Not Used		8
Quadrature X4 Counter with External Reset and Hold	A Type input	B Type input	Z Type Reset	Hold	9

**Micro830/Micro850/Micro870 24-point Controller HSC Input Wiring Mapping**

<b>Modes of Operation</b>	<b>Input 0 (HSC0) Input 2 (HSC1) Input 4 (HSC2) Input 6 (HSC3)</b>	<b>Input 1 (HSC0) Input 3 (HSC1) Input 5 (HSC2) Input 7 (HSC3)</b>	<b>Input 2 (HSC0) Input 6 (HSC2)</b>	<b>Input 3 (HSC0) Input 7 (HSC2)</b>	<b>Mode Value in User Program</b>
Counter with Internal Direction (mode 1a)	Count Up	Not Used			0
Counter with Internal Direction, External Reset and Hold (mode 1b)	Count Up	Not Used	Reset	Hold	1
Counter with External Direction (mode 2a)	Count Up/Down	Direction	Not Used		2
Counter with External Direction, Reset and Hold (mode 2b)	Count Up/Down	Direction	Reset	Hold	3
Two Input Counter (mode 3a)	Count Up	Count Down	Not Used		4
Two Input Counter with External Reset and Hold (mode 3b)	Count Up	Count Down	Reset	Hold	5
Quadrature Counter (mode 4a)	A Type input	B Type input	Not Used		6
Quadrature Counter with External Reset and Hold (mode 4b)	A Type input	B Type input	Z Type Reset	Hold	7
Quadrature X4 Counter (mode 5a)	A Type input	B Type input	Not Used		8
Quadrature X4 Counter with External Reset and Hold	A Type input	B Type input	Z Type Reset	Hold	9

**Micro830/Micro850 48-point Controller HSC Input Wiring Mapping**

<b>Modes of Operation</b>	<b>Input 0 (HSC0) Input 2 (HSC1) Input 4 (HSC2) Input 6 (HSC3) Input 8 (HSC4) Input 10 (HSC5)</b>	<b>Input 1 (HSC0) Input 3 (HSC1) Input 5 (HSC2) Input 7 (HSC3) Input 9 (HSC4) Input 11 (HSC5)</b>	<b>Input 2 (HSC0) Input 6 (HSC2) Input 10 (HSC4)</b>	<b>Input 3 (HSC0) Input 7 (HSC2) Input 11 (HSC4)</b>	<b>Mode Value in User Program</b>
Counter with Internal Direction (mode 1a)	Count Up	Not Used			0
Counter with Internal Direction, External Reset and Hold (mode 1b)	Count Up	Not Used	Reset	Hold	1
Counter with External Direction (mode 2a)	Count Up/Down	Direction	Not Used		2
Counter with External Direction, Reset and Hold (mode 2b)	Count Up/Down	Direction	Reset	Hold	3
Two Input Counter (mode 3a)	Count Up	Count Down	Not Used		4
Two Input Counter with External Reset and Hold (mode 3b)	Count Up	Count Down	Reset	Hold	5
Quadrature Counter (mode 4a)	A Type input	B Type input	Not Used		6

**Micro830/Micro850 48-point Controller HSC Input Wiring Mapping**

<b>Modes of Operation</b>	<b>Input 0 (HSC0) Input 2 (HSC1) Input 4 (HSC2) Input 6 (HSC3) Input 8 (HSC4) Input 10 (HSC5)</b>	<b>Input 1 (HSC0) Input 3 (HSC1) Input 5 (HSC2) Input 7 (HSC3) Input 9 (HSC4) Input 11 (HSC5)</b>	<b>Input 2 (HSC0) Input 6 (HSC2) Input 10 (HSC4)</b>	<b>Input 3 (HSC0) Input 7 (HSC2) Input 11 (HSC4)</b>	<b>Mode Value in User Program</b>
Quadrature Counter with External Reset and Hold (mode 4b)	A Type input	B Type input	Z Type Reset	Hold	7
Quadrature X4 Counter (mode 5a)	A Type input	B Type input	Not Used		8
Quadrature X4 Counter with External Reset and Hold	A Type input	B Type input	Z Type Reset	Hold	9

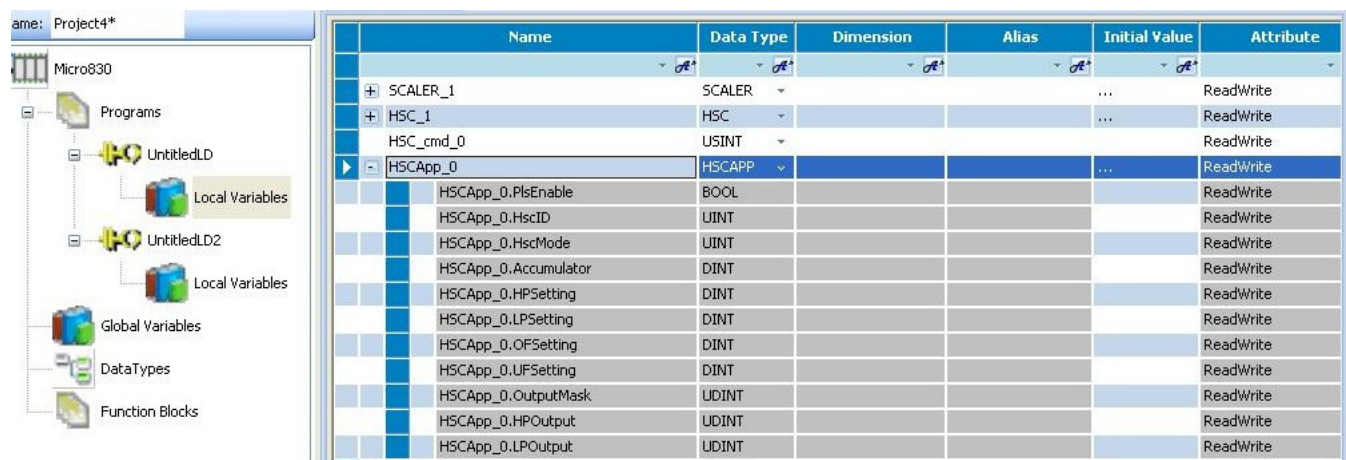
## High Speed Counter (HSC) Data Structures

The following section describes HSC data structures.

### HSC APP Data Structure

Define a HSC App Data (configuration data, data type HSCAPP) when programming a HSC. During HSC counting, the data should not be changed, except if the configuration needs to be reloaded.

To reload HSC configuration, change the HSC APP Data, then call HSC function block with command 0x03 (set/reload). Otherwise, the change to HSC App Data during HSC counting will be ignored.



Name	Data Type	Dimension	Alias	Initial Value	Attribute
SCALER_1	SCALER			...	ReadWrite
HSC_1	HSC			...	ReadWrite
HSC_cmd_0	USINT				ReadWrite
HSCApp_0	HSCAPP			...	ReadWrite
HSCApp_0.PlsEnable	BOOL				ReadWrite
HSCApp_0.HscID	UINT				ReadWrite
HSCApp_0.HscMode	UINT				ReadWrite
HSCApp_0.Accumulator	DINT				ReadWrite
HSCApp_0.HpSetting	DINT				ReadWrite
HSCApp_0.LpSetting	DINT				ReadWrite
HSCApp_0.OfSetting	DINT				ReadWrite
HSCApp_0.UfSetting	DINT				ReadWrite
HSCApp_0.OutputMask	UDINT				ReadWrite
HSCApp_0.HpOutput	UDINT				ReadWrite
HSCApp_0.LpOutput	UDINT				ReadWrite

**TIP** HSC1, HSC3, and HSC5 support mode 0, 2, 4, 6, and 8 only, and HSC0, HSC2 and HSC4 support all counting modes.

### PLS Enable (HSCAPP.PLSEnable)

Description	Data Format	User Program Access
PLSEnable	bit	read/write

This bit enables and disables the HSC Programmable Limit Switch (PLS) function.

When the PLS function is enabled, the setting in

- HSCAPP.HpSetting
- HSCAPP.LpSetting
- HSCAPP.HpOutput
- HSCAPP.LpOutput

are superseded by corresponding data values from PLS data. See Programmable Limit Switch (PLS) Function on page 159 for more information.

### HSCID (HSCAPP.HSCID)

Description	Data Format	User Program Access
HSCID	Word (UINT)	read/write

The following table lists the definition for HSCID.

#### HSCID Definition

Bits	Description
15...13	HSC Module Type: 0x00: Embedded 0x01: Expansion (not yet implemented) 0x02: Plug-in module
12...8	Module Slot ID: 0x00: Embedded 0x01...0x1F: Expansion (not yet implemented) 0x01...0x05: Plug-in module
7...0	Module internal HSC ID: 0x00-0x0F: Embedded 0x00-0x07: Expansion (not yet implemented) 0x00-0x07: Plug-in module

For Embedded HSC, valid HSCID value is only 0...5.

### HSC Mode (HSCAPP.HSCMode)

Description	Data Format	User Program Access
HSC Mode	word (UINT)	read/write

The HSCMode variable sets the High-Speed Counter to one of 10 types of operation. This integer value is configured through the programming device and is accessible in the control program.

#### HSC Operating Modes

Mode Number	Type
0	Up Counter – The accumulator is immediately cleared (0) when it reaches the high preset. A low preset cannot be defined in this mode.
1	Up Counter with external reset and hold – The accumulator is immediately cleared (0) when it reaches the high preset. A low preset cannot be defined in this mode.
2	Counter with external direction
3	Counter with external direction, reset, and hold
4	Two input counter (up and down)
5	Two input counter (up and down) with external reset and hold
6	Quadrature counter (phased inputs A and B)
7	Quadrature counter (phased inputs A and B) with external reset and hold
8	Quadrature X4 counter (phased inputs A and B)
9	Quadrature X4 counter (phased inputs A and B) with external reset and hold

The main high-speed counters support 10 types of operation mode and the sub high-speed counters support 5 types (mode 0, 2, 4, 6, 8). If the main high-speed counter is set to mode 1, 3, 5, 7 or 9, then the resub high-speed counter will be disabled.

For more information on HSC Function Operating Modes and Input Assignments, see [HSC Inputs and Wiring Mapping on page 135](#).

*HSC Mode 0 – Up Counter*

**HSC Mode 0 Examples**

Input Terminals	Embedded Input 0				Embedded Input 1				Embedded Input 2				Embedded Input 3				CE Bit	Comments
Function	Count				Not Used				Not Used				Not Used					
<b>Example 1</b>	↑																on (1)	HSC Accumulator + 1 count
<b>Example 2</b>	↑	on (1)	↓	off (0)													off (0)	Hold accumulator value

Blank cells = don't care, ↑ = rising edge, ↓ = falling edge

**TIP** Inputs 0...11 are available for use as inputs to other functions regardless of the HSC being used.

*HSC Mode 1 – Up Counter with External Reset and Hold*

**HSC Mode 1 Examples**

Input Terminals	Embedded Input 0				Embedded Input 1				Embedded Input 2				Embedded Input 3				CE Bit	Comments
Function	Count				Not Used				Reset				Hold					
<b>Example 1</b>	↑									on (1)	↓	off (0)				off (0)	on (1)	HSC Accumulator + 1 count
<b>Example 2</b>										on (1)	↓	off (0)		on (1)				Hold accumulator value
<b>Example 3</b>										on (1)	↓	off (0)					off (0)	Hold accumulator value
<b>Example 4</b>		on (1)	↓	off (0)						on (1)	↓	off (0)						Hold accumulator value
<b>Example 5</b>									↑									Clear accumulator (=0)

Blank cells = don't care, ↑ = rising edge, ↓ = falling edge

**TIP** Inputs 0...11 are available for use as inputs to other functions regardless of the HSC being used.

*HSC Mode 2 – Counter with External Direction*

**HSC Mode 2 Examples**

Input Terminals	Embedded Input 0				Embedded Input 1				Embedded Input 2				Embedded Input 3				CE Bit	Comments
Function	Count				Direction				Not Used				Not Used					
<b>Example 1</b>	↑							off (0)									on (1)	HSC Accumulator + 1 count
<b>Example 2</b>	↑					on (1)											on (1)	HSC Accumulator - 1 count
<b>Example 3</b>																	off (0)	Hold accumulator value

Blank cells = don't care, ↑ = rising edge, ↓ = falling edge

**TIP** Inputs 0...11 are available for use as inputs to other functions regardless of the HSC being used.

*HSC Mode 3 – Counter with External Direction, Reset, and Hold*

**HSC Mode 3 Examples**

Input Terminals	Embedded Input 0				Embedded Input 1				Embedded Input 2				Embedded Input 3				CE Bit	Comments
Function	Count				Direction				Reset				Hold					
<b>Example 1</b>	↑							off (0)		on (1)	↓	off (0)				off (0)	on (1)	HSC Accumulator + 1 count
<b>Example 2</b>	↑						on (1)			on (1)	↓	off (0)				off (0)	on (1)	HSC Accumulator - 1 count
<b>Example 3</b>										on (1)	↓	off (0)			on (1)			Hold accumulator value
<b>Example 4</b>										on (1)	↓	off (0)					off (0)	Hold accumulator value
<b>Example 5</b>		on (1)	↓	off (0)						on (1)	↓	off (0)						Hold accumulator value
<b>Example 6</b>									↑									Clear accumulator (=0)

Blank cells = don't care, ↑ = rising edge, ↓ = falling edge

**TIP** Inputs 0...11 are available for use as inputs to other functions regardless of the HSC being used.



*HSC Mode 4 – Two Input Counter (up and down)***HSC Mode 4 Examples**

Input Terminals	Embedded Input 0		Embedded Input 1		Embedded Input 2		Embedded Input 3		CE Bit	Comments
Function	Count Up		Count Down		Not Used		Not Used			
<b>Example 1</b>	↑			on (1)	↓	off (0)			on (1)	HSC Accumulator + 1 count
<b>Example 2</b>		on (1)	↓	off (0)	↑				on (1)	HSC Accumulator - 1 count
<b>Example 3</b>									off (0)	Hold accumulator value

Blank cells = don't care, ↑ = rising edge, ↓ = falling edge

**TIP** Inputs 0 through 11 are available for use as inputs to other functions regardless of the HSC being used.

*HSC Mode 5 – Two Input Counter (up and down) with External Reset and Hold***HSC Mode 5 Examples**

Input Terminals	Embedded Input 0		Embedded Input 1		Embedded Input 2		Embedded Input 3		CE Bit	Comments	
Function	Count		Direction		Reset		Hold				
<b>Example 1</b>	↑			on (1)	↓	off (0)		on (1)	off (0)	on (1)	HSC Accumulator + 1 count
<b>Example 2</b>		on (1)	↓	off (0)	↑			on (1)	off (0)	on (1)	HSC Accumulator - 1 count
<b>Example 3</b>								on (1)	off (0)	on (1)	Hold accumulator value
<b>Example 4</b>								on (1)	off (0)	off (0)	Hold accumulator value
<b>Example 5</b>		on (1)	↓	off (0)				on (1)	off (0)		Hold accumulator value
<b>Example 6</b>								↑			Clear accumulator (=0)

Blank cells = don't care, ↑ = rising edge, ↓ = falling edge

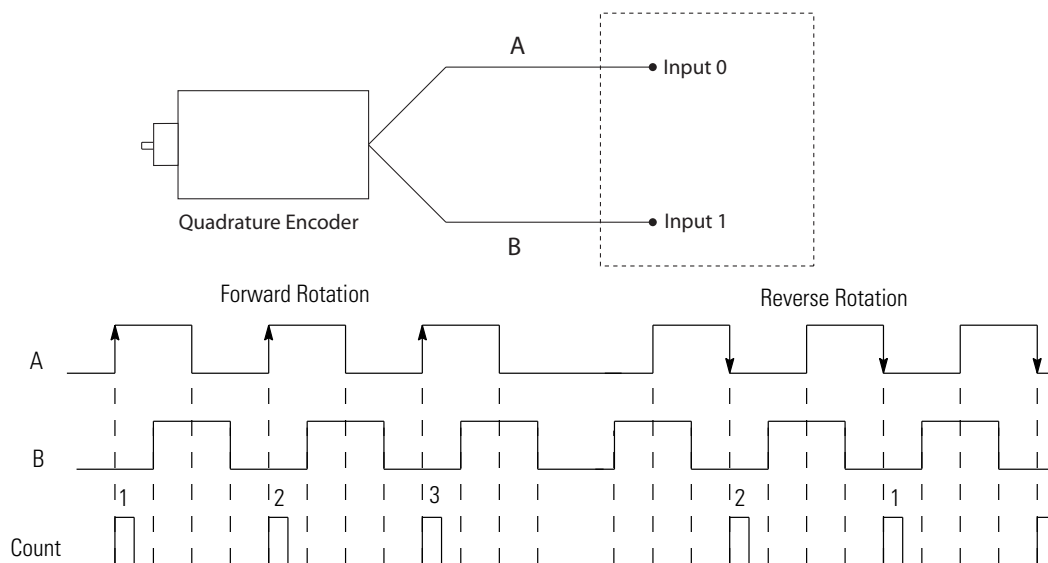
**TIP** Inputs 0...11 are available for use as inputs to other functions regardless of the HSC being used.

### Using the Quadrature Encoder

The Quadrature Encoder is used for determining direction of rotation and position for rotating, such as a lathe. The Bidirectional Counter counts the rotation of the Quadrature Encoder.

The figure below shows a quadrature encoder connected to inputs 0, 1, and 2. The count direction is determined by the phase angle between A and B. If A leads B, the counter increments. If B leads A, the counter decrements.

The counter can be reset using the Z input. The Z outputs from the encoders typically provide one pulse per revolution.



HSC Mode 6 – Quadrature Counter (phased inputs A and B)

### HSC Mode 6 Examples

Input Terminals	Embedded Input 0	Embedded Input 1	Embedded Input 2	Embedded Input 3	CE Bit	Comments
<b>Function</b>	<b>Count A</b>	<b>Count B</b>	<b>Not Used</b>	<b>Not Used</b>		
<b>Example 1<sup>(1)</sup></b>	↑		off (0)		on (1)	HSC Accumulator + 1 count
<b>Example 2<sup>(2)</sup></b>		↓	off (0)		on (1)	HSC Accumulator - 1 count
<b>Example 3</b>		off (0)				Hold accumulator value
<b>Example 4</b>	on (1)					Hold accumulator value
<b>Example 5</b>		on (1)				Hold accumulator value
<b>Example 6</b>					off (0)	Hold accumulator value

(1) Count input A leads count input B.

(2) Count input B leads count input A.

Blank cells = don't care, ↑ = rising edge, ↓ = falling edge

**TIP** Inputs 0...11 are available for use as inputs to other functions regardless of the HSC being used.

### *HSC Mode 7 – Quadrature Counter (phased inputs A and B) With External Reset and Hold*

#### HSC Mode 7 Examples

Input Terminals	Embedded Input 0		Embedded Input 1		Embedded Input 2		Embedded Input 3		CE Bit	Comments
Function	Count A		Count B		Z reset		Hold			
<b>Example 1<sup>(1)</sup></b>	↑				off (0)			off (0)	on (1)	HSC Accumulator + 1 count
<b>Example 2<sup>(2)</sup></b>		↓			off (0)		off (0)	off (0)	on (1)	HSC Accumulator - 1 count
<b>Example 3</b>		↓	off (0)		off (0)	on (1)				Reset accumulator to zero
<b>Example 4</b>	on (1)									Hold accumulator value
<b>Example 5</b>				on (1)						Hold accumulator value
<b>Example 6</b>							off (0)	on (1)		Hold accumulator value
<b>Example 7</b>							off (0)		off (0)	Hold accumulator value

(1) Count input A leads count input B.

(2) Count input B leads count input A.

Blank cells = don't care, ↑ = rising edge, ↓ = falling edge

**TIP** Inputs 0...11 are available for use as inputs to other functions regardless of the HSC being used.

### *HSC Mode 8 – Quadrature X4 Counter*

#### HSC Mode 8 Examples

Embedded Input 1(HSC0) (A)	Embedded Input 1(HSC0) (B)	Value of CE Bit	Accumulator and Counter Action
▲	OFF	TRUE	Count Up Acc. Value
▲	ON	TRUE	Count Down Acc. Value
▼	OFF	TRUE	Count Down Acc. Value
▼	ON	TRUE	Count Up Acc. Value
OFF	▲	TRUE	Count Down Acc. Value
ON	▲	TRUE	Count Up Acc. Value
OFF	▼	TRUE	Count Up Acc. Value
ON	▼	TRUE	Count Down Acc. Value
OFF or ON	OFF or ON	X	Hold Acc. Value
X	X	FALSE	Hold Acc. Value

*HSC Mode 9 – Quadrature X4 Counter with External Reset and Hold*

**HSC Mode 9 Examples**

Embedded Input 0(HSC0) (A)	Embedded Input 1(HSC0) (B)	Embedded Input 2(HSC0) (Reset)	Embedded Input 3(HSC0) (Hold)	Value of CE Bit	Accumulator and Counter Action
▲	OFF	X	-	TRUE	Count Up Acc. Value
▲	ON	X	-	TRUE	Count Down Acc. Value
▼	OFF	X	-	TRUE	Count Down Acc. Value
▼	ON	X	-	TRUE	Count Up Acc. Value
OFF	▲	X	-	TRUE	Count Down Acc. Value
ON	▲	X	-	TRUE	Count Up Acc. Value
OFF	▼	X	-	TRUE	Count Up Acc. Value
ON	▼	X	-	TRUE	Count Down Acc. Value
OFF or ON	OFF or ON	OFF	X	X	Hold Acc. Value
OFF	OFF	ON	X	X	Reset Acc. to Zero
X	X	OFF	ON	X	Hold Acc. Value
X	X	OFF	X	FALSE	Hold Acc. Value

**Accumulator (HSCAPP.Accumulator)**

Description	Data Format	User Program Access
HSCAPP.Accumulator	long word (32-bit INT)	read/write

This parameter is the initial HSC Accumulator value that need to be set when starting the HSC. This parameter is updated by the HSC sub-system automatically when the HSC is in Counting mode, reflecting the actual HSC accumulator value.

**High Preset (HSCAPP.HPSetting)**

Description	Data Format	User Program Access
HSCAPP.HPSetting	long word (32-bit INT)	read/write

The HSCAPP.HPSetting is the upper setpoint (in counts) that defines when the HSC sub-system generates an interrupt.

The data loaded into the high preset must be less than or equal to the data resident in the overflow (HSCAPP.OFSetting) parameter or an HSC error is generated.

## Low Preset (HSCAPP.LPSetting)

Description	Data Format	User Program Access
HSCAPP.LPSetting	long word (32-bit INT)	read/write

The HSCAPP.LPSetting is the lower setpoint (in counts) that defines when the HSC sub-system generates an interrupt.

The data loaded into the low preset must be greater than or equal to the data resident in the underflow (HSCAPP.UFSetting) parameter, or an HSC error is generated. (If the underflow and low preset values are negative numbers, the low preset must be a number with a smaller absolute value.)

## Overflow Setting (HSCAPP.OFSetting)

Description	Data Format	Type	User Program Access
HSCAPP.OFSetting	long word (32-bit INT)	control	read/write

The HSCAPP.OFSetting defines the upper count limit for the counter. If the counter's accumulated value increments past the value specified in this variable, an overflow interrupt is generated. When the overflow interrupt is generated, the HSC sub-system rolls the accumulator over to the underflow value and the counter continues counting from the underflow value (counts are not lost in this transition). The user can specify any value for the overflow position, provided it is greater than the underflow value and falls between -2,147,483,648 and 2,147,483,647.

**TIP** Data loaded into the overflow variable must be greater than or equal to the data resident in the high preset (HSCAPP.HPSetting) or an HSC error is generated.

## Underflow Setting (HSCAPP.UFSetting)

Description	Data Format	User Program Access
HSCAPP.UFSetting	long word (32-bit INT)	read/write

The HSCAPP.UFSetting defines the lower count limit for the counter. If the counter's accumulated value decrements past the value specified in this variable, an underflow interrupt is generated. When the underflow interrupt is generated, the HSC sub-system resets the accumulated value to the overflow value and the counter then begins counting from the overflow value (counts are not lost in this transition). The user can specify any value for the underflow position, provided it is less than the overflow value and falls between -2,147,483,648 and 2,147,483,647.

**TIP** Data loaded into the underflow variable must be less than or equal to the data resident in the low preset (HSCAPP.LPSetting) or an HSC error is generated.

### Output Mask Bits (HSCAPP.OutputMask)

Description	Data Format	User Program Access
HSCAPP.OutputMask	word (32-bit binary)	read/write

The HSCAPP.OutputMask defines which embedded outputs on the controller can be directly controlled by the high-speed counter. The HSC sub-system has the ability to directly (without control program interaction) turn outputs ON or OFF based on the HSC accumulator reaching the High or Low presets. The bit pattern stored in the HSCAPP.OutputMask variable defines which outputs are controlled by the HSC and which outputs are not controlled by the HSC.

For example, if the user wants to control outputs 0, 1, 3, using HSC then the user needs to assign,  
 HscAppData.OutputMask = 2#1011  
 (OR using Decimal Value: HscAppData.OutputMask = 11)

The bit pattern of the HSCAPP.OutputMask variable directly corresponds to the output bits on the controller. Bits that are set (1) are enabled and can be turned on or off by the HSC sub-system. Bits that are clear (0) cannot be turned on or off by the HSC sub-system. The mask bit pattern can be configured only during initial setup.

The following table shows example of how HPOutput and OutputMask controls Embedded output.

#### Effect of HSC Output Mask on Embedded Outputs

Output Variable	32-Bit Signed Integer Data Word																							
	32...20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			
HSCAPP.HPOutput (high preset output)		0	1	0	1	0	1	0	1	0	0	1	1	0	0	0	1	1	0	0	1			
HSCAPP.OutputMask (output mask)		1	1	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0	0	1	1			
Embedded output (10-point)																				0	1			
Embedded output (16-point)																				0	1	0	1	
Embedded output (24-point)																				1	0	1	0	1

**Effect of HSC Output Mask on Embedded Outputs**

Output Variable	32-Bit Signed Integer Data Word																					
	32...20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Embedded output (48-point)		0	1								0	1				0	1				0	1

The outputs shown in the black boxes are the outputs under the control of the HSC sub-system. The mask defines which outputs can be controlled. The high preset output or low preset output values (HSCAPP.HPOutput or HSCAPP.LPOutput) define if each output is either ON (1) or OFF (0). Another way to view this is that the high or low preset output is written through the output mask, with the output mask acting like a filter.

The bits in the gray boxes are unused. For the 10-point controller, the first 4 bits of the mask word are used and the remaining mask bits are not functional because they do not correlate to any physical outputs on the base unit. For the 16, 24 and 48-point controllers, the first 6, 10 and 20 bits of the mask word are used, respectively.

The mask bit pattern can be configured only during initial setup.

**High Preset Output (HSCAPP.HPOutput)**

Description	Data Format	User Program Access
HSCAPP.HPOutput	long word (32-bit binary)	read/write

The High Preset Output defines the state (1 = ON or 0 = OFF) of the outputs on the controller when the high preset is reached. For more information on how to directly turn outputs on or off based on the high preset being reached, see [Output Mask Bits \(HSCAPP.OutputMask\) on page 148](#).

The high output bit pattern can be configured during initial setup, or while the controller is operating. Use the HSC function block to load the new parameters while the controller is operating.

**Low Preset Output (HSCAPP.LPOutput)**

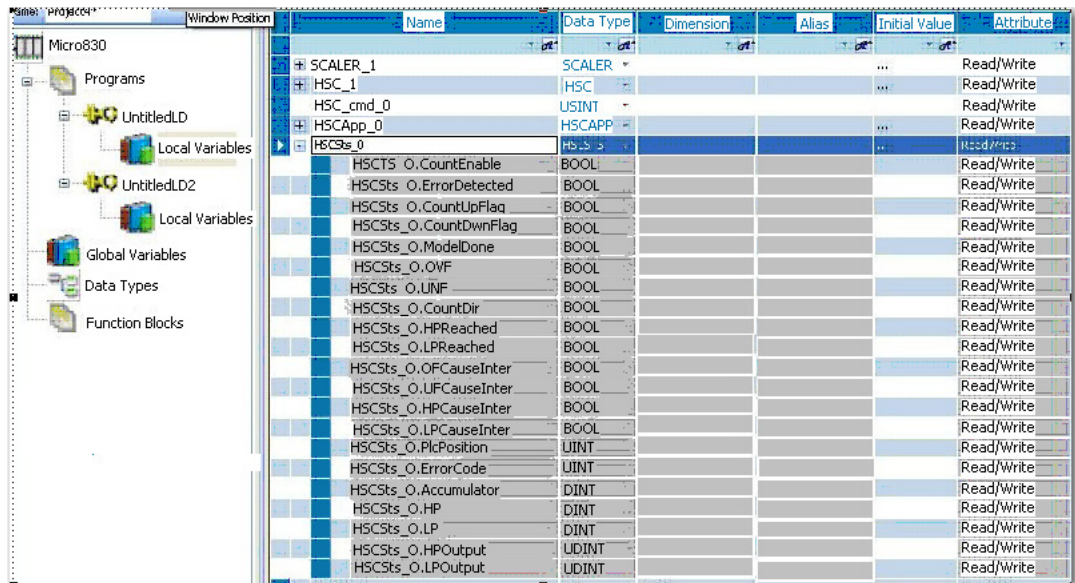
Description	Data Format	User Program Access
HSCAPP.LPOutput	long word (32-bit binary)	read/write

The Low Preset Output defines the state (1 = “on”, 0 = “off”) of the outputs on the controller when the low preset is reached. See [Output Mask Bits \(HSCAPP.OutputMask\) on page 148](#) for more information on how to directly turn outputs on or off based on the low preset being reached.

The low output bit pattern can be configured during initial setup, or while the controller is operating. Use the HSC function block to load the new parameters while the controller is operating.

## HSC STS (HSC Status) Data Structure

Define a HSC STS data (HSC status information data, data type HSCSTS) when programming a HSC.



### Counting Enabled (HSCSTS.CountEnable)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
HSCSTS.CountEnable	bit	0...9	read only

(1) For Mode descriptions, see [HSC Mode \(HSCAPP.HSCMode\) on page 140](#).

The Counting Enabled control bit is used to indicate the status of the High-Speed Counter, whether counting is enabled (1) or disabled (0, default).

### Error Detected (HSCSTS.ErrorDetected)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
HSCSTS.ErrorDetected	bit	0...9	read/write

(1) For Mode descriptions, see [HSC Mode \(HSCAPP.HSCMode\) on page 140](#).

The Error Detected flag is a status bit that can be used in the control program to detect if an error is present in the HSC sub-system. The most common type of error that this bit represents is a configuration error. When this bit is set (1), you should look at the specific error code in parameter HSCSTS.ErrorCode. This bit is maintained by the controller and is set when there is an HSC error. This bit can be cleared by the user, if necessary.



## Count Up (HSCSTS.CountUpFlag)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
HSCSTS.CountUpFlag	bit	0...9	read only

(1) For Mode descriptions, see [HSC Mode \(HSCAPP.HSCMode\) on page 140](#).

The Count Up bit is used with all of the HSCs (modes 0...9). If the HSCSTS.CountEnable bit is set, the Count Up bit is set (1). If the HSCSTS.CountEnable is cleared, the Count Up bit is cleared (0).

## Count Down (HSCSTS.CountDownFlag)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
SCSTS.CountDownFlag	bit	2...9	read only

(1) For Mode descriptions, see [HSC Mode \(HSCAPP.HSCMode\) on page 140](#).

The Count Down bit is used with the bidirectional counters (modes 2...9). If the HSCSTS.CountEnable bit is set, the Count Down bit is set (1). If the HSCSTS.CountEnable bit is clear, the Count Down bit is cleared (0).

## Mode Done (HSCSTS.Mode1Done)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
HSCSTS.Mode1Done	bit	0 or 1	read/write

(1) For Mode descriptions, see [HSC Mode \(HSCAPP.HSCMode\) on page 140](#).

The Mode Done status flag is set (1) by the HSC sub-system when the HSC is configured for Mode 0 or Mode 1 behavior, and the accumulator counts up to the High Preset.

## Overflow (HSCSTS.OVF)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
HSCSTS.OVF	bit	0...9	read/write

(1) For Mode descriptions, see [HSC Mode \(HSCAPP.HSCMode\) on page 140](#).

The HSCSTS.OVF status flag is set (1) by the HSC sub-system whenever the accumulated value (HSCSTS.Accumulator) has counted through the overflow variable (HSCAPP.OFSetting).

This bit is transitional and is set by the HSC sub-system. It is up to the control program to utilize, track if necessary, and clear (0) the overflow condition.

Overflow conditions do not generate a controller fault.

### Underflow (HSCSTS.UNF)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
HSCSTS.UNF	bit	0...9	read/write

(1) For Mode descriptions, see [HSC Mode \(HSCAPP.HSCMode\) on page 140](#).

The Underflow status flag is set (1) by the HSC sub-system whenever the accumulated value (HSCSTS.Accumulator) has counted through the underflow variable (HSCAPP.UFSetting).

This bit is transitional and is set by the HSC sub-system. It is up to the control program to utilize, track if necessary, and clear (0) the underflow condition.

Underflow conditions do not generate a controller fault.

### Count Direction (HSCSTS.CountDir)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
HSCSTS.CountDir	bit	0...9	read only

(1) For Mode descriptions, see [HSC Mode \(HSCAPP.HSCMode\) on page 140](#).

The Count Direction status flag is controlled by the HSC sub-system. When the HSC accumulator counts up, the direction flag is set (1). Whenever the HSC accumulator counts down, the direction flag is cleared (0).

If the accumulated value stops, the direction bit retains its value. The only time the direction flag changes is when the accumulated count reverses.

This bit is updated continuously by the HSC sub-system whenever the controller is in a run mode.

### High Preset Reached (HSCSTS.HPReached)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
HSCSTS.HPReached	bit	2...9	read/write

(1) For Mode descriptions, see [Count Down \(HSCSTS.CountDownFlag\) on page 151](#).

The High Preset Reached status flag is set (1) by the HSC sub-system whenever the accumulated value (HSCSTS.Accumulator) is greater than or equal to the high preset variable (HSCAPP.HPSetting).

This bit is updated continuously by the HSC sub-system whenever the controller is in an executing mode. Writing to this element is not recommended.

## Low Preset Reached (HSCSTS.LPReached)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
HSCSTS.LPReached	bit	2...9	read only

(1) For Mode descriptions, see [HSC Mode \(HSCAPP.HSCMode\) on page 140](#).

The Low Preset Reached status flag is set (1) by the HSC sub-system whenever the accumulated value (HSCSTS.Accumulator) is less than or equal to the low preset variable HSCAPP.LPSetting).

This bit is updated continuously by the HSC sub-system whenever the controller is in an executing mode. Writing to this element is not recommended.

## Overflow Interrupt (HSCSTS.OFCauseInter)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
HSCSTS.OFCauseInter	bit	0...9	read/write

(1) For Mode descriptions, see [HSC Mode \(HSCAPP.HSCMode\) on page 140](#).

The Overflow Interrupt status bit is set (1) when the HSC accumulator counts through the overflow value and the HSC interrupt is triggered. This bit can be used in the control program to identify that the overflow variable caused the HSC interrupt. If the control program needs to perform any specific control action based on the overflow, this bit is used as conditional logic.

This bit can be cleared (0) by the control program and is also cleared by the HSC sub-system whenever these conditions are detected:

- Low Preset Interrupt executes
- High Preset Interrupt executes
- Underflow Interrupt executes

## Underflow Interrupt (HSCSTS.UFCauseInter)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
HSCSTS.UFCauseInter	bit	2...9	read/write

(1) For Mode descriptions, see [HSC Mode \(HSCAPP.HSCMode\) on page 140](#).

The Underflow Interrupt status bit is set (1) when the HSC accumulator counts through the underflow value and the HSC interrupt is triggered. This bit can be used in the control program to identify that the underflow condition caused the HSC interrupt. If the control program needs to perform any specific control action based on the underflow, this bit is used as conditional logic.

This bit can be cleared (0) by the control program and is also cleared by the HSC sub-system whenever these conditions are detected:

- Low Preset Interrupt occurs

- High Preset Interrupt occurs
- Overflow Interrupt occurs

### High Preset Interrupt (HSCSTS.HPCauseInter)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
HSCSTS.HPCauseInter	bit	0...9	read/write

(1) For Mode descriptions, see [HSC Mode \(HSCAPP.HSCMode\) on page 140](#).

The High Preset Interrupt status bit is set (1) when the HSC accumulator reaches the high preset value and the HSC interrupt is triggered. This bit can be used in the control program to identify that the high preset condition caused the HSC interrupt. If the control program needs to perform any specific control action based on the high preset, this bit is used as conditional logic.

This bit can be cleared (0) by the control program and is also cleared by the HSC sub-system whenever these conditions are detected:

- Low Preset Interrupt occurs
- Underflow Interrupt occurs
- Overflow Interrupt occurs

### Low Preset Interrupt (HSCSTS.LPCauseInter)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
HSCSTS.LPCauseInter	bit	2...9	read/write

(1) For Mode descriptions, see [HSC Mode \(HSCAPP.HSCMode\) on page 140](#).

The Low Preset Interrupt status bit is set (1) when the HSC accumulator reaches the low preset value and the HSC interrupt has been triggered. This bit can be used in the control program to identify that the low preset condition caused the HSC interrupt. If the control program needs to perform any specific control action based on the low preset, this bit would be used as conditional logic.

This bit can be cleared (0) by the control program and is also be cleared by the HSC sub-system whenever these conditions are detected:

- High Preset Interrupt occurs
- Underflow Interrupt occurs
- Overflow Interrupt occurs

### Programmable Limit Switch Position (HSCSTS.PLSPosition)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
HSCSTS.PLSPosition	Word (INT)	0...9	read only

(1) For Mode descriptions, see [HSC Mode \(HSCAPP.HSCMode\) on page 140](#).

When the HSC is in Counting mode, and PLS is enabled, this parameter indicates which PLS element is used for the current HSC configuration.

### Error Code (HSCSTS.ErrorCode)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
HSCSTS.ErrorCode	Word (INT)	0...9	read only

(1) For Mode descriptions, see [HSC Mode \(HSCAPP.HSCMode\) on page 140](#).

The Error Codes detected by the HSC sub-system are displayed in this word.

Errors include:

Error Code Sub-element	HSC counting Error Code	Error Description
Bit 15...8 (high byte)	0...255	The non-zero value for high byte indicates that the HSC error is due to PLS data setting. The value of high byte indicates which element of PLS data triggers the error.
Bit 7-0 (low byte)	0x00	No error
	0x01	Invalid HSC counting mode
	0x02	Invalid High preset
	0x03	Invalid overflow
	0x04	Invalid underflow
	0x05	No PLS data

Writing to this element is not recommended except for clearing existing errors and to capture new HSC errors.

### Accumulator (HSCSTS.Accumulator)

Description	Data Format	User Program Access
HSCSTS.Accumulator	long word (32-bit INT)	read only

HSCSTS.Accumulator contains the number of counts detected by the HSC sub-system. If either mode 0 or mode 1 is configured, the accumulator is reset to 0 when a high preset is reached or when an overflow condition is detected.

### High Preset (HSCSTS.HP)

Description	Data Format	User Program Access
HSCSTS.HP	long word (32-bit INT)	read only

The HSCSTS.HP is the upper setpoint (in counts) that defines when the HSC sub-system generates an interrupt.

The data loaded into the high preset must be less than or equal to the data resident in the overflow (HSCAPP.OFSetting) parameter or an HSC error is generated.

This is the latest high preset setting, which may be updated by PLS function from the PLS data block.

### Low Preset (HSCSTS.LP)

Description	Data Format	User Program Access
HSCSTS.LP	long word (32-bit INT)	read only

The HSCSTS.LP is the lower setpoint (in counts) that defines when the HSC sub-system generates an interrupt.

The data loaded into the low preset must greater than or equal to the data resident in the underflow (HSCAPP.UFSetting) parameter, or an HSC error is generated. If the underflow and low preset values are negative numbers, the low preset must be a number with a smaller absolute value.

This is the latest low preset setting, which may be updated by PLS function from the PLS data block.

### High Preset Output (HSCSTS.HPOutput)

Description	Data Format	User Program Access
HSCSTS.HPOutput	long word (32-bit binary)	read only

The High Preset Output defines the state (1 = ON or 0 = OFF) of the outputs on the controller when the high preset is reached. See Output Mask Bits (HSCAPP.OutputMask) on page 148 for more information on how to directly turn outputs on or off based on the high preset being reached.

This is the latest high preset output setting, which may be updated by PLS function from the PLS data block.

### Low Preset Output (HSCSTS.LPOutput)

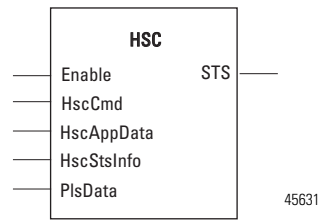
Description	Data Format	User Program Access
HSCSTS.LPOutput	long word (32-bit binary)	read only

The Low Preset Output defines the state (1 = “on”, 0 = “off”) of the outputs on the controller when the low preset is reached. See Output Mask Bits (HSCAPP.OutputMask) on page 148 for more information on how to directly turn outputs on or off based on the low preset being reached.

This is the latest low preset output setting, which may be updated by PLS function from the PLS data block.

## HSC (High Speed Counter) Function Block

The HSC function block can be used to start/stop HSC counting, to refresh HSC status, to reload HSC setting, and to reset HSC accumulator.



### HSC Parameters

Parameter	Parameter Type	Data Type	Parameter Description
Enable	Input	BOOL	Enable function block. When Enable = TRUE, perform the HSC operation specified in "HSC command" parameter. When Enable = FALSE, there is no HSC operation, and no HSC status update.
HscCmd	Input	USINT	Refer to HSC Commands on page 158
HscAppData	Input	See HSC APP Data Structure on page 139	HSC application configuration. Only initial configuration is needed usually.
PlsData	Input	See array of Programmable Limit Switch (PLS) Function on page 159	Programmable Limit Switch (PLS) Data
HscStsInfo	Output	See HSC STS (HSC Status) Data Structure on page 150	HSC dynamic status. Status info is usually continuously updated during HSC counting.
Sts	Output	UINT	HSC function block execution status

### HSC Commands (HscCmd)

HscCmd is an input parameter with data type USINT. All HSC commands (1...4) are Level commands. Users are advised to disable the instruction before updating the command.

**HscCmd = 1** starts the HSC mechanism. Once the HSC is in running mode, the **HscCmd = 2** must be issued to stop counting. Setting the Enable input parameter to False does not stop counting while in running mode.

**HscCmd = 3** reloads the following parameter values: HighPreset, LowPreset, Overflow, UnderFlow, HighPreset Output, and LowPreset Output.

The parameter values shown in the Variable Monitor may not match the values in the Hardware. Command 3 must be executed to load the values from the variables to the hardware without stopping the HSC.

If the HSC Enable is True, HscCmd = 3 will continuously load the parameters. Trigger HscCmd = 3 only once.

**HscCmd = 4** (reset) sets the Acc value to the HSC AppData.Accumalator value. The HscCmd =4 does not stop HSC counting. If HSC is counting when the HscCmd =4 is issued, some counting may be lost.

To reset the Acc value and then continue the counting, trigger the HscCmd =4 only once. If the command is enabled continuously, it may cause errors.

HSC AppData.Accumalator value is updated automatically by the HSC mechanism with the same value as the HSC Sts.Accumulator. To set one specific value to HSC Acc while counting, write the value to HSC AppData.Accumalator immediately before HscCmd =4 is issued.

### HSC Commands

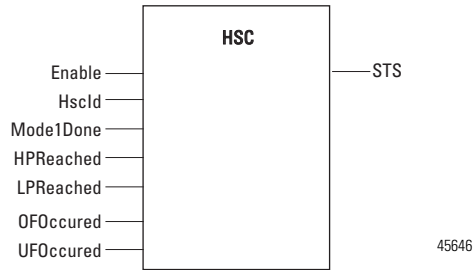
HSC Command	Description
0x00	Reserved
0x01	HSC RUN <ul style="list-style-type: none"> <li>• Start HSC (if HSC in Idle mode and Rung is Enabled)</li> <li>• Update HSC Status Info only (if HSC already in RUN mode and Rung is Enabled)</li> <li>• Update HSC status Info only (if Rung is disabled)</li> </ul>
0x02	HSC Stop: Stop a HSC counting (if HSC is in RUN mode and Rung is Enabled.)
0x03	HSC Load: reload HSC Configuration (if Rung is Enabled) for 6 input elements: HPSSetting, LPSetting, HPOOutput, LPOOutput, OFSetting, and UFSetting. HSC accumulator is NOT reloaded by cmd = 0x03.
0x04	HSC Reset: set Accumulator to assigned value, and reset HSC status information (if Rung is Enabled)

### HSC Function Block Status Codes

HSC Status Code	Description
0x00	No action from Controller because the function block is not enabled
0x01	HSC function block successfully executed
0x02	HSC command invalid
0x03	HSC ID out of range
0x04	HSC Configuration Error



## HSC\_SET\_STS Function Block



The HSC Set Status function block can be used to change the HSC counting status. This function block is called when the HSC is not counting (stopped).

### HSC Parameters

Parameter	Parameter Type	Data Type	Parameter Description
Enable	Input	BOOL	Enable function block. When Enable = TRUE, set/reset the HSC status. When Enable = FALSE, there is no HSC status change.
HscId	Input	See HSC APP Data Structure on page 139	Describes which HSC status to set.
Mode1Done	Input	BOOL	Mode 1A or 1B counting is done.
HPReached	Input	BOOL	High Preset reached. This bit can be reset to FALSE when HSC is not counting.
LPReached	Input	BOOL	Low Preset reached. This bit can be reset to FALSE when HSC is not counting.
OFOccurred	Input	BOOL	Overflow occurred. This bit can be reset to FALSE when necessary.
UFOccurred	Input	BOOL	Underflow occurred. This bit can be reset to FALSE when necessary.
Sts	Output	UINT	HSC function block execution status Refer to HSC Function Block Status Codes on page 158 for HSC status code description (except 0x02 and 0x04).

## Programmable Limit Switch (PLS) Function

The Programmable Limit Switch function allows you to configure the High-Speed Counter to operate as a PLS (programmable limit switch) or rotary cam switch.

When PLS operation is enabled (`HSCAPP.PLSEnable = True`), the HSC (High-Speed Counter) uses PLS data for limit/cam positions. Each limit/cam position has corresponding data parameters that are used to set or clear physical outputs on the controller's base unit. The PLS data block is illustrated below.

**IMPORTANT** The PLS Function only operates in tandem with the HSC of a Micro830 controller. To use the PLS function, an HSC must first be configured.

### PLS Data structure

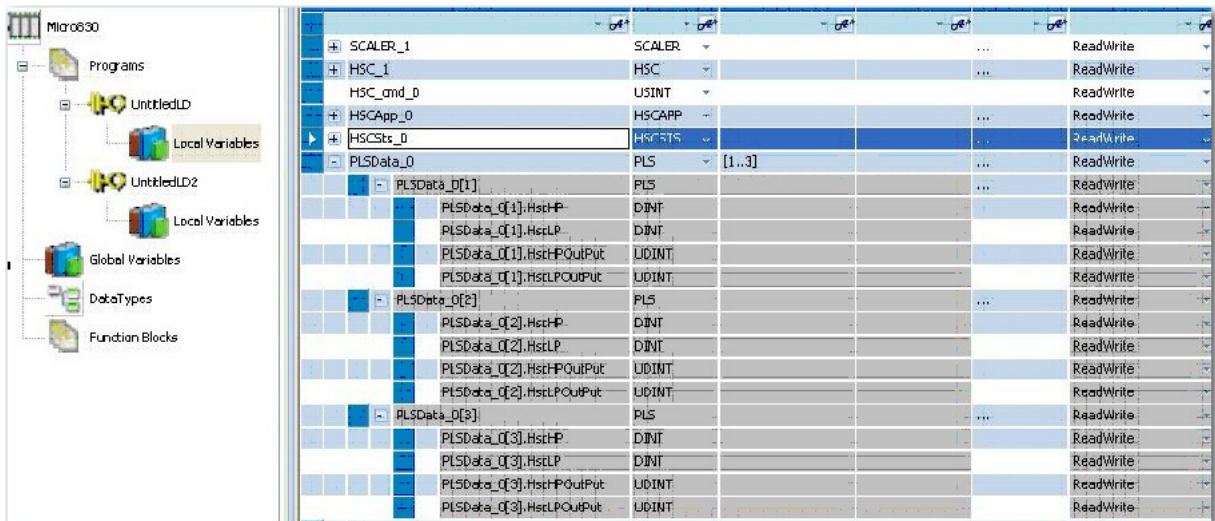
The Programmable Limit Switch function is an additional set of operating modes for the High Speed Counter. When operating in these modes, the preset and output data values are updated using user supplied data each time one of the presets is reached. These modes are programmed by providing a PLS data block that contains the data sets to be used.

PLS data structure is a flexible array, with each element defined as follows,

Element Order	Data Type	Element Description
Word 0...1	DINT	High preset setting
Word 2...3	DINT	Low preset setting
Word 4...5	UDINT	High preset Output data
Word 6...7	UDINT	Low preset Output data

The total number of elements for one PLS data cannot be larger than 255.

When PLS is not enabled, PLS data are still required to be defined, but can be not initialized.



### PLS Operation

When the PLS function is enabled, and the controller is in the run mode, the HSC counts incoming pulses. When the count reaches the first preset (HstHP or HstLP) defined in the PLS data, the output source data (HstHPOutput or HstLPOutput) is written through the HSC mask (HstAPP.OutputMask).

At that point, the next presets (HSCHP and HSCLP) defined in the PLS data become active.

When the HSC counts to that new preset, the new output data is written through the HSC mask. This process continues until the last element within the PLS data block is loaded. At that point the active element within the PLS data block is reset to zero. This behavior is referred to as circular operation.

**TIP** The HSCOutput is only written when HSCHP is reached. The HSCLOutput is written when HSCLP is reached.

**TIP** Output High Data is only operational when the counter is counting up. Output Low Data is only operational when the counter is counting down.

If invalid data is loaded during operation, an HSC error is generated and causes a controller fault.

You can use the PLS in Up (high), Down (low), or both directions. If your application only counts in one direction, ignore the other parameters.

The PLS function can operate with all of the other HSC capabilities. The ability to select which HSC events generate a user interrupt are not limited.

## PLS Example

### *Setting Up the PLS data*

Using Connected Components Workbench, define the PLS data HSC\_PLS's dimension as [1..4].

#### **PLS Data Definition**

<b>Data</b>	<b>Description</b>	<b>Data Format</b>
HSCHP	High Preset	32-bit signed integer
HSCLP	Low Preset	
HSCHPOutput	Output High Data	32-bit binary (bit 31--> 0000 0000 0000 0000 0000 0000 0000 0000 <--bit 0)
HSCLPOutput	Output Low Data	

Name	Data Type	Dimension	Initial Value	Attribute
HSC_1	HSC		...	ReadWrite
HSC_STS	HSCSTS		...	ReadWrite
HSC_APP	HSCAPP		...	ReadWrite
HSC_PLS	PLS	[1..4]	...	ReadWrite
HSC_PLS[1]	PLS		...	ReadWrite
HSC_PLS[1].HscHP	DINT		250	ReadWrite
HSC_PLS[1].HscLP	DINT		-2	ReadWrite
HSC_PLS[1].HscHPOutPut	UDINT		3	ReadWrite
HSC_PLS[1].HscLPOutPut	UDINT		0	ReadWrite
HSC_PLS[2]	PLS		...	ReadWrite
HSC_PLS[2].HscHP	DINT		500	ReadWrite
HSC_PLS[2].HscLP	DINT		-2	ReadWrite
HSC_PLS[2].HscHPOutPut	UDINT		7	ReadWrite
HSC_PLS[2].HscLPOutPut	UDINT		0	ReadWrite
HSC_PLS[3]	PLS		...	ReadWrite
HSC_PLS[3].HscHP	DINT		750	ReadWrite
HSC_PLS[3].HscLP	DINT		-2	ReadWrite
HSC_PLS[3].HscHPOutPut	UDINT		15	ReadWrite
HSC_PLS[3].HscLPOutPut	UDINT		0	ReadWrite
HSC_PLS[4]	PLS		...	ReadWrite
HSC_PLS[4].HscHP	DINT		1000	ReadWrite
HSC_PLS[4].HscLP	DINT		-2	ReadWrite
HSC_PLS[4].HscHPOutPut	UDINT		31	ReadWrite
HSC_PLS[4].HscLPOutPut	UDINT		0	ReadWrite

Once the values above for all 4 PLS data elements have been entered, the PLS is configured.

Assume that HSCAPP.OutputMask = 31 (HSC mechanism controls Embedded Output 0...4 only), and HSCAPP.HSCMode = 0.

### PLS Operation for This Example

When the ladder logic first runs, HSCSTS.Accumulator = 1, therefore all the outputs are turned off. The value of HSCSTS.HP = 250

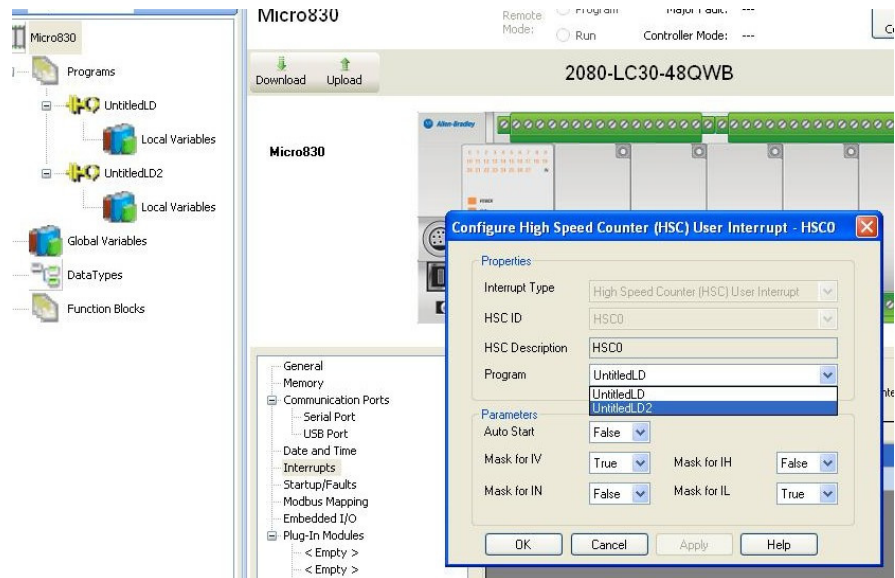
When HSCSTS.Accumulator = 250, the HSC\_PLS[1].HscHPOutput is sent through the HSCAPP.OutputMask and energizes the outputs 0 and 1.

This will repeat as the HSCSTS.Accumulator reaches 500, 750, and 1000. The controller energizes outputs 0...2, 0...3, and 0...4 respectively. Once completed, the cycle resets and repeats from HSCSTS.HP = 250.

## HSC Interrupts

An interrupt is an event that causes the controller to suspend the task it is currently performing, perform a different task, and then return to the suspended task at the point where it suspended. Micro800 supports up to six HSC interrupts.

An HSC interrupt is a mechanism that Micro830, Micro850, and Micro870 controllers provide to execute selected user logic at a pre-configured event.

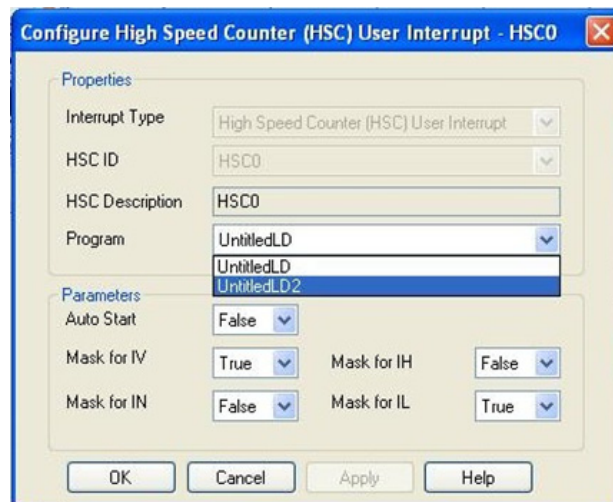


HSC0 is used in this document to define how HSC interrupts work.

## HSC Interrupt Configuration

In the User Interrupt configuration window, select HSC, and HSC ID, which is the interrupt triggering the User Interrupt.

The following diagram shows the selectable fields in the Interrupt configuration window.



## HSC Interrupt POU

This is the name of the Program Organizational Unit (POU) which is executed immediately when this HSC Interrupt occurs. You can choose any pre-programmed POU from the drop-down list.

### Auto Start (HSC0.AS)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
AS - Auto Start	bit	0...9	read only

(1) For Mode descriptions, see Count Down (HSCSTS.CountDownFlag) on page 151.

The Auto Start is configured with the programming device and stored as part of the user program. The auto start bit defines if the HSC interrupt function automatically starts whenever the controller enters any run or test mode.

### Mask for IV (HSC0.MV)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
MV - Overflow Mask	bit	0...9	read only

(1) For Mode descriptions, see Count Down (HSCSTS.CountDownFlag) on page 151..

The MV (Overflow Mask) control bit is used to enable (allow) or disable (not allow) an overflow interrupt from occurring. If this bit is clear (0), and an overflow reached condition is detected by the HSC, the HSC user interrupt is not executed.

This bit is controlled by the user program and retains its value through a power cycle. It is up to the user program to set and clear this bit.

### Mask for IN (HSC0.MN)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
MN - Underflow Mask	bit	2...9	read only

(1) For Mode descriptions, see Count Down (HSCSTS.CountDownFlag) on page 151.

The MN (Underflow Mask) control bit is used to enable (allow) or disable (not allow) a underflow interrupt from occurring. If this bit is clear (0), and a Underflow Reached condition is detected by the HSC, the HSC user interrupt is not executed.

This bit is controlled by the user program and retains its value through a power cycle. It is up to the user program to set and clear this bit.

## Mask for IH (HSC0.MH)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
MH - High Preset Mask	bit	0...9	read only

(1) For Mode descriptions, see Count Down (HSCSTS.CountDownFlag) on page 151.

The MH (High Preset Mask) control bit is used to enable (allow) or disable (not allow) a high preset interrupt from occurring. If this bit is clear (0), and a High Preset Reached condition is detected by the HSC, the HSC user interrupt is not executed.

This bit is controlled by the user program and retains its value through a power cycle. It is up to the user program to set and clear this bit.

## Mask for IL (HSC0.ML)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
ML - Low Preset Mask	bit	2...9	read only

(1) For Mode descriptions, see Count Down (HSCSTS.CountDownFlag) on page 151.

The ML (Low Preset Mask) control bit is used to enable (allow) or disable (not allow) a low preset interrupt from occurring. If this bit is clear (0), and a Low Preset Reached condition is detected by the HSC, the HSC user interrupt is not executed.

This bit is controlled by the user program and retains its value through a power cycle. It is up to the user program to set and clear this bit.

## HSC Interrupt Status Information

### User Interrupt Enable (HSC0.Enabled)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
HSC0.Enabled	bit	0...9	read only

(1) For Mode descriptions, see Count Down (HSCSTS.CountDownFlag) on page 151.

The Enabled bit is used to indicate HSC interrupt enable or disable status.

### User Interrupt Executing (HSC0.EX)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
HSC0.EX	bit	0...9	read only

(1) For Mode descriptions, see Count Down (HSCSTS.CountDownFlag) on page 151.

The EX (User Interrupt Executing) bit is set (1) whenever the HSC sub-system begins processing the HSC subroutine due to any of the following conditions:

- Low preset reached
- High preset reached
- Overflow condition – count up through the overflow value
- Underflow condition – count down through the underflow value

The HSC EX bit can be used in the control program as conditional logic to detect if an HSC interrupt is executing.

The HSC sub-system will clear (0) the EX bit when the controller completes its processing of the HSC subroutine.

### User Interrupt Pending (HSC0.PE)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
HSC0.PE	bit	0...9	read only

(1) For Mode descriptions, see Count Down (HSCSTS.CountDownFlag) on page 151.

The PE (User Interrupt Pending) is a status flag that represents an interrupt is pending. This status bit can be monitored or used for logic purposes in the control program if you need to determine when a subroutine cannot be executed immediately. This bit is maintained by the controller and is set and cleared automatically.

### User Interrupt Lost (HSC0.LS)

Description	Data Format	HSC Modes <sup>(1)</sup>	User Program Access
HSC0.LS	bit	0...9	read/write

(1) For Mode descriptions, see Count Down (HSCSTS.CountDownFlag) on page 151.

The LS (User Interrupt Lost) is a status flag that represents an interrupt has been lost. The controller can process 1 active and maintain up to 1 pending user interrupt conditions before it sets the lost bit.

This bit is set by the controller. It is up to the control program to utilize, track the lost condition if necessary.

## Use HSC

To use HSC, refer to [Use the High Speed Counter on page 264](#).



## Controller Security

Micro800 security generally has two components:

- **Exclusive Access** which prevents simultaneous configuration of the controller by two users
- **Controller Password Protection** which secures the Intellectual Property contained within the controller and prevents unauthorized access

### Exclusive Access

Exclusive access is enforced on the Micro800 controller regardless of whether the controller is password-protected or not. This means that only one Connected Components Workbench session is authorized at one time and only an authorized client has exclusive access to the controller application. This ensures that only one software session has exclusive access to the Micro800 application-specific configuration.

Exclusive access is enforced on Micro800 firmware revision 1 and 2. When a Connected Components Workbench user connects to a Micro800 controller, the controller is given exclusive access to that controller.

### Password Protection

By setting a password on the controller, a user effectively restricts access to the programming software connections to the controller to software sessions that can supply the correct password. Essentially, Connected Components Workbench operation such as upload and download are prevented if the controller is secured with a password and the correct password is not provided.

Micro800 controllers with firmware revision 2 and later are shipped with no password but a password can be set through the Connected Components Workbench software (revision 2 or later).

In Connected Components Workbench software revision 10 or later, a stronger password algorithm is introduced to provide better security. To take full advantage of this enhancement, the Micro800 controller must have firmware revision 10 or later, and the project must also be version 10 or later.

The controller password is also backed up to the memory backup module (that is, 2080-MEMBAK-RTC2 for Micro830, Micro850 and Micro870; 2080-MEMBAK-RTC for Micro830 and Micro850; 2080-LCD for Micro810; and microSD card for Micro820 controllers).

**TIP** For instructions on how to set, change, and clear controller passwords, see [Configure Controller Password on page 261](#).

## Compatibility

The Controller Password feature is supported on:

- Connected Components Workbench **revision 2** and later
- Micro800 controllers with **revision 2** firmware

For users with earlier versions of the software and/or hardware, refer to the compatibility scenarios below.

### *Connected Components Workbench revision 1 with Micro800 controller firmware revision 2*

Connection to a Micro800 controller with firmware revision 2 using an earlier version of the Connected Components Workbench software (revision 1) is possible and connections will be successful. However, the software will not be able to determine whether the controller is locked or not.

If the controller is not locked, access to the user application will be allowed, provided the controller is not busy with another session. If the controller is locked, access to the user application will fail. Users will need to upgrade to revision 2 of the Connected Components Workbench software.

### *Connected Components Workbench revision 2 with Micro800 controller firmware revision 1*

Connected Components Workbench revision 2 is capable of "discovering" and connecting to Micro800 controllers with firmware revision earlier than revision 2 (that is, not supporting the Controller Password feature). However, the Controller Password feature will not be available to these controllers. The user will not be able see interfaces associated with the Controller Password feature in the Connected Components Workbench session.

Users are advised to upgrade the firmware. See [Flash Upgrade Your Micro800 Firmware on page 247](#) for instructions.



**ATTENTION:** Connected Components Workbench revision 9 or earlier with Micro800 controller revision 10 or later

If a Micro800 controller with firmware revision 10 or later is locked using the new password algorithm introduced in Connected Components Workbench software revision 10 or later, it cannot be accessed using Components Workbench software revision 9 or earlier. Users are advised to upgrade to the latest version of Connected Components Workbench software.

---

## Work with a Locked Controller

The following workflows are supported on compatible Micro800 controllers (firmware revision 2) and Connected Components Workbench software revision 2.

### Upload from a Password-Protected Controller

1. Launch the Connected Components Workbench software.
2. In the Project Organizer, expand Catalog by clicking the + sign.
3. Select the target controller.
4. Select Upload.
5. When requested, provide the controller password.

---

**IMPORTANT** When using Connected Components Workbench software revision 9 or earlier:

- You cannot upload a revision 10 or later project from the controller.
- You can upload a revision 9 or earlier project from the controller if it was downloaded to the controller using Connected Components Workbench software revision 10 or later, but you cannot go online.

---

### Debug a Password-Protected Controller

To debug a locked controller, you have to connect to the controller through the Connected Components Workbench software and provide the password before you can proceed to debug.

1. Launch the Connected Components Workbench software.
2. In the Project Organizer, expand Catalog by clicking the + sign.
3. Select the catalog number of your controller.
4. When requested, provide the controller password.
5. Build and save your project.
6. Debug.

### Download to a Password-Protected Controller

1. Launch the Connected Components Workbench software.
2. Click Connect.
3. Select the target controller.
4. When requested, provide the controller password.
5. Build and save the project, if needed.

6. Click Download.
7. Click Disconnect.

---

**IMPORTANT** If the controller has a password locked revision 10 or later project, you cannot access the controller using Connected Workbench software revision 9 or earlier. If you use Connected Components Workbench software revision 10 or later to download a revision 9 or earlier project, the password in the controller will be automatically converted to the old algorithm.

---

---

**IMPORTANT** If the controller has a password locked revision 9 or earlier project and you use Connected Components Workbench software revision 10 or later, to download a revision 10 or later project, the password in the controller will be automatically converted to the new algorithm.

---

---

**IMPORTANT** If communication is lost during the download, repeat the download and verify that the controller is password protected.

---

## Transfer Controller Program and Password-Protect Receiving Controller

In this scenario, the user needs to transfer user application from controller1 (locked) to another Micro800 controller with the same catalog number. The transfer of the user application is done through the Connected Components Workbench software by uploading from controller1, then changing the target controller in the Micro800 project, and then downloading to controller2. Finally, controller2 will be locked.

1. In the Project Organizer, click the Discover icon.  
The Browse Connections dialog appears.
2. Select target controller1.
3. When requested, enter the controller password for controller1.
4. Build and save the project.
5. Click Disconnect.
6. Power down controller1.
7. Swap controller1 hardware with controller2 hardware.
8. Power up controller2.
9. Click Connect.
10. Select target controller2.
11. Click Download.
12. Lock controller2. See [Configure Controller Password on page 261](#).

---

## Back Up and Restore a Password-Protected Controller

In this workflow, user application will be backed up from a Micro800 controller that is locked to a memory plug-in device.

1. In the Project Organizer, click the Discover icon.  
The Browse Connections dialog appears.
2. Select the target controller.
3. When requested, enter the controller password.
4. Back up controller contents to the memory module.  
The project in the memory module is now password locked.
5. Remove the memory module from controller1 and insert into controller2.
6. Restore contents from the memory module to controller2.  
This operation succeeds only if:
  - the controller has no password – the project can be restored to the controller by setting the “Load on power up” option for the memory module to Load Always.
  - the controller’s password matches the project’s password.

---

**IMPORTANT** Even though the password matches, the restore operation will fail if either one of the controller or project in the memory module is protected using the old password algorithm, and the other is protected using the new password algorithm. You can flash update the controller using the Reset option to clear the password before restoring the project to the controller.

---

## Configure Controller Password

To set, change, and clear controller password, see the quickstart instructions [Configure Controller Password on page 261](#).

---

**IMPORTANT** After creating or changing the controller password, you need to power down the controller in order for the password to be saved.

---

## Recover from a Lost Password

If the controller is secured with a password and the password has been lost, then it becomes impossible to access the controller using the Connected Components Workbench software.

To recover, the controller must be set to Program Mode using the keyswitch for Micro830, Micro850, and Micro870 controllers, the 2080-LCD for Micro810 controllers, or the 2080-REMLCD for Micro820 controllers. Then, ControlFlash can be used to update the controller firmware, which also clears the controller memory. In Connected Components Workbench software version 10 or later, the Reset option must be selected for the controller memory to be cleared during the firmware update. If the Upgrade or Downgrade option is selected, the password is retained.



**ATTENTION:** The project in the controller will be lost but a new project can be downloaded.

---

## Using the Memory Module Plug-in

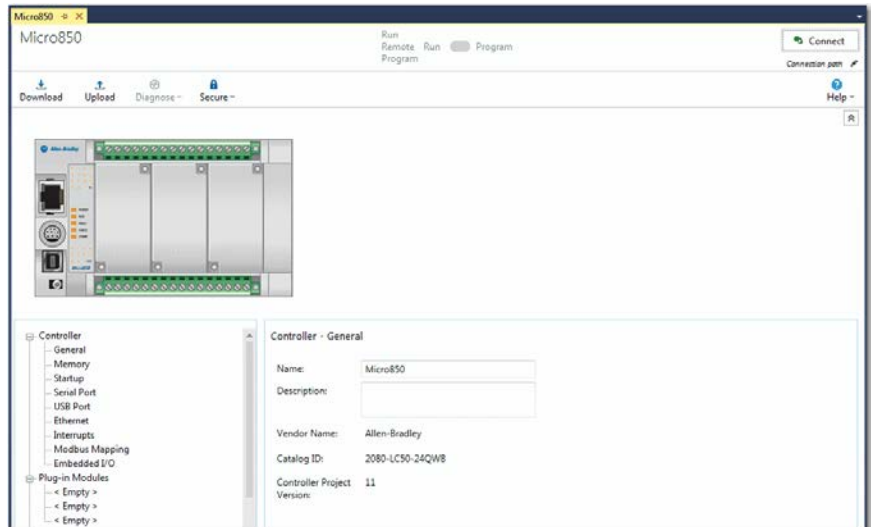
You can use the memory module to download a program into different controllers. Make sure that the module is compatible with the Micro800 controllers. The 2080-MEMBAK-RTC2 module is compatible with Micro 830, Micro850, and Micro870 controllers. The 2080-MEMBAK-RTC module is compatible with Micro830 and Micro850 controllers.

### *Back up the project*

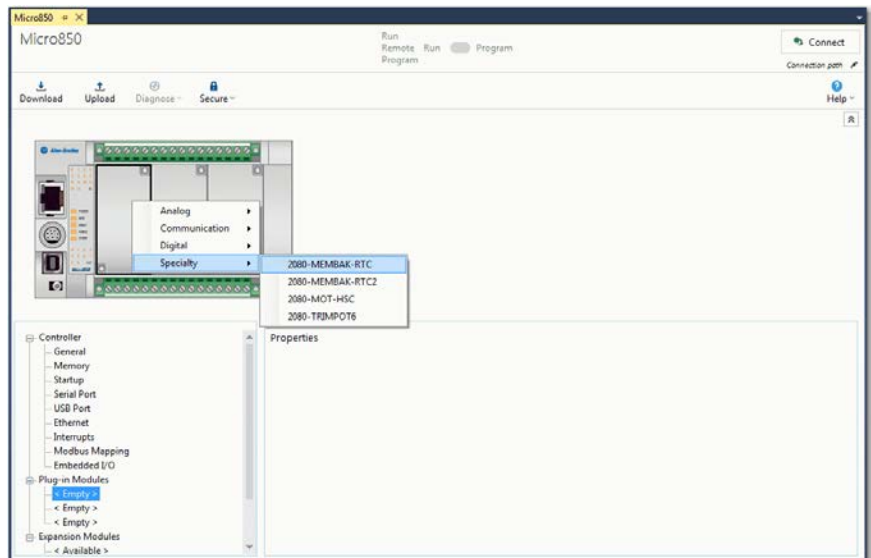
To perform a project backup from a controller to the memory module, follow these steps:

1. Create a new program and choose the desired controller.  
The Micro850 controller is used for this example.

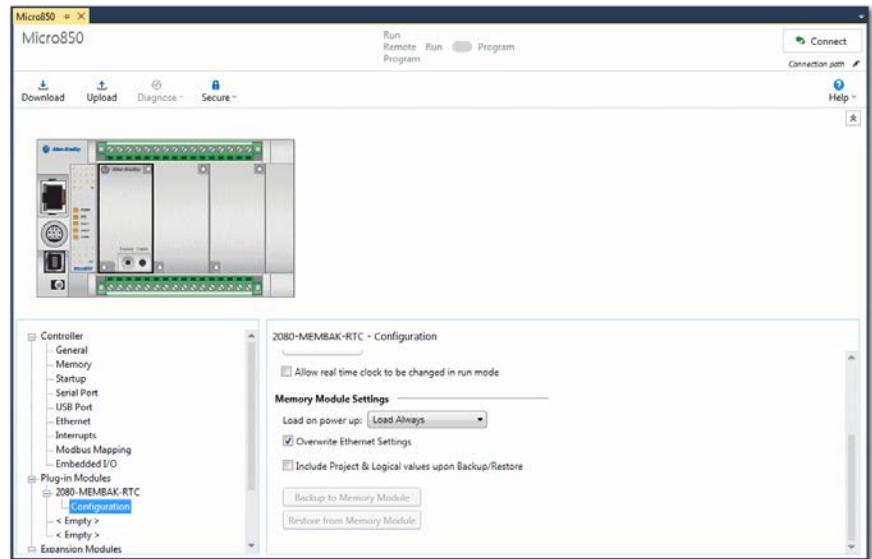
2. Double-click on the controller icon under Project Organizer to bring up the controller properties window.



3. Add the memory module to the first slot in the controller.



- Click on Configuration under the MEMBAK-RTC properties and select “Load Always” or “Load on Memory Error” for the Load on power up option.



- Build and Download the project to the controller.
- While connected to the controller and being in the MEMBAK-RTC properties, make sure that the controller is changed to Program Mode and click on “Backup to Memory Module” under Memory Module Settings. Select Yes to download the program into the Memory Module. A window should pop up stating that the operation has been completed successfully.

---

**IMPORTANT** The Password Mismatch status must be at “False”, this means that the Controller and Backup project have the same security condition. If the status is “True” then the Controller will not load from the Memory module as the security condition is mismatched.

---

### *Restore the project*

To restore the project from the memory module to the controller, follow these steps:

- While connected to the controller and being in the MEMBAK-RTC properties, make sure that the controller is changed to Program Mode and click on “Restore from Memory Module” under Memory Module Settings. Select Yes to download the program into the controller. A window should pop up stating that the operation has been completed successfully.



*Using the memory module to copy a project to multiple controllers*

You can use the memory module to download a project to multiple controllers without connecting them to a PC with Connected Components Workbench software installed. To do this:

1. Back up a project with “Load Always” option enabled.
2. Remove the module and plug it into a different controller.
3. Cycle the power. Observe the Status LED on the module lights up for a few seconds while the project is being downloaded from the module to the controller.
4. When the operation is finished you can unplug the module and leave the slot empty, or plug in a different MEMBAK-RTC module if you want to use the RTC functionality.

**Notes:**

## Using microSD Cards

This chapter provides a description of microSD card support on Micro830, Micro850, and Micro870 controllers.

Topic	Page
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The last section provides quickstart projects for the data log and recipe functions.

### Overview

With firmware revision 12.011 or later, Micro830, Micro850, and Micro870 controllers support microSD cards through the use of the microSD card plug-in (an Encompass™ partner product) for Micro800 controllers for the following purposes:

- Project backup and restore
- Data log and Recipe

We recommend to use the Allen-Bradley 2080-SD-2GB microSD card.

---

**IMPORTANT** For optimum performance, the microSD card should not be more than 90% full. Regularly check available space on your microSD card and ensure that the card is exclusively used for the Micro800 controller and no unnecessary files are present. Regularly delete old data log files and directories.

---

**IMPORTANT** Do not remove the microSD card or power down while operations such as upload, download, delete, search, backup and restore are ongoing to prevent data loss. A blinking SD status LED indicates that these operations are ongoing.

Note the following:

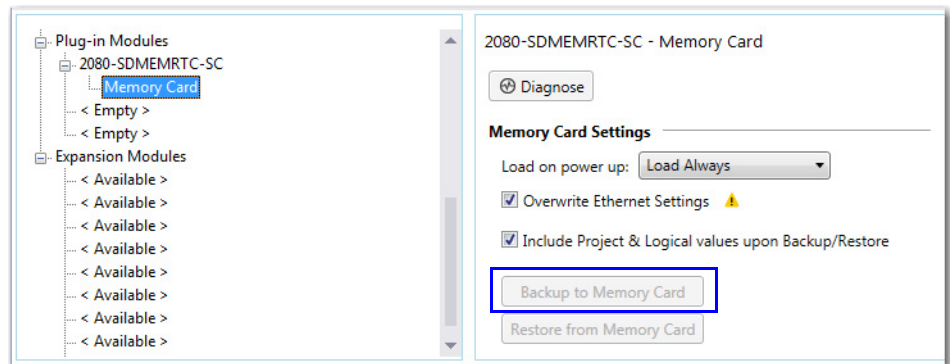
- The SD status LED will not blink when flash upgrading the firmware from the microSD card.
- The SD status LED does not blink continuously for the entire duration of the restore operation.

**IMPORTANT** To prevent data loss, recipe and data log function blocks must indicate Idle status before microSD card is removed.

## Project Backup and Restore

Project backup and restore on Micro830, Micro850, and Micro870 controllers are mainly supported through the microSD card. Both backup and restore can be initiated or manually triggered and configured through the Connected Components Workbench, and the ConfigMeFirst.txt file in the microSD card. These backup files are not the same as Connected Components Workbench project files.

Backup and restore can only occur when the controller is in PROGRAM mode. On controller powerup, restore automatically occurs if the Load Always or Load on Memory Error option has been configured in Connected Components Workbench.



**IMPORTANT** To learn about restore and backup using the Connected Components Workbench, refer to the software Online Help.

**IMPORTANT** For Micro800 controllers that support microSD cards, IP protection of user project can only be achieved through the POU password protection mechanism in Connected Components Workbench (Developer Edition) and NOT via Controller Lock feature.

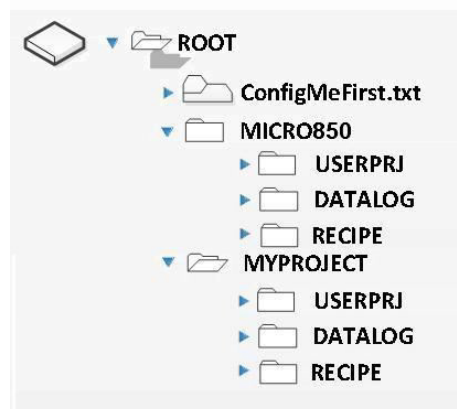
**IMPORTANT** If the Load Always setting is enabled and power is lost when restoring a project from the microSD card, the controller will attempt to load the project using the default project name and directory after power is restored. If your project is not using the default name and directory, the operation will fail and a fault occurs, or the wrong project will be loaded. The default project name is the name of the controller, for example “Micro850”, and the default directory is “Micro850\USERPRJ”. If you change the name of the controller from the default, you must configure the UPD setting in the ConfigMeFirst.txt file.

The microSD card stores the controller password in encrypted format. When the password is mismatched, the contents of the microSD card is not restored on the controller.

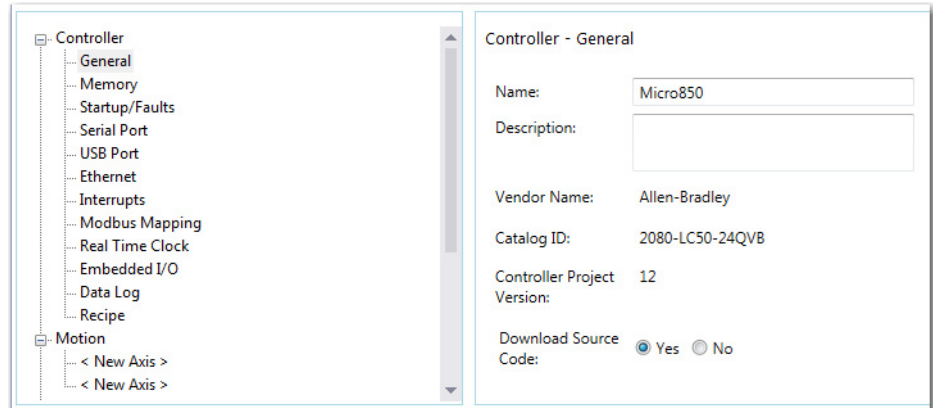
Backup and restore can be configured to trigger through the following ways:

Method	Backup	Restore
Online with Connected Components Workbench	Yes	Yes
Project configuration on memory card at powerup	No	Load Always and/or Load on Memory Error options
ConfigMeFirst.txt at powerup	Yes (Through the [BKD] command)	Yes (Through the [RSD] command)

## Backup and Restore Directory Structure



When a user project is backed up, a subdirectory named <Micro800>\USERPRJ is created on the microSD card. The folder name takes the name of the project specified in the General Page in Connected Components Workbench, which is the name of the controller by default. However, if the ConfigMeFirst.txt file specifies a different subdirectory (example: MyProject), the project is backed up to that directory. See [General Configuration Rules in ConfigMeFirst.txt on page 182](#).



Project restore is done from the subdirectory specified in ConfigMeFirst.txt file or the <Micro800>/USERPRJ default folder, if none is specified in the ConfigMeFirst.txt file. The user needs to ensure that the directory is populated with correct contents before restoring.

The ConfigMeFirst.txt file is a configuration file stored on the microSD card that the user can optionally create to customize backup, restore, recipe and data log directories. The following sections include information on how to configure the ConfigMeFirst.txt properly.

---

**IMPORTANT** The Micro800 controller reports a major fault when project backup does not succeed because the memory card size is exceeded.

---

## Powerup Settings in ConfigMeFirst.txt

On powerup, the controller reads and carries out configuration settings described in the ConfigMeFirst.txt file. However, the UPD setting also takes effect when the microSD card is inserted. The configuration settings for the ConfigMeFirst.txt file are shown in the following table.

### ConfigMeFirst.txt Configuration Settings

Setting	Takes Effect On...	Description
<b>Firmware update settings</b>		
[FWFILE]	Powerup	File path location of the firmware revision on the microSD card. The default location is in the following format: firmware<catalog number><filename of firmware>
[FWDOWN]	Powerup	Sets whether to upgrade or downgrade the controller firmware from the current revision. 0 = Upgrade firmware; 1 = Downgrade firmware  <b>IMPORTANT:</b> Firmware Upgrade will happen if [FWFILE] setting points to a newer version of firmware file compared to current firmware in the controller, irrespective of [FWDOWN] setting.

**ConfigMeFirst.txt Configuration Settings**

Setting	Takes Effect On...	Description
<b>Controller settings</b>		
[PM]	Powerup	Power up and switch to PROGRAM mode.
[CF]	Powerup	Power up and attempt to clear fault.
<b>Project settings</b>		
[BKD = My Proj1]	Powerup	Power up and save the controller project into backup directory, My Proj1\USERPRJ. Require extra power cycle to clear existing fault first using [CF] setting or other means.
[RSD = MyProj2]	Powerup	Power up and read the project from restore directory MyProj2\USERPRJ into controller. Require extra power cycle to clear existing fault first using [CF] setting or other means. This setting overwrites UPD (or its default) load always or load on error restore function.
[UPD = My Proj]	Powerup and Insertion	For normal usage of backup and restore (that is, through Connected Components Workbench, Load Always, or Load on Memory Error settings), set the user project directory name. For example, My Proj, during powerup or when the microSD card is inserted.  This directory is also used by data logging and recipe function.
<b>Network settings</b>		
[ESFD]	Powerup	Embedded Serial Factory Defaults. Power up and revert embedded serial comms to factory defaults.
[IPA = xxx.xxx.xxx.xxx]	Powerup	Power up and set IP address to xxx (must be numbers only).
[SNM = xxx.xxx.xxx.xxx]	Powerup	Power up and set subnet mask to xxx (must be numbers only).
[GWA = xxx.xxx.xxx.xxx]	Powerup	Power up and set gateway address to xxx (must be numbers only).
<b>General settings</b>		
[END]	Powerup	End of setting. This setting is <b>always</b> required even when the ConfigMeFirst.txt file does not contain any other setting. The SD LED goes off when this setting is not present.

**IMPORTANT Flash Upgrade Settings**

With Connected Components Workbench software version 12 or later, you can flash upgrade your Micro800 controller from the microSD card in addition to using ControlFLASH. See [Flash Upgrade From MicroSD Card on page 250](#) for instructions.

- [FWFILE] and [FWDOWN] settings must be placed at the beginning of the file.

**IMPORTANT Directory Settings**

- If no directory has been specified in the ConfigMeFirst.txt file, then backup and restore will occur in the controller name directory (<Micro800>/USERPRJ, by default).
- If [UPD] is configured in the ConfigMeFirst.txt file, then backup and restore will occur in the [UPD] directory specified.
- [BKD] setting is implemented even when the controller is locked or password protected.
- [BKD] directory is automatically created if it does not yet exist.

**IMPORTANT Powerup Network Parameter Settings**

- [IPA], [SNM] and [GWA] follow the general IP configuration rules.
- [IPA], when set in ConfigMeFirst.txt, should always be configured with a valid [SNM] and vice versa.
- When optional [GWA] setting is used, make sure that [IPA] and [SNM] settings are also present in ConfigMeFirst.txt.
- The [ESFD], [IPA], [SNM], and [GWA] settings overwrite the respective communication settings from project restore due to [RSD], Load Always or Load on Memory Error.

*Sample ConfigMeFirst.txt File*

```

ConfigMeFirst.txt - Notepad
File Edit Format View Help
# This is a comment because there is a "#"
# These settings take effect after power cycle
#
# [PM] # Force to Program mode.
# [CF] # Clear any faults if possible.
# [ESFD] # Set embedded serial port back to factory defaults.
# [IPA=192.168.0.100] # Ethernet IP address
# [SNM=255.255.255.0] # Ethernet subnet mask
# [GWA=192.168.0.1] # Ethernet gateway address
[BKD=MyProj1] # First, back up current project in machine.
[RSD=MyProj2] # Then, put new project in machine.
[END] # This setting should always exist, even if there are no
# other configurations.

```

**General Configuration Rules in ConfigMeFirst.txt**

- All settings must be in upper case and enclosed in brackets [ ].
- Each line must contain only one setting.
- Settings must always appear first in a line.
- Comments are started with the # symbol.
- No action related to the setting will be carried out when the setting does not exist, or a # symbol appears before the setting (example, #[PM]).



## ConfigMeFirst.txt Errors

The SD status LED goes off when the microSD card is inserted during PROGRAM or RUN mode (or on powerup) and the ConfigMeFirst.txt file is either unreadable or invalid. The ConfigMeFirst.txt file will be invalid when it has the following errors:

- unrecognized setting (that is, the first three configuration rules have not been followed),
- the setting parameters after the = symbol is invalid, does not exist, or out of range,
- the same setting exists twice or more,
- one or more non-setting characters exist within the same bracket,
- space in between setting characters (example, [P M]), or
- space in between IP address, subnet mask, and gateway address (for example, xxx. x xx.xxx.xxx)
- only one of the network parameter settings ([IPA], [SNM], or [GWA]) is assigned
- [END] setting does not exist (even if there are no other settings in the configuration file).

The microSD card becomes unusable until the ConfigMeFirst.txt file becomes readable or the errors are corrected.

## Deliver Project Updates to Customers Through Email

A benefit of using the project backup and restore feature is to allow you to deliver project updates to customers through email. You can do so by following the example shown below.

### *Backup project to microSD card*

The first step is to back up the project from the controller into the microSD card.

1. In Connected Components Workbench, verify that you have downloaded the updated project to your controller.
2. Insert a microSD card into the microSD card slot.
3. Set the controller to program mode.
4. Under the Memory Card option in your controller settings, click Backup to Memory Card.

---

**IMPORTANT** The Backup to Memory Card button is enabled when the controller is in program mode and a microSD card is in the microSD card slot.

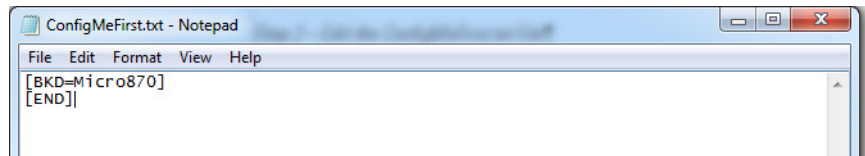
---

5. After the backup is completed, click OK.

The image files are stored in the default location on the microSD card <Micro800>\USERPRJ. This location is where the controller loads from when the Load on power up setting is configured to “Load Always” or “Load on Error”.

Alternatively, if you do not want to use Connected Components Workbench software to create the project backup, you can also use the ConfigMeFirst.txt file.

**Figure 1 - Example Configuration for Project Backup**

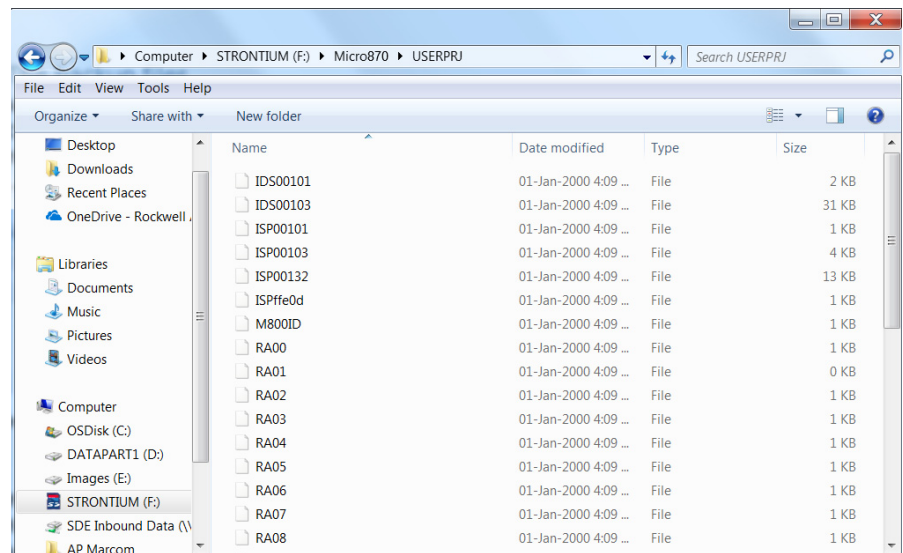


The ConfigMeFirst.txt file also allows you to restore from the backup if you want to configure the Load on power up setting to “Disable”.

*Send image files through email*

The next step is to retrieve the image files from the microSD card and send them to your customer through email.

1. Remove the microSD card from the controller and read the card using your computer.
2. Navigate to the location where the image files are stored (default is <Micro800>\USERPRJ).



3. Use a compression program to zip these image files and send them to your customer through email.

The customer must unzip these image files into the root directory of their microSD card and verify that the location is identical to the original (default is <Micro800>\USERPRJ).

### *Restore project from backup*

The last step is to restore the project to your controller from the microSD card. There are two methods to restore the backup, depending on the configuration of the controller.

### **Existing Controller - Load Always / Load on Error**

For this example, the Load on power up setting was configured to “Load Always”. This means that the controller loads the project from the memory card whenever it is powered on.

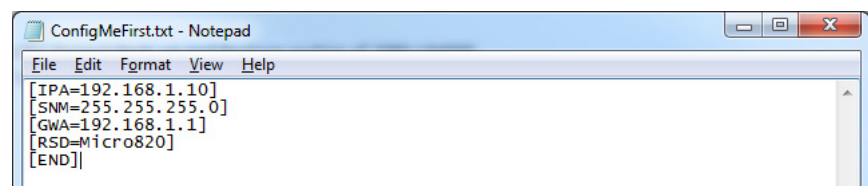
1. Insert the microSD card into the microSD card slot.
2. Cycle power to the controller.
3. When the SD LED displays a steady green light, the project restore is complete.

This method is used for an existing controller that has been configured and you want to update the program.

### **New Controller**

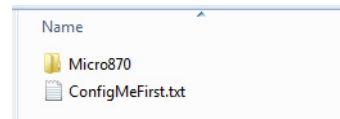
If your controller is new, you can use the ConfigMeFirst.txt file to restore the project backup.

**Figure 2 - Example Configuration for Project Restore**



In the example shown above, the ConfigMeFirst.txt file configures the IP address, subnet mask, and gateway of the controller, and restores the project from the location specified on the microSD card.

The ConfigMeFirst.txt file must be placed in the same root directory as the backup folder in the microSD card.



1. Insert the microSD card into the microSD card slot.
2. Cycle power to the controller.
3. When the SD LED displays a steady green light, the project restore is complete.

## Data Log

The data logging feature allows you to capture global and local variables with timestamp from the Micro800 controller into the microSD card. You can retrieve the recorded datasets on the microSD card by reading the contents of the microSD card through a card reader or by doing an upload through the Connected Components Workbench software.

A maximum number of 10 datasets is supported for a Micro800 program. Each dataset can contain up to 128 variables, with a maximum of four (4) data string variables per dataset. String variables can have a maximum of 252 characters. All datasets are written to the same file. For more information on how data logs are stored on the microSD card, see the [Data Log Directory Structure on page 187](#).

You can retrieve data log files from the microSD card using a card reader or by uploading the data logs through Connected Components Workbench.

---

**IMPORTANT** Uploading data log files in PROGRAM mode is recommended for optimum performance and to prevent file access conflict. For example, if the data log instruction is executing, Connected Components Workbench will not upload the last data log file.

---

See the sample quickstart project to get you started on the Data Log feature, [Use the Data Log Feature on page 196](#).

---

**IMPORTANT** Data log execution time depends on the user application and its complexity. Users are advised to data log **no faster than every two seconds** for typical applications. Note that housekeeping takes at least 5 ms per program scan. See [Program Execution in Micro800 on page 75](#) for more information on program scan and execution rules and sequence. See also [Data Log – Data Payload vs. Performance Time on page 237](#).

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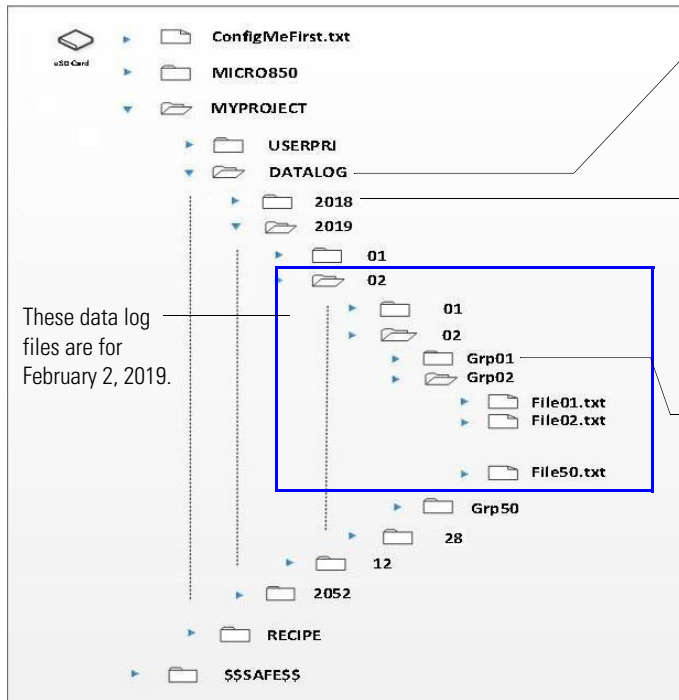


---

**IMPORTANT** Note that in cases where there are simultaneous RCP and DLG function block execution or uploads/downloads/searches, the activities are queued up and handled one by one by the program scan. Users will notice a slowdown in performance in these cases.

---

## Data Log Directory Structure



These data log files are for February 2, 2019.

The DATALOG folder is created under the current project directory in the microSD card. In this example, the current project directory is MYPROJECT. By default, the current project directory name is taken from the downloaded project's controller name or from the ConfigMeFirst.txt. See [ConfigMeFirst.txt Configuration Settings on page 180](#).

Subdirectories are also created following the controller RTC timestamp. This means that if RTC date at the time of function block execution is February 02, 2019, the subfolder 2019 is created under DATALOG. Under the 2019 folder, the subfolder 02 (which stands for the month of February) is created. Under 02, another subfolder 02 is created, corresponding to the current date.

Under the current working folder, the subfolder Grp01 is created. A maximum of 50 Grpxx folders can be generated on the microSD card per day.

Under the current Grpxxx working folder, the data log file File01.txt is created. Once this file reaches more than 4 KB, another file, File02.txt, is automatically created to store data. The file size is kept small in order to minimize data loss in case the card is removed or when there is unexpected power off.

Each Grpxx folder can accommodate up to 50 files. This means that, for example, when the Grp01 folder already stores 50 files, a new folder Grp02 is automatically created to store the next data log files for that day. This automatic folder and file generation goes on until the Grpxx folder reaches 50 for that day.

When a microSD card is inserted, the DLG function block looks for the last Grpxx folder and filexx.txt file, and proceeds to do the data logging based on that information.

The following table summarizes data logging performance on Micro800 controllers.

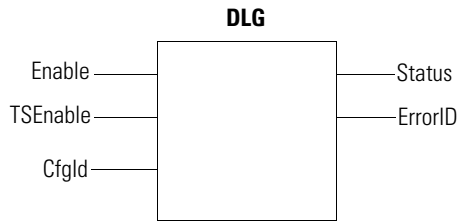
### Data Log Specifications

Attribute	Value	
Maximum datasets	10	All datasets are stored in the same file.
Maximum variables per dataset	128	Configured in Connected Components Workbench software.
Minimum size per file	4 KB	
Maximum files per Grpxx folder <sup>(1)</sup>	50	When directory is full, a new directory is automatically created in RUN mode.
Maximum files (Filexx.txt) per day	50	When file reaches maximum size, a new file is automatically created in RUN mode.
Typical data per day	10 MB	

<sup>(1)</sup> Once the data log limits is reached (that is, 50 Grpxx folders per day, then an error (ErrorID 3: DLG\_ERR\_DATAFILE\_ACCESS) is returned.

## Data Log Function (DLG) Block

The data logging function block lets a user program to write run-time global values into the data logging file in microSD card.



### DLG Input and Output Parameters

Parameter	Parameter Type	Data Type	Description
Enable	INPUT	BOOL	Data logging write function enable. On rising edge (that is, Enable value is triggered from low to high), the function block executes. The precondition for execution is that the last operation has completed.
TSEnable	INPUT	BOOL	Date and timestamp logging enable flag.
CfgId	INPUT	USINT	Configured dataset (DSET) number (1...10).
Status	OUTPUT	USINT	Data logging function block current status.
ErrorID	OUTPUT	UDINT	Error ID if DLG Write fails.

### DLG Function Block Status

Status Code	Description
0	Data logging IDLE status.
1	Data logging BUSY status.
2	Data logging COMPLETE SUCCEED status.
3	Data logging COMPLETE ERROR status.

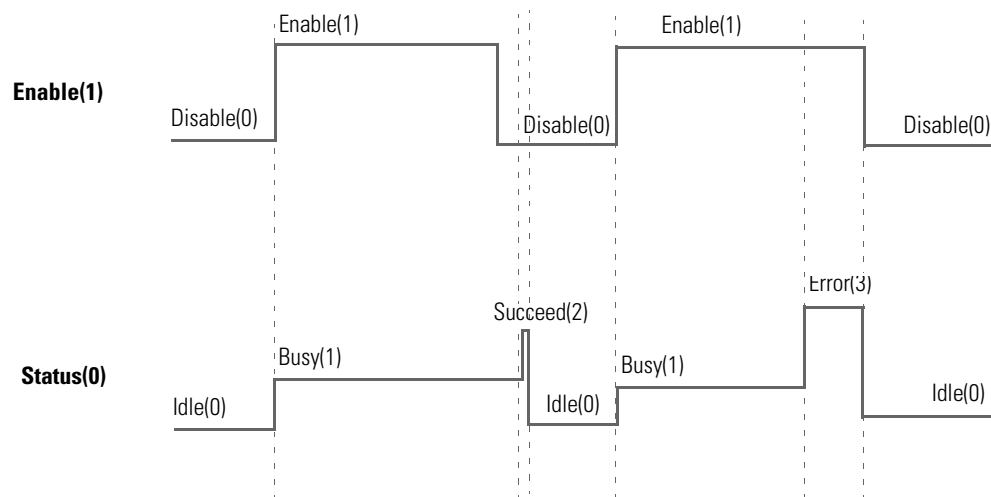
### DLG Function Block Errors

Status Code	Name	Description
0	DLG_ERR_NONE	No error.
1	DLG_ERR_NO_SDCARD	microSD card is missing.
2	DLG_ERR_RESERVED	Reserved.
3	DLG_ERR_DATAFILE_ACCESS	Error accessing data log file in microSD card.
4	DLG_ERR_CFG_ABSENT	Data log configuration file is absent.
5	DLG_ERR_CFG_ID	Configuration ID is missing in data log configuration file.
6	DLG_ERR_RESOURCE_BUSY	Same Configuration ID is used with other data log function block call at the same time

**DLG Function Block Errors**

Status Code	Name	Description
7	DLG_ERR_CFG_FORMAT	Data log configuration file format is wrong.
8	DLG_ERR_RTC	Real time clock is invalid.
9	DLG_ERR_UNKNOWN	Unspecified error has occurred.

**IMPORTANT** File access error will be returned during DLG function block execution when card is full.

**Figure 3 - Data Log Function Block Timing Diagram**

**IMPORTANT Data Log Function Block Execution**

- There are three possible states for the Data Log function block: Idle, Busy and Complete (which includes Complete with Succeed and Complete with Error).
- For one Data Log function block execution, the typical status starts from Idle, then Busy and finishes with Complete. To trigger another function block execution, the status needs to go back to Idle first.
- Idle status changes to Busy status only when Enable input signal is in rising edge. Complete status enters Idle status when Enable input signal is Disable status only.
- TSEnable and Cfgld input parameters are only sampled at Enable input parameter's rising edge when a new function block execution starts. During function block execution, the input parameters of TSEnable and Cfgld are locked and any changes are ignored.
- When execution completes, the status changes from Busy to Complete. At this stage, if input Enable is False, status changes to Idle after indicating Complete for exactly one scan time. Otherwise function block status is kept as Complete until input Enable changes to False.
- The data log file can only be created by the DLG instruction block. Connected Components Workbench can only upload and delete the data log file.
- There are separators in between every data variable in the data file which is defined during configuration in Connected Components Workbench.  
See [Supported Data Types for Data Log and Recipe Function Blocks on page 190](#).
- Data variable values are sampled when data logging function block is in Busy state. However, data logging file is only created when data logging function block is in Complete state.

**Supported Data Types for Data Log and Recipe Function Blocks**

Data Type	Description	Example format in output data log file
BOOL <sup>(1)</sup>	Logical Boolean with values TRUE and FALSE	0: FALSE 1: TRUE)
SINT	Signed 8-bit integer value	-128, 127
INT	Signed 16-bit integer value	-32768, 32767
DINT	Signed 32-bit integer value	-2147483648, 2147483647
LINT	Signed 64-bit integer value	-9223372036854775808, 9223372036854775807
USINT(BYTE)	Unsigned 8-bit integer value	0, 255
UINT(WORD)	Unsigned 16-bit integer value	0, 65535
UDINT(DWORD)	Unsigned 32-bit integer value	0, 4294967295
ULINT(LWORD)	Unsigned 64-bit integer value	0, 18446744073709551615



**Supported Data Types for Data Log and Recipe Function Blocks**

Data Type	Description	Example format in output data log file
REAL	32-bit floating point value	-3.40282347E+38, +3.40282347E+38
LREAL	64-bit floating point value	-1.7976931348623157E+308, +1.7976931348623157E+308
STRING <sup>(2)</sup>	character string (1 byte per character)	"Rotation Speed"
DATE <sup>(1)</sup>	Unsigned 32-bit integer value	1234567 (Date variables are stored as 32-bit words, a positive number of seconds beginning at 1970-01-01 at midnight GMT.)
TIME <sup>(1)</sup>	Unsigned 32-bit integer value	1234567 (Time variables are stored as 32-bit words, positive number of milliseconds.)

<sup>(1)</sup> BOOL, DATE, TIME data variables are presented in decimal digital format in the microSD Card. Users have the option to convert this format to a more friendly format. For example, use ANY\_TO\_STRING function block to convert BOOL data type (0, 1) to FALSE or TRUE. You can similarly do the same for DATE and TIME data types. DATE data type is presented in differential decimal digital value between system baseline time (1970/01/01,00:00:00) and current date value. Unit is millisecond. Time should be absolute time value. Unit is second.

<sup>(2)</sup> String data variables are enclosed in double quotation marks in the data log file. The example below shows DSET1 using string variables and DSET2 using integers.

```
DSET1, "Temperature", "Humidity", "Pressure"
DSET2, 30, 50, 125
```

## Recipe

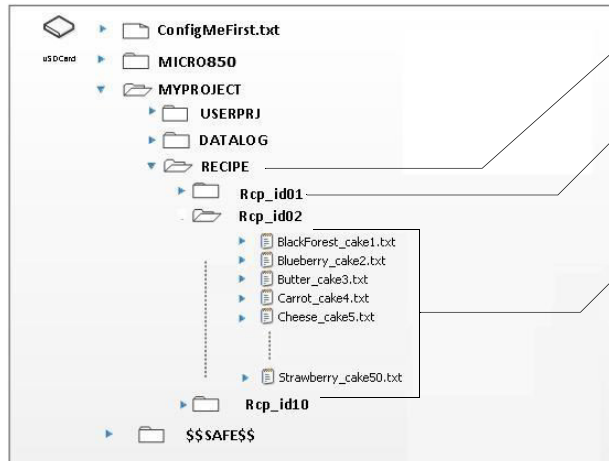
Micro800 controllers support the Recipe feature and allows users to store and load a list of data to and/or from recipe data files using the RCP instruction. It also allows users to download, upload, and delete Recipe data on the microSD card through Connected Components Workbench.

A maximum number of 10 recipe sets is supported for a Micro800 program. Each recipe can contain up to 128 variables, with a maximum of four (4) data string variables per recipe. String variables can have a maximum of 252 characters. Variations of the recipe are stored in separate files with unique file names. For more information on how recipes are stored on the microSD card, see the [Recipe Directory Structure on page 192](#).

### Recipe Specifications

Attribute	Value	
Maximum number of recipe sets	10	Recipe sets are stored in 10 directories (Rcp_Id01...Rcp_Id10) with a maximum number of 50 recipe files in each directory.
Maximum number of recipes in each set	50	
Maximum number of variables per recipe	128	Configured in Connected Components Workbench software.
Maximum bytes per recipe file	4 KB	

## Recipe Directory Structure



On first execution of RCP, it creates the RECIPE folder under the current project directory on the microSD card.

It also creates 10 subdirectories for each recipe set with a name following the CfgID input value (1...10). If the CfgID value is 1, then the subfolder Rcp\_Id01 is created.

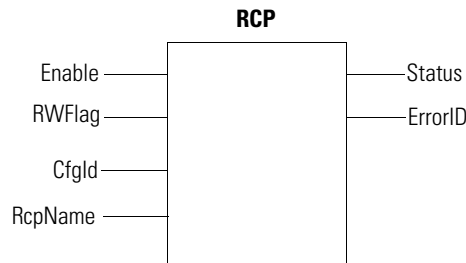
Recipe files are then created/written into the folder, with file names that correspond to the input value of RcpName parameter for the RCP function block, as configured in Connected Components Workbench. Each Recipe set can contain up to 50 recipe files or variations. Filenames for recipe files should not exceed 30 characters.

### Recipe Configuration and Retrieval

You can retrieve recipe files from the microSD card using a card reader or by uploading and downloading the recipe sets through Connected Components Workbench.

## Recipe Function (RCP) Block

The RCP function block allows a user program to read variable values from an existing recipe data file which is in the recipe folder of the microSD card and update run-time global or local variable values in the controller. The RCP function block also allows the user program to write run-time global or local variable values from smaller controller into the recipe data file in the microSD card.



**RCP Input and Output Parameters**

Parameter	Parameter Type	Data Type	Description
Enable	INPUT	BOOL	Recipe read/write function enable. If Rising Edge (Enable is triggered from "low" to "high"), starts recipe function block and the precondition is that last operation is completed.
RWFlag	INPUT	BOOL	TRUE: Recipe write data variables to recipe files into the microSD card.  FALSE: Recipe reads saved data variables from the microSD card and update these variables accordingly.
CfgId	INPUT	USINT	Recipe set number (1...10).
RcpName	INPUT	STRING	Recipe data filename (maximum 30 characters).
Status	OUTPUT	USINT	Current state of Recipe function block.
ErrorID	OUTPUT	UDINT	Detailed error ID information if RCP read/write fails.

**RCP Function Block Status**

Status Code	Description
0	Recipe Idle status.
1	Recipe Busy status.
2	Recipe Complete Succeed status.
3	Recipe Complete Error status.

**RCP Function Block Errors**

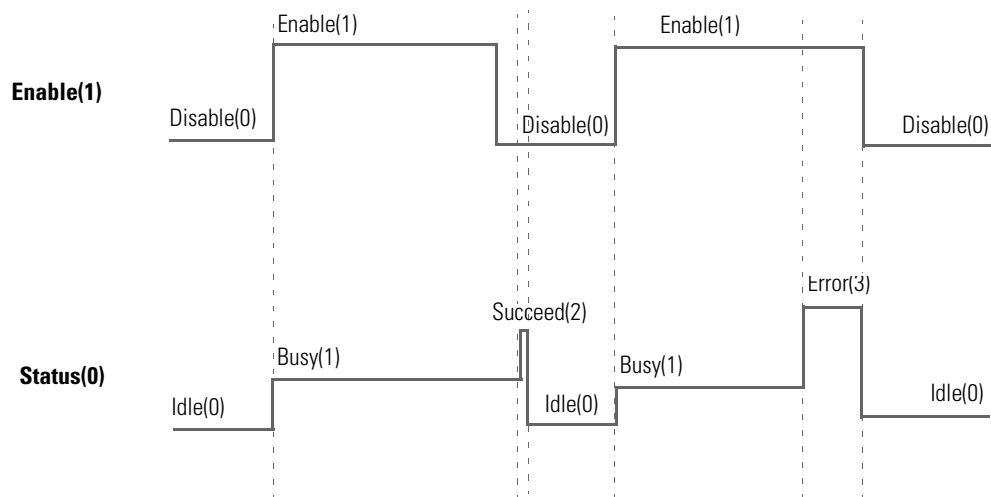
Error ID	Error name	Description
0	RCP_ERR_NONE	No error.
1	RCP_ERR_NO_SDCARD	microSD card is absent.
2	RCP_ERR_DATAFILE_FULL	Recipe files exceed maximum number of files per recipe set folder.
3	RCP_ERR_DATAFILE_ACCESS	Error to access recipe data file in microSD card.
4	RCP_ERR_CFG_ABSENT	Recipe configuration file is absent.
5	RCP_ERR_CFG_ID	Configure ID is absent in recipe configuration file.
6	RCP_ERR_RESOURCE_BUSY	The Recipe operation resource linked to this Recipe ID is used by another function block operation.
7	RCP_ERR_CFG_FORMAT	Recipe configuration file format is invalid.
8	RCP_ERR_RESERVED	Reserved.
9	RCP_ERR_UNKNOWN	Unspecified error has occurred.
10	RCP_ERR_DATAFILE_NAME	Recipe data file name is invalid.
11	RCP_ERR_DATAFOLDER_INVALID	Recipe dataset folder is invalid.

**RCP Function Block Errors**

Error ID	Error name	Description
12	RCP_ERR_DATAFILE_ABSENT	Recipe data file is absent.
13	RCP_ERR_DATAFILE_FORMAT	Recipe data file contents are wrong.
14	RCP_ERR_DATAFILE_SIZE	Recipe data file size is too big (>4K).

**IMPORTANT** File access error will be returned during RCP function block execution when card is full.

**Figure 4 - Recipe Function Block Timing Diagram**



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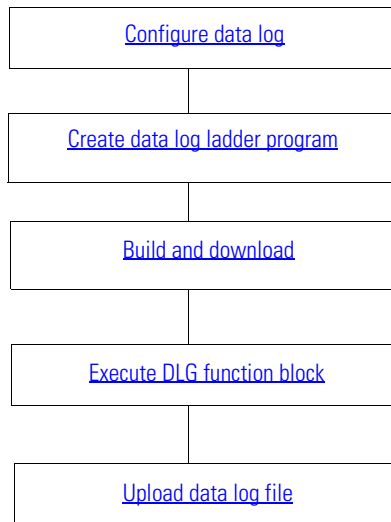
**IMPORTANT RCP Function Block Execution**

- There are three possible states for Recipe function block: Idle, Busy, Complete (Complete with Succeed and Complete with Error)
  - For one Recipe function block execution, the typical status starts from Idle then Busy and finishes with Complete. To trigger another function block execution, the status needs to go back to Idle first.
  - Idle status changes to Busy status only when Enable input signal is in rising edge. Complete status enters Idle status when Enable input signal is on Disable status.
  - RWFlag, CfgId and RcpName input parameters are only sampled at Enable input parameter's rising edge when a new function block execution starts. During function block execution, input parameters of RWFlag, CfgId and RcpName are locked and any changes are ignored.
  - When the function block execution finishes, the function block status changes from Busy to Complete. At this stage, if input Enable is False, function block status changes to Idle after staying as Complete for exactly one scan time. Otherwise, function block status remains Complete until input Enable changes to False.
  - Recipe function block file name supports a maximum of 30 bytes in length, and only supports upper and lower case letters Aa...Zz, numbers 0...9 and underscore (\_).
  - The RcpName input parameter does not allow file extension (for example, .txt) to be added to its value. The recipe data file is written to the microSD card with the .txt extension.
  - There are separators in between every data variable in the recipe data file which is defined during configuration in Connected Components Workbench. Redundant tab, space, carriage return and line feed characters are strictly not allowed.  
See [Supported Data Types for Data Log and Recipe Function Blocks on page 190](#).
  - Double quotes are not allowed within a string in a recipe file.
- 

## Quickstart Projects for Data Log and Recipe Function Blocks

The following sample quickstart projects provide step-by-step instructions on how to use the Data Log and Recipe function blocks in Connected Components Workbench to generate and manage your recipe files and data logs.

## Use the Data Log Feature

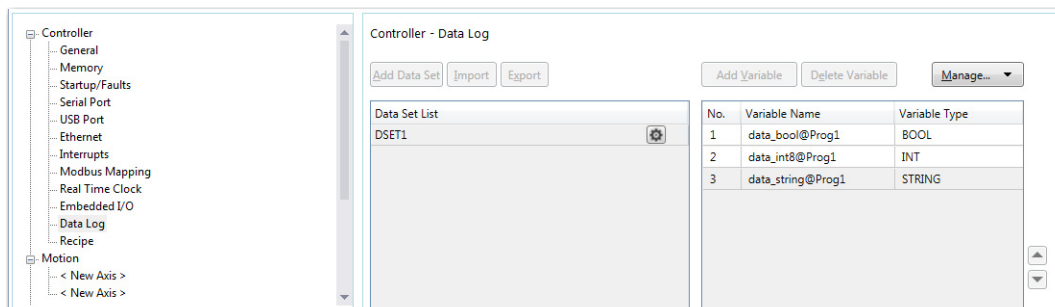


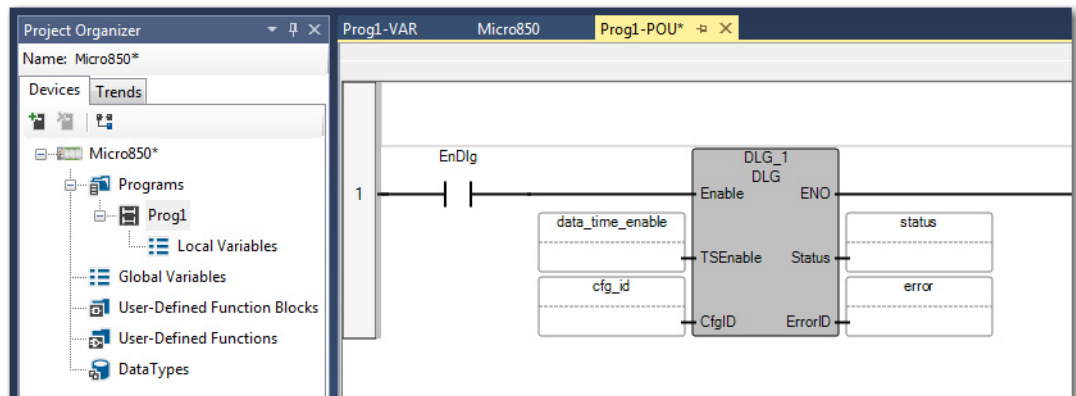
### Configure data log

1. In Connected Components Workbench, go to the Properties pane to configure your data log.
2. Select Data Log. Click Add Dataset to add a dataset. Note that each dataset will be stored in the same file. You can add up to 10 datasets per configuration.
3. Click Add Variable to add variables to the dataset. You can add up to 128 variables to each dataset.  
For this quickstart sample project, add the following variables that you have previously created to Dataset 1.

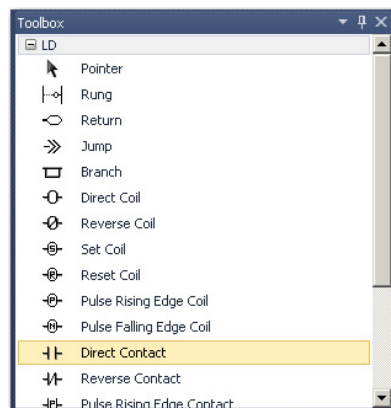
### Local Variables

Variable Name	Data Type
data_bool	BOOL
data_int8	INT
data_string	STRING



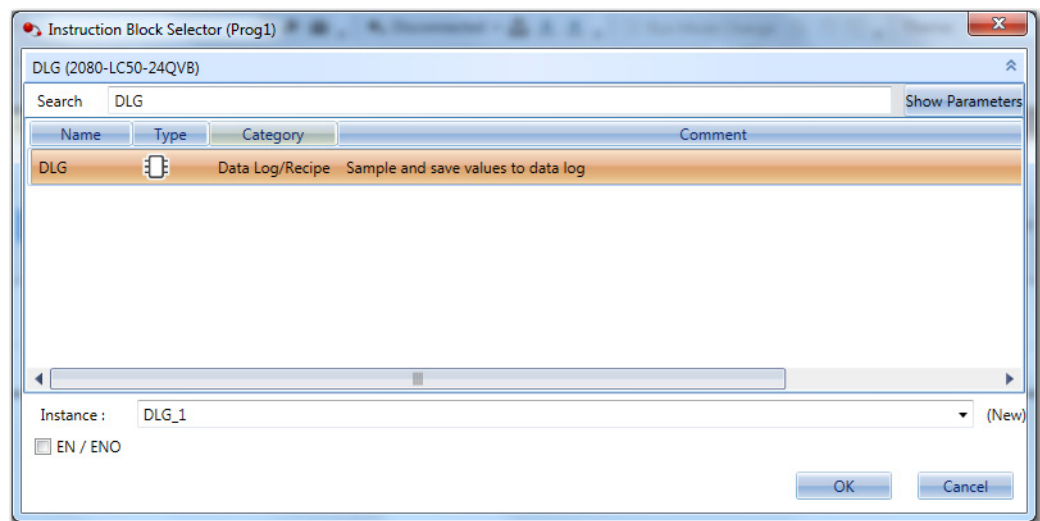
*Create data log ladder program*

1. Launch Connected Components Workbench. Create a user program for your Micro800 controller.
2. Right-click Programs. Select Add New LD: Ladder Diagram. Name the Program (for example, Prog1).
3. From the Toolbox, double-click Direct Contact to add it to the rung.

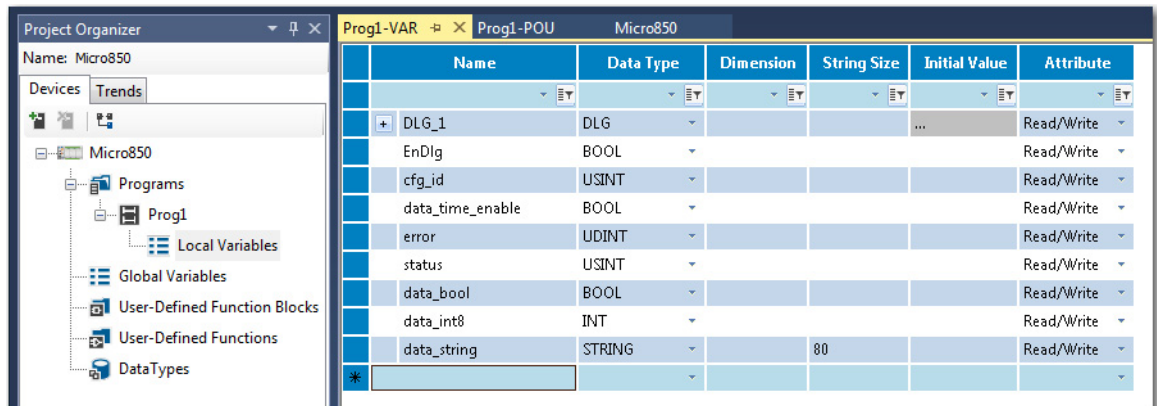


4. From the Toolbox, double-click Block to add it to the rung.

- On the Block Selector window that appears, type DLG to filter the DLG function block from the list of available function blocks. Click OK.



- Create the following local variables for your project.

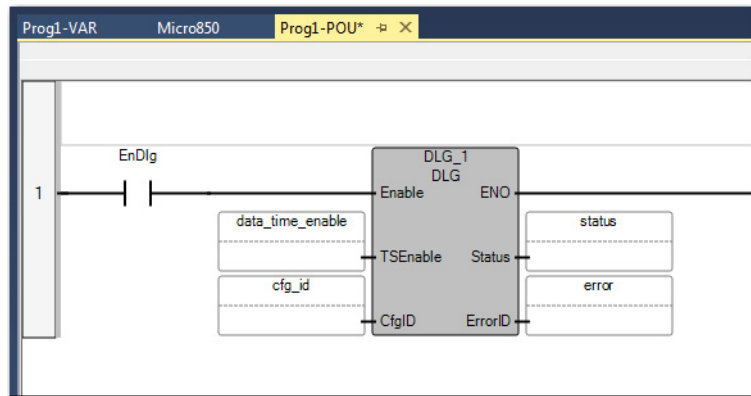


**Local Variables**

Variable Name	Data Type
EnDlg	BOOL
cfg_id	USINT
data_time_enable	BOOL
error	UDINT
status	USINT
data_bool	BOOL
data_int8	INT
data_string	STRING



7. Assign the variables to the DLG input and output parameters as follows:



Note: For CfgID input parameter, you can choose a predefined variable by choosing from the Defined Words in Connected Components Workbench. To do so, click the CfgID input box. From the Variable Selector window that appears, click the Defined Words tab and choose from the list of defined words (for example, DSET1 which corresponds to DSET1 in your recipe configuration). See the following screenshot.

The Variable Selector window shows the following data:

Word	Equivalent	Comment
IRQ_UPM1	1048576	
IRQ_EI15	4096	
IRQ_STI0	32768	
IRQ_STI1	65536	
<b>DSET1</b>	<b>1</b>	
DSET2	2	
DSET3	3	
DSET4	4	
DSET5	5	
DSET6	6	
DSET7	7	
DSET8	8	
DSET9	9	
DSET10	10	
RCP1		
RCP2		
RCP3		

The Controller - Data Log window shows the following data:

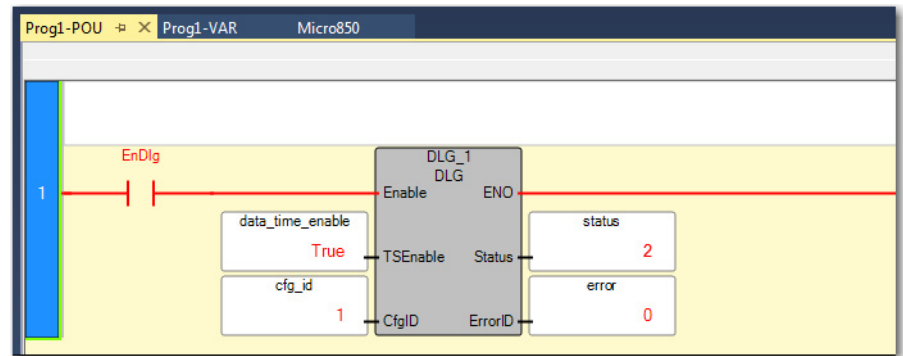
No.	Variable Name	Variable Type
1	data_bool@Prog1	BOOL
2	data_int8@Prog1	INT
3	data_string@Prog1	STRING

*Build and download*

After configuring data log properties, build the program and download to the controller.

*Execute DLG function block*

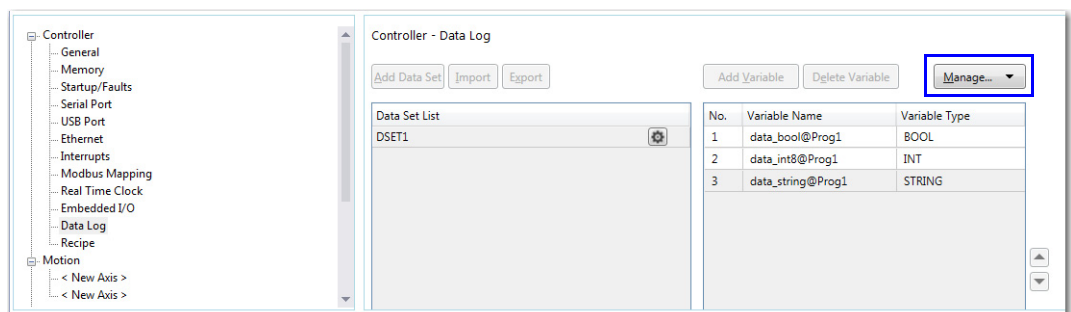
Execute the DLG function block. Notice the Status output go from 0 (Idle) to 1 (Enable), and 2 (Succeed).



*Upload data log file*

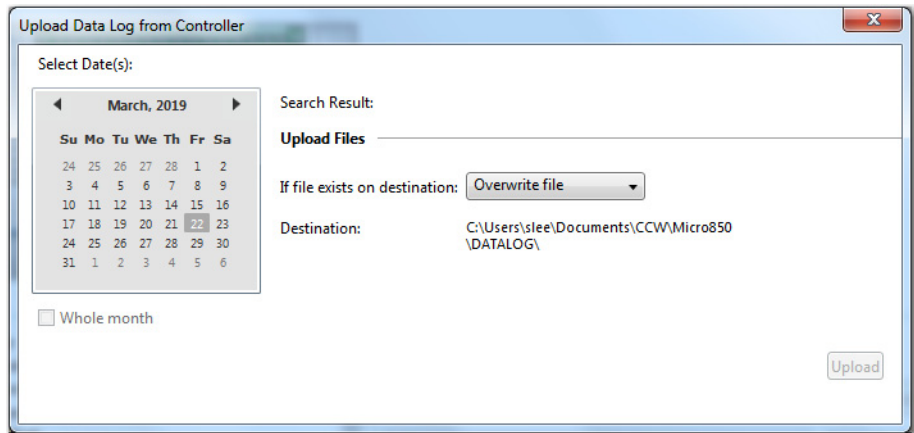
You can retrieve data log files from the microSD card using a card reader or by uploading the data logs through Connected Components Workbench.

1. To use the Upload feature, go to the Properties section of your project in Connected Components Workbench.
2. Select Data Log. Click Manage and then choose Upload.



**IMPORTANT** The Manage button is not available in DEBUG mode. You need to stop DEBUG mode to use the Manage button to upload data log files. Uploading data log files in PROGRAM mode is recommended for performance and file locking reasons.

- From the Upload window that appears, select the date of the data log files that you would like to upload. You can upload data logs for the entire month by clicking Whole Month option button.



- If the file already exists in your destination folder, select whether you would like to Overwrite file, Skip file, or Preserve both files.
- Click Upload. The progress bar should tell you whether the upload is successful or not.

---

**IMPORTANT** Do not take out the microSD card from the slot while data is being written or retrieved from the card. Ongoing write and retrieval operations are indicated by a flashing SD status LED.

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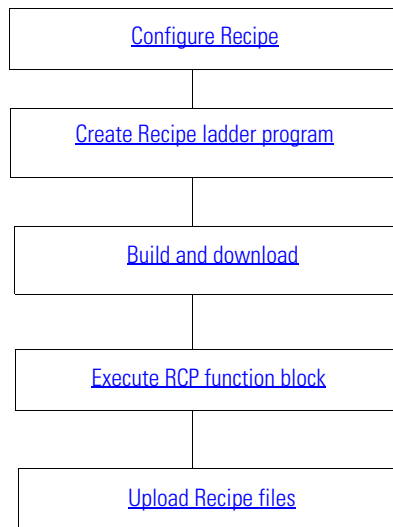


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**IMPORTANT** For better data log file management, you can use a third-party tool or DOS CMD to merge all your data log files into a single file and import as a CSV file in Excel.

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## Use the Recipe Feature

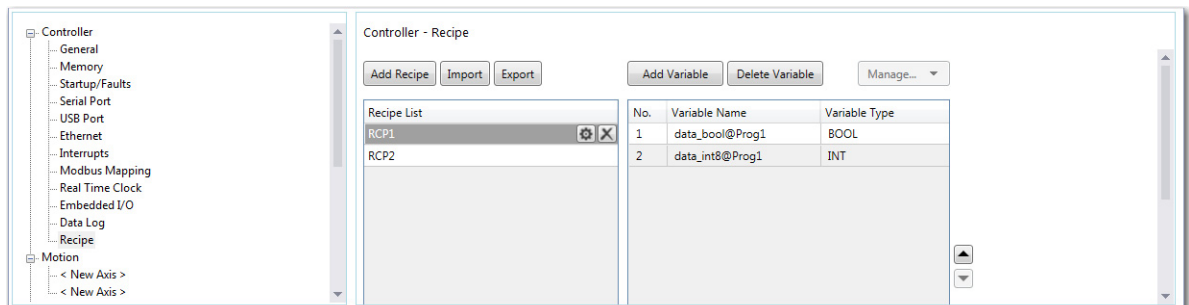


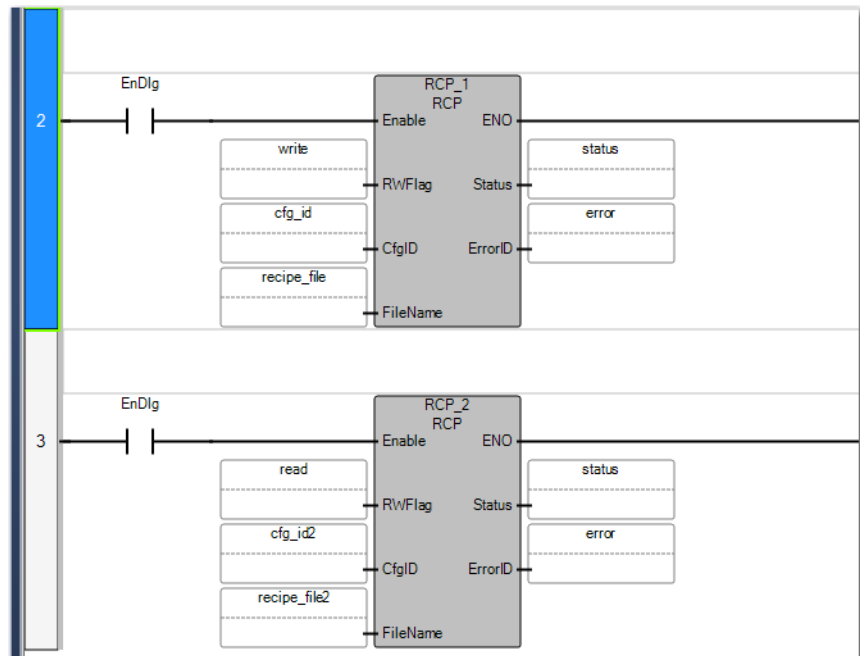
### Configure Recipe

1. In Connected Components Workbench, go to the Properties pane to configure Recipe.
2. Select Recipe. Click Add Recipe to add a recipe. Note that each recipe will be stored in separate files. You can add up to 10 recipes per configuration.
3. Click Add Variable button to add variables to the recipe. You can add up to 128 variables to each recipe.  
For this quickstart sample project, add the following variables that you have previously created to RCP 1:

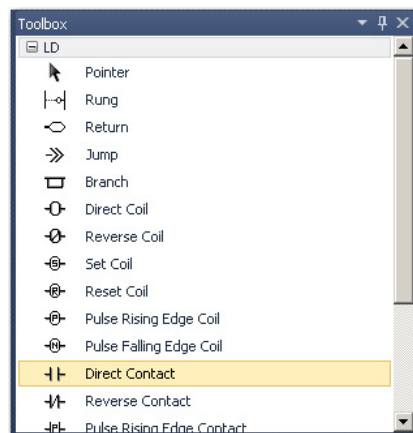
### Local Variables

Variable Name	Data Type
data_bool	BOOL
data_int8	INT



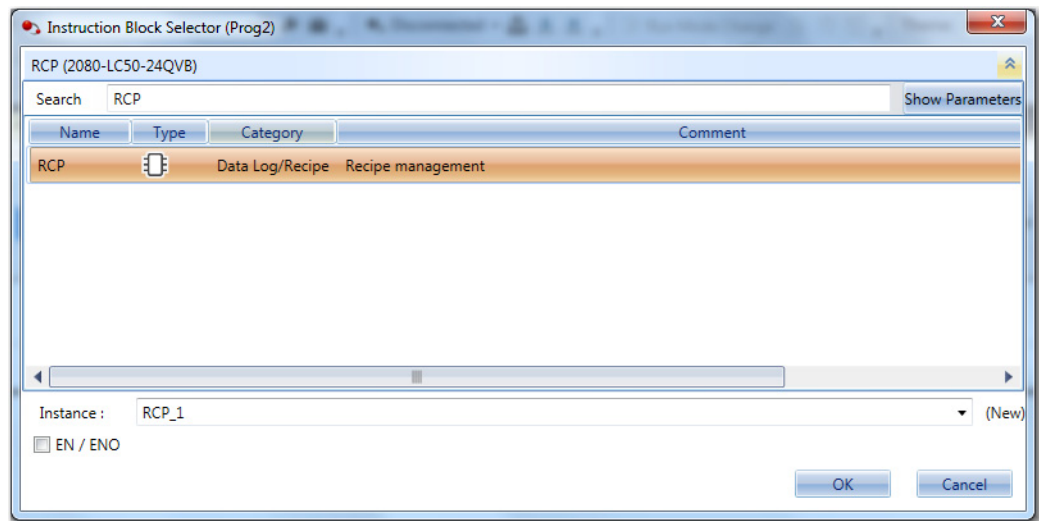
*Create Recipe ladder program*

1. Launch Connected Components Workbench. Create a user program for your Micro800 controller.
2. Right-click Programs. Select Add New LD: Ladder Diagram. Name the Program (for example, Prog2).
3. From the Toolbox, double-click Direct Contact to add it to the first rung.



4. From the Toolbox, double-click Block to add it to the rung.

- On the Block Selector window that appears, type RCP to filter the Recipe function block from the list of available function blocks. Click OK.



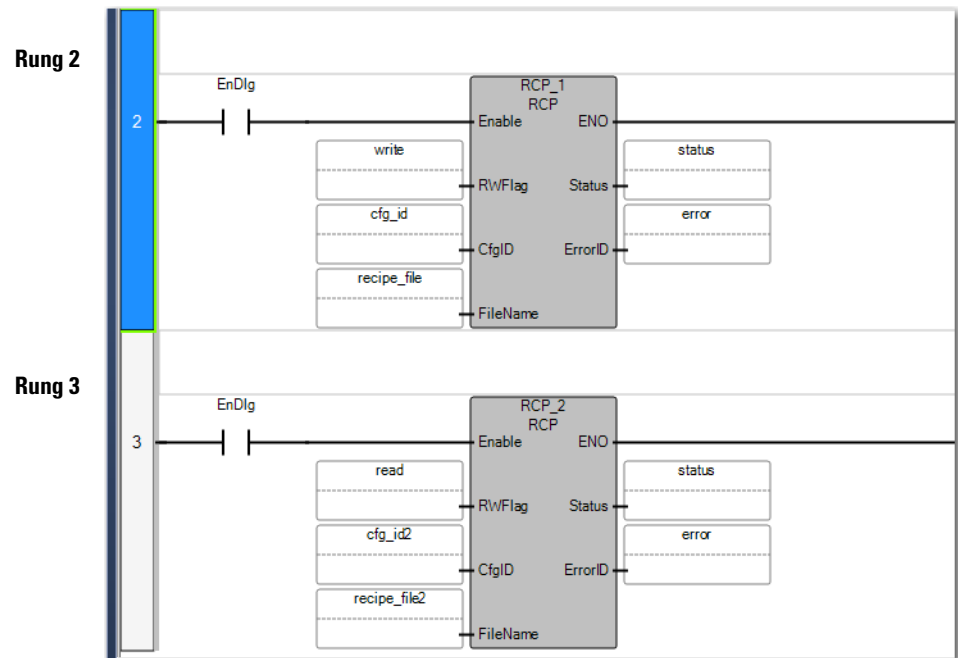
- From the Toolbox, double-click rung to add another rung.
- Add a Direct Contact and RCP function block to this second rung by following steps 3...5.
- Create the following local variables for your program, in addition to the ones that you have already created for data log.

recipe_file	STRING	80	"MyFirstRecipe"	Read/Write
recipe_file2	STRING	80	"MySecondRecipe"	Read/Write
cfg_id2	USINT	2		Read/Write
read	BOOL		FALSE	Read/Write
write	BOOL		TRUE	Read/Write
+ RCP_1	RCP		...	Read/Write
+ RCP_2	RCP		...	Read/Write

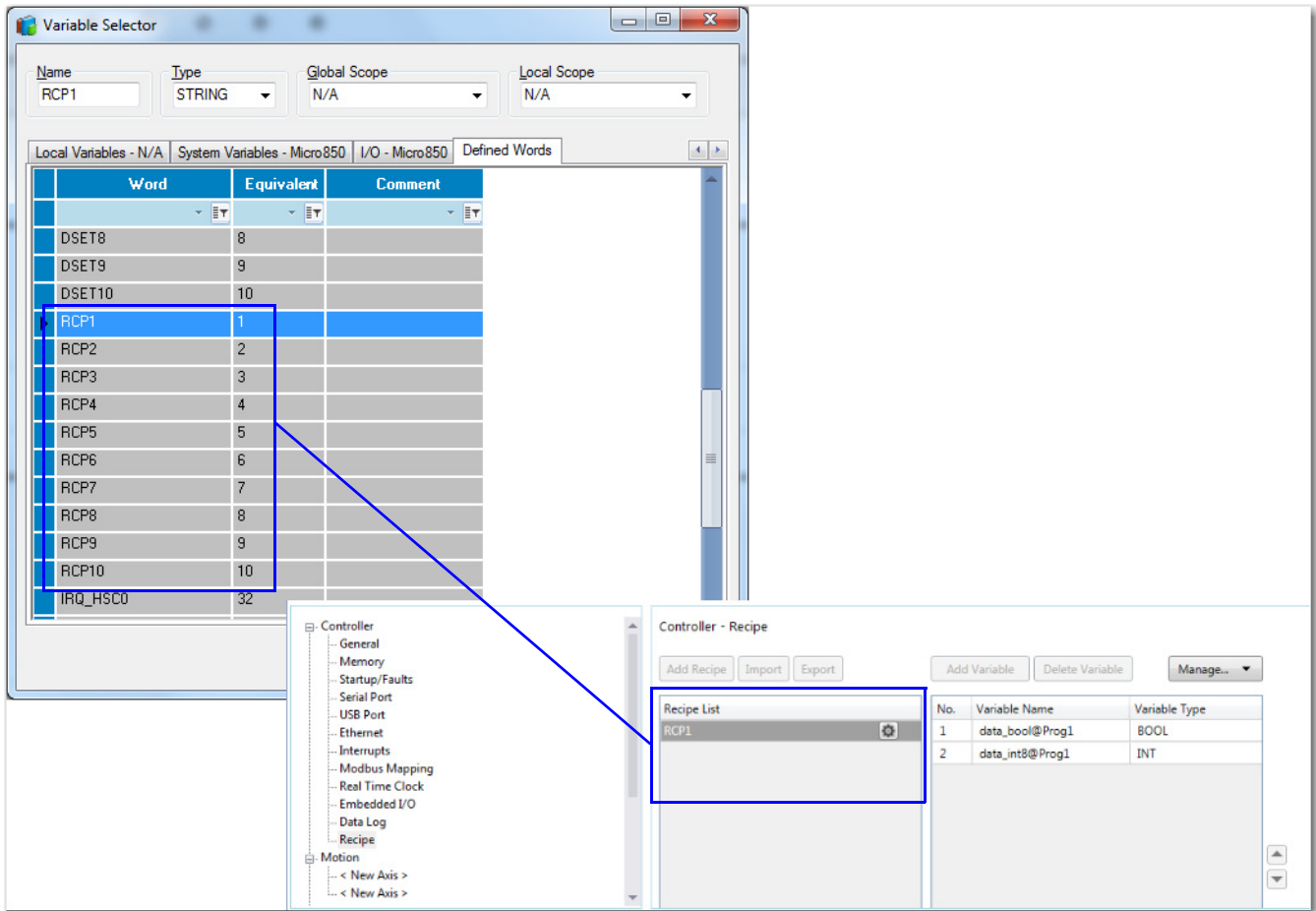
### Local Variables

Variable Name	Data Type
recipe_file	STRING
recipe_file2	STRING
cfg_id2	USINT
read	BOOL
write	BOOL

9. Assign the variables to the RCP input and output parameters as follows:



Note: For CfgID input parameter, you can choose a predefined variable by choosing from the Defined Words in Connected Components Workbench. To do so, click the CfgID input box. From the Variable Selector window that appears, click the Defined Words tab and choose from the list of defined words (for example, RCP1 which corresponds to RCP1 in your recipe configuration). See the following screenshot.



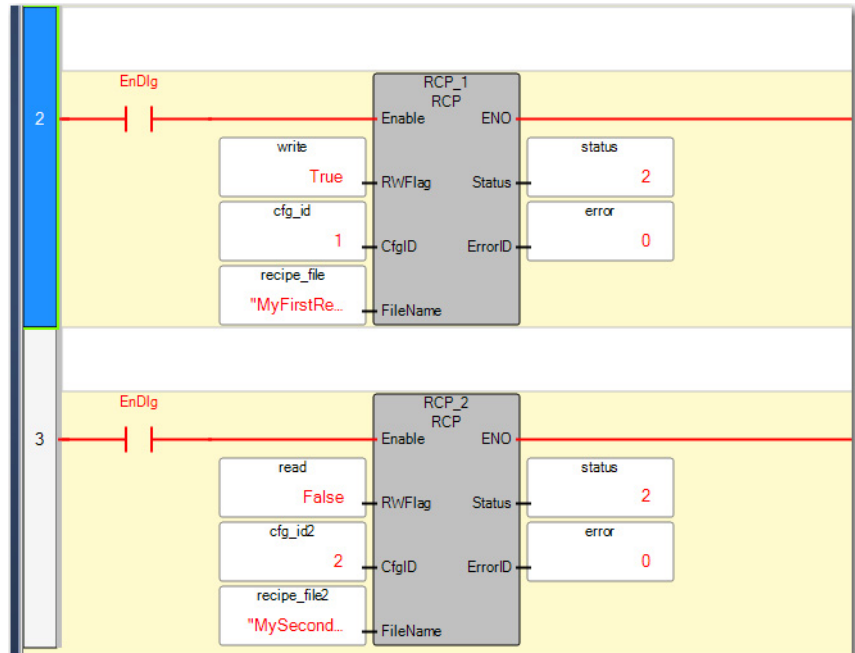
*Build and download*

After configuring Recipe, build the program and download to the controller.



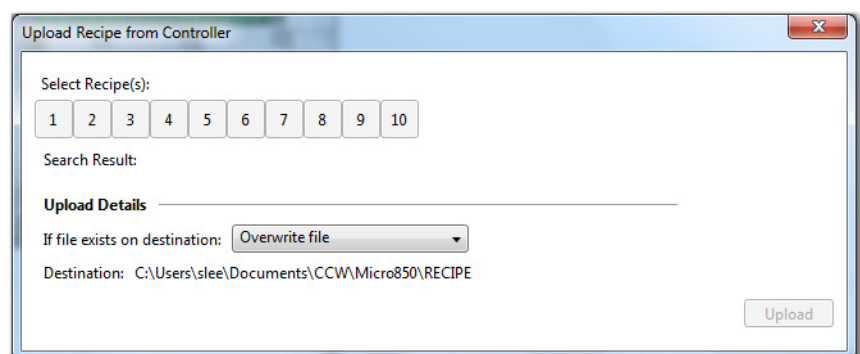
*Execute RCP function block*

Execute the RCP function block. Notice the Status output go from 0 (Idle) to 1 (Enable), and 2 (Succeed).

*Upload Recipe files*

You can retrieve recipe files from the microSD card using a card reader or by uploading the recipe files through Connected Components Workbench.

1. To use the Upload feature, go to the Properties section of your project in Connected Components Workbench.
2. Select Recipe. Click Manage and then choose Upload. Through the Manage button, you can also choose to Download and Delete recipe files.
3. From the Upload window that appears, select the batch of recipe files that you would like to upload.



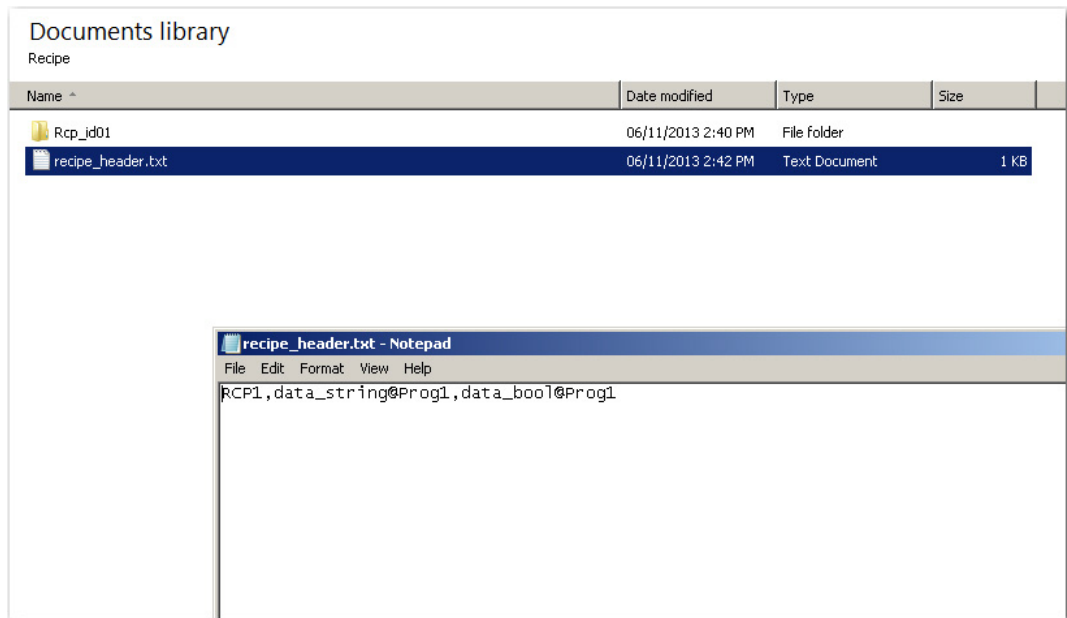
4. If the file already exists in your destination folder, select whether you would like to Overwrite file, Skip file, or Preserve both Files.
5. Click Upload. The progress bar should tell you whether the upload is successful or not.

---

**IMPORTANT** Do not take out the microSD card from the slot while data is being written or retrieved from the card. Ongoing write and retrieval operations are indicated by a flashing SD status LED.

---

A recipe header file will be saved with the uploaded recipes.



## Specifications

- IMPORTANT** Specifications for the analog and discrete Micro800 plug-in and expansion I/O modules are available in the following Rockwell Automation publications:
- Micro800 Expansion I/O Modules User Manual, publication [2080-UM003](#)
  - Micro800 Plug-in Modules User Manual, publication [2080-UM004](#)



At the end of its life, this equipment should be collected separately from any unsorted municipal waste.

## Micro830 Controllers

The following tables provide specifications, ratings, and certifications for the Micro830 controllers.

### Micro830 10-Point Controllers

#### General Specifications

Attribute	2080-LC30-10QWB	2080-LC30-10QVB
Number of I/O	10 (6 inputs, 4 outputs)	
Dimensions (HxWxD)	90 x 100 x 80 mm (3.54 x 3.94 x 3.15 in.)	
Shipping weight, approx.	0.302 kg (0.666 lb)	
Wire size	0.14...2.5 mm <sup>2</sup> (26...14 AWG) solid copper wire or 0.14...1.5 mm <sup>2</sup> (26...16 AWG) stranded copper wire rated @ 90 °C (194 °F) insulation max	
Wiring category <sup>(1)</sup>	2 – on signal ports 2 – on power ports	
Wire type	Use copper conductors only	
Terminal screw torque, max	0.6 Nm (4.4 lb-in) (using a 2.5 mm (0.10 in.) flat-blade screwdriver)	
Input circuit type	12/24V sink/source (standard) 24V sink/source (high-speed)	
Output circuit type	Relay	24V DC sink transistor (standard and high-speed)
Event input interrupt support	Yes	
Power consumption, max	5 W – without plug-in modules 7.88 W – with plug-in modules	

**General Specifications**

Attribute	2080-LC30-10QWB	2080-LC30-10QVB
Power supply voltage range	20.4...26.4V DC Class 2	
I/O rating	Input: 24V DC, 8.8 mA Output: 2 A, 240V AC, general use	Input: 24V DC, 8.8 mA Output: 2 A, 24V DC, 1 A per point (Surrounding air temperature 30 °C) 24 V DC, 0.3 A per point (Surrounding air temperature 65 °C)
Isolation voltage	250V (continuous), Reinforced Insulation Type, Outputs to Aux and Network, Inputs to Outputs Type tested for 60 s @ 720V DC, Inputs to Aux and Network, 3250 V DC Outputs to Aux and Network, Inputs to Outputs	50V (continuous), Reinforced Insulation Type, I/O to Aux and Network, Inputs to Outputs Type tested for 60 s @ 720V DC, I/O to Aux and Network, Inputs to Outputs
Pilot duty rating	C300, R150	—
Insulation stripping length	7 mm (0.28 in.)	
Enclosure type rating	Meets IP20	
North American temp code	T4	

(1) Use this Conductor Category information for planning conductor routing. Refer to Industrial Automation Wiring and Grounding Guidelines, publication [1770-4.1](#).

**Inputs**

Attribute	2080-LC30-10QWB, 2080-LC30-10QVB	
	High-Speed DC Input (Inputs 0...3)	Standard DC Input (inputs 4 and higher)
Number of Inputs	4	2
Input group to backplane isolation	Verified by one of the following dielectric tests: 1,414V DC for 2 s 75V DC working voltage (IEC Class 2 reinforced insulation)	
Voltage category	24V DC sink/source	
Off-state voltage, max	5V DC	
On-state voltage, nom	24V DC	
On-state voltage range	16.8...26.4V DC @ 65 °C (149 °F) 16.8...30.0V DC @ 30 °C (86 °F)	10...26.4V DC @ 65 °C (149 °F) 10...30.0V DC @ 30 °C (86 °F)
Off-state current, max	1.5 mA	
On-state current, min	5.0 mA @ 16.8V DC	1.8 mA @ 10V DC
On-state current, nom	8.8 mA @ 24V DC	8.5 mA @ 24V DC
On-state current, max	12.0 mA @ 30V DC	
Nominal impedance	3 kΩ	3.74 kΩ
IEC input compatibility	Type 3	
AC input filter setting	8 ms for all embedded inputs (In Connected Components Workbench, go to the Embedded I/O configuration window to reconfigure the filter setting for each input group)	

**Isolated AC Inputs**

Attribute	2080-LC30-10QWB, 2080-LC30-10QVB (Inputs 0...3)
On-state voltage, nom	12/24V AC @ 50/60 Hz
Off-state voltage, min	4V AC @ 50/60Hz
Operating frequency, nom	50/60 Hz

**Outputs**

Attribute	2080-LC30-10QWB	2080-LC30-10QVB	
	Relay Output	Hi-Speed Output (Outputs 0...1)	Standard Output (Outputs 2...3)
Output voltage, min	5V DC, 5V AC	10.8V DC	10V DC
Output voltage, max	125V DC, 265V AC	26.4V DC	26.4V DC
Load current, min	10 mA	10 mA	
Load current, max	2.0 A	100 mA (high-speed operation) 1.0 A @ 30 °C 0.3 A @ 65 °C (standard operation)	1.0 A @ 30 °C 0.3 A @ 65 °C (standard operation)
Surge current, per point	Refer to Relay Contacts Ratings on page 211	4.0 A every 1 s @ 30 °C; every 2 s @ 65 °C <sup>(1)</sup>	
Current, per common, max	5 A	2 A	4 A
Current, per controller, max	1440V A	2 A	4 A
Turn on time/ Turn off time, max	10 ms	2.5 μs	ON: 0.1 ms OFF: 1.0 ms

(1) Applies for general purpose operation only. Does not apply for high-speed operation.

**Relay Contacts Ratings**

Maximum Volts	Amperes		Amperes Continuous	Volt-Amperes	
	Make	Break		Make	Break
120V AC	15 A	1.5 A	2.0 A	1800V A	180V A
240V AC	7.5 A	0.75 A			
24V DC	1.0 A		1.0 A	28V A	
125V DC	0.22 A				

For the Micro830 controller relay chart, see [Relay Chart for Micro830, Micro850, and Micro870 Controllers on page 234](#).

## Micro830 16-Point Controllers

### General Specifications

Attribute	2080-LC30-16AWB	2080-LC30-16QWB	2080-LC30-16QVB
Number of I/O	16 (10 inputs, 6 outputs)		
Dimensions (HxWxD)	90 x 100 x 80 mm (3.54 x 3.94 x 3.15 in.)		
Shipping weight, approx.	0.302 kg (0.666 lb)		
Wire size	0.14...2.5 mm <sup>2</sup> (26...14 AWG) solid copper wire or 0.14...1.5 mm <sup>2</sup> (26...16 AWG) stranded copper wire rated @ 90 °C (194 °F) insulation max		
Wiring category <sup>(1)</sup>	2 – on signal ports 2 – on power ports		
Wire type	Use Copper Conductors only		
Terminal screw torque, max	0.6 Nm (4.4 lb-in.) (using a 2.5 mm (0.10 in.) flat-blade screwdriver)		
Input circuit type	120V AC	12/24V sink/source (standard) 24V sink/source (high-speed)	
Output circuit type	Relay	12/24V DC sink transistor (standard and high-speed)	
Event input interrupt support	Yes		
Power consumption, max	5 W – without plug-in modules 7.88 W – with plug-in modules		
Power supply voltage range	20.4...26.4V DC Class 2		
I/O rating	Input: 120V AC, 16 mA Output: 2 A, 240V AC, general use	Input: 24V DC, 8.8 mA Output: 2 A, 240V AC, general use	Input: 24V DC, 8.8 mA Output: 24V DC, 1 A per point (Surrounding air temperature 30 °C) 24V DC, 0.3 A per point (Surrounding air temperature 65 °C)
Isolation voltage	250V (continuous), Reinforced Insulation Type, Outputs to Aux and Network, Inputs to Outputs Type tested for 60 s @ 3250V DC I/O to Aux and Network, Inputs to Outputs	250V (continuous), Reinforced Insulation Type, Outputs to Aux and Network, Inputs to Outputs Type tested for 60 s @ 720V DC, Inputs to Aux and Network, 3250V DC Outputs to Aux and Network, Inputs to Outputs	50V (continuous), Reinforced Insulation Type, I/O to Aux and Network, Inputs to Outputs Type tested for 60s @ 720 V DC, I/O to Aux and Network, Inputs to Outputs
Pilot duty rating	C300, R150		–
Insulation stripping length	7 mm (0.28 in.)		
Enclosure type rating	Meets IP20		
North American temp code	T4		

(1) Use this Conductor Category information for planning conductor routing. Refer to Industrial Automation Wiring and Grounding Guidelines, publication [1770-4.1](#).

**Inputs**

Attribute	2080-LC30-16AWB	2080-LC30-16QVB, 2080-LC30-16QWB	
	120V AC Input	High-Speed DC Input (Inputs 0...3)	Standard DC Input (Inputs 4...9)
Number of Inputs	10	4	6
Input group to backplane isolation	Verified by the following dielectric tests: 1,400V AC for 2 s 132V working voltage (IEC Class 2 reinforced insulation)	Verified by the following dielectric tests: 1,414V DC for 2 s 75V DC working voltage (IEC Class 2 reinforced insulation)	
Voltage category	110V AC	24V DC sink/source	
On-state voltage range	79...132V AC 47...63 Hz	16.8...26.4V DC	10...26.4V DC
Off-state voltage, max	20V AC	5V DC	
Off-state current, max	1.5 mA		
On-state current, min	5 mA @ 79V AC	5.0 mA @ 16.8V DC	1.8 mA @ 10V DC
On-state current, nom	12 mA @ 120V AC	7.66 mA @ 24V	6.15 mA @ 24V
On-state current, max	16 mA @ 132V AC	12.0 mA @ 30V DC	
Nominal impedance	12 k $\Omega$ @ 50 Hz 10 k $\Omega$ @ 60 Hz	3 k $\Omega$	3.74 k $\Omega$
Inrush current, max	250 mA @ 120V AC	—	
Turn on time/ Turn off time, max (without filtering)	ON: 1 ms OFF: 8 ms	ON: 3.2 $\mu$ s OFF: 0.6 $\mu$ s	ON: 33 $\mu$ s...0.1 ms OFF: 22 $\mu$ s...0.02 ms
IEC input compatibility	Type 3		
AC input filter setting	8 ms for all embedded inputs (In Connected Components Workbench, go to the Embedded I/O configuration window to reconfigure the filter setting for each input group)		

**Isolated AC Inputs**

Attribute	2080-LC30-16QWB, 2080-LC30-16QVB (Inputs 0...3)
On-state voltage, nom	12/24V AC @ 50/60 Hz
Off-state voltage, min	4V AC @ 50/60 Hz
Operating frequency, nom	50/60 Hz

**Outputs**

Attribute	2080-LC30-16AWB, 2080-LC30-16QWB	2080-LC30-16QVB	
	Relay Output	Hi-Speed Output (Outputs 0...1)	Standard Output (Outputs 2...5)
Number of outputs	6	2	4
Output voltage, min	5V DC, 5V AC	10.8V DC	10V DC
Output voltage, max	125V DC, 265V AC	26.4V DC	26.4V DC

## Outputs

Attribute	2080-LC30-16AWB, 2080-LC30-16QWB	2080-LC30-16QVB	
	Relay Output	Hi-Speed Output (Outputs 0...1)	Standard Output (Outputs 2...5)
Load current, min	10 mA	10 mA	10 mA
Load current, max	2.0 A	100 mA (high-speed operation) 1.0 A @ 30 °C 0.3 A @ 65 °C (standard operation)	1.0 A @ 30 °C 0.3 A @ 65 °C (standard operation)
Surge current, per point	Refer to Relay Contacts Ratings on page 214	4.0 A every 1 s @ 30 °C; every 2 s @ 65 °C <sup>(1)</sup>	
Current, per common, max	5 A	—	—
Turn on time/ Turn off time, max	10 ms	2.5 μs	ON: 0.1 ms OFF: 1 ms

(1) Applies for general purpose operation only. Does not apply for high-speed operation.

### Relay Contacts Ratings

Maximum Volts	Amperes		Amperes Continuous	Volt-Amperes	
	Make	Break		Make	Break
120V AC	15 A	1.5 A	2.0 A	1800V A	180V A
240V AC	7.5 A	0.75 A			
24V DC	1.0 A		1.0 A	28V A	
125V DC	0.22 A				

For the Micro853 controller relay chart, see [Relay Chart for Micro830, Micro850, and Micro870 Controllers on page 234](#).

## Micro830 24-Point Controllers

### General Specifications

Attribute	2080-LC30-24QWB	2080-LC30-24QVB	2080-LC30-24QBB
Number of I/O	24 (14 inputs, 10 outputs)		
Dimensions (HxWxD)	90 x 150 x 80 mm (3.54 x 5.91 x 3.15 in.)		
Shipping weight, approx.	0.423 kg (0.933 lb)		
Wire size	0.2...2.5 mm <sup>2</sup> (24...14 AWG) solid copper wire or 0.2...2.5 mm <sup>2</sup> (24...14 AWG) stranded copper wire rated @ 90 °C (194 °F) insulation max		
Wiring category <sup>(1)</sup>	2 – on signal ports 2 – on power ports		
Wire type	Use Copper Conductors only		
Terminal screw torque, max	0.6 Nm (4.4 lb-in) (using a 2.5 mm (0.10 in.) flat-blade screwdriver)		



**General Specifications**

Attribute	2080-LC30-24QWB	2080-LC30-24QVB	2080-LC30-24QBB
Input circuit type	12/24V sink/source (standard) 24V sink/source (high-speed)		
Output circuit type	Relay	24V DC sink (standard and high-speed)	24V DC source (standard and high-speed)
Event input interrupt support	Yes		
Power consumption, max	8 W – without plug-in modules 12.32 W – with plug-in modules		
Power supply voltage range	20.4...26.4V DC Class 2		
I/O rating	Input: 24V DC, 8.8 mA Output: 2 A, 240V AC, general use	Input: 24V DC, 8.8 mA Output: 24V DC, Class 2, 1 A per point (Surrounding air temperature 30 °C) 24 V DC, Class 2, 0.3 A per point (Surrounding air temperature 65 °C)	
Isolation voltage	250V (continuous), Reinforced Insulation Type, Outputs to Aux and Network, Inputs to Outputs Type tested for 60 s @ 720V DC, Inputs to Aux and Network, 3250 V DC Outputs to Aux and Network, Inputs to Outputs	50V (continuous), Reinforced Insulation Type, I/O to Aux and Network, Inputs to Outputs Type tested for 60 s @ 720V DC, I/O to Aux and Network, Inputs to Outputs	
Pilot duty rating	C300, R150 (2080-LC30-24QWB only)	—	
Insulation stripping length	7 mm (0.28 in.)		
Enclosure type rating	Meets IP20		
North American temp code	T4		

(1) Use this Conductor Category information for planning conductor routing. Refer to Industrial Automation Wiring and Grounding Guidelines, publication [1770-4.1](#).

**Inputs**

Attribute	2080-LC30-24QWB, 2080-LC30-24QVB, 2080-LC30-24QBB	
	High-Speed DC Input (Inputs 0...7)	Standard DC Input (Inputs 8 and higher)
Number of Inputs	8	6
Voltage category	24V DC sink/source	
Operating voltage range	16.8...26.4V DC	10...26.4V DC
Off-state voltage, max	5V DC	
Off-state current, max	1.5 mA	
On-state current, min	5.0 mA @ 16.8V DC	1.8 mA @ 10V DC
On-state current, nom	8.8 mA @ 24V DC	8.5 mA @ 24V DC
On-state current, max	12.0 mA @ 30V DC	
Nominal impedance	3 k $\Omega$	3.74 k $\Omega$
IEC input compatibility	Type 3	
AC input filter setting	8 ms for all embedded inputs (In Connected Components Workbench software, go to the Embedded I/O configuration window to re-configure the filter setting for each input group)	

### Isolated AC Inputs

Attribute	2080-LC30-24QWB, 2080-LC30-24QVB, 2080-LC30-24QBB (Inputs 0...7)
On-state voltage, nom	12/24V AC @ 50/60 Hz
Off-state voltage, min	4V AC @ 50/60Hz
Operating frequency, nom	50/60 Hz

### Outputs

Attribute	2080-LC30-24QWB	2080-LC30-24QVB, 2080-LC30-24QBB	
	Relay Output	Hi-Speed Output (Outputs 0...1)	Standard Output (Outputs 2 and higher)
Number of outputs	10	2	8
Output voltage, min	5V DC, 5V AC	10.8V DC	10V DC
Output voltage, max	125V DC, 265V AC	26.4V DC	26.4V DC
Load current, min	10 mA		
Load current, max	2.0 A	100 mA (high-speed operation) 1.0 A @ 30 °C 0.3 A @ 65 °C (standard operation)	1.0 A @ 30 °C 0.3 A @ 65 °C (standard operation)
Surge current, per point	Refer to Relay Contacts Ratings on page 216	4.0 A every 1 s @ 30 °C; every 2 s @ 65 °C <sup>(1)</sup>	
Current, per common, max	5 A	—	—
Turn on time/ Turn off time, max	10 ms	2.5 μs	ON: 0.1 ms OFF: 1 ms

(1) Applies for general purpose operation only. Does not apply for high-speed operation.

### Relay Contacts Ratings

Maximum Volts	Amperes		Amperes Continuous	Volt-Amperes	
	Make	Break		Make	Break
120V AC	15 A	1.5 A	2.0 A	1800V A	180V A
240V AC	7.5 A	0.75 A			
24V DC	1.0 A		1.0 A	28V A	
125V DC	0.22 A				

For the Micro830 controller relay chart, see [Relay Chart for Micro830, Micro850, and Micro870 Controllers on page 234](#).

## Micro830 48-Point Controllers

### General Specifications

Attribute	2080-LC30-48AWB	2080-LC30-48QWB	2080-LC30-48QVB	2080-LC30-48QBB
Number of I/O	48 (28 inputs, 20 outputs)			
Dimensions (HxWxD)	90 x 230 x 80 mm (3.54 x 9.06 x 3.15 in.)			
Shipping weight, approx.	0.725 kg (1.60 lb)			
Wire size	0.2...2.5 mm <sup>2</sup> (24...14 AWG) solid copper wire or 0.2...2.5 mm <sup>2</sup> (24...14 AWG) stranded copper wire rated @ 90 °C (194 °F) insulation max			
Wiring category <sup>(1)</sup>	2 – on signal ports 2 – on power ports			
Wire type	Use copper conductors only			
Terminal screw torque, max	0.6 Nm (4.4 lb-in) (using a 2.5 mm (0.10 in.) flat-blade screwdriver)			
Input circuit type	120V AC	12/24V sink/source (standard) 24V sink/source (high-speed)		
Output circuit type	Relay		24V DC sink (standard and high-speed)	24V DC source (standard and high-speed)
Event input interrupt support	Yes, inputs 0...15 only			
Power consumption, max	11 W – without plug-in modules 18.2 W – with plug-in modules			
Power supply voltage range	20.4...26.4V DC Class 2			
I/O rating	Input: 120V AC, 16 mA Output: 2 A, 240V AC, general use	Input: 24V DC, 8.8 mA Output: 2 A, 240V AC, general use	Input: 24V DC, 8.8 mA Output: 24V DC, 1 A per point (Surrounding air temperature 30 °C) 24 V DC, 0.3 A per point (Surrounding air temperature 65 °C)	
Insulation stripping length	7 mm (0.28 in.)			
Enclosure type rating	Meets IP20			
Pilot duty rating	C300, R150		—	
Isolation voltage	250V (continuous), Reinforced Insulation Type, Outputs to Aux and Network, Inputs to Outputs Type tested for 60 s @ 3250V DC I/O to Aux and Network, Inputs to Outputs	250V (continuous), Reinforced Insulation Type, Outputs to Aux and Network, Inputs to Outputs Type tested for 60 s @ 720V DC, Inputs to Aux and Network, 3250V DC Outputs to Aux and Network, Inputs to Outputs	50V (continuous), Reinforced Insulation Type, I/O to Aux and Network, Inputs to Outputs Type tested for 60 s @ 720V DC, I/O to Aux and Network, Inputs to Outputs	
North American temp code	T4			

(1) Use this Conductor Category information for planning conductor routing. Refer to Industrial Automation Wiring and Grounding Guidelines, publication [1770-4.1](#).

**Inputs**

Attribute	2080-LC30-48AWB	2080-LC30-48QWB, 2080-LC30-48QVB, 2080-LC30-48QBB	
	120V AC Input	High-Speed DC Input (Inputs 0...11)	Standard DC Input (Inputs 12 and higher)
Number of Inputs	28	12	16
Voltage category	110V AC	24V DC sink/source	
Operating voltage	132V, 60Hz AC, max	16.8...26.4V DC	10...26.4V DC
Off-state voltage, max	20V AC	5V DC	
Off-state current, max	1.5 mA	1.5 mA	
On-state current, min	5 mA @ 79V AC	5.0 mA @ 16.8V DC	1.8 mA @ 10V DC
On-state current, nom	12 mA @ 120V AC	8.8 mA @ 24V DC	8.5 mA @ 24V DC
On-state current, max	16 mA @ 132V AC	12.0 mA @ 30V DC	
Nominal impedance	12 kΩ @ 50 Hz 10 kΩ @ 60 Hz	3 kΩ	3.74 kΩ
IEC input compatibility	Type 3		
Inrush current, max	250 mA @ 120V AC		
Input frequency, max	63 Hz		
AC input filter setting	8 ms for all embedded inputs (In Connected Components Workbench, go to the Embedded I/O configuration window to reconfigure the filter setting for each input group)		

**Isolated AC Inputs**

Attribute	2080-LC30-48QWB, 2080-LC30-48QVB, 2080-LC30-48QBB (Inputs 0...11)
On-state voltage, nom	12/24V AC @ 50/60 Hz
Off-state voltage, min	4V AC @ 50/60Hz
Operating frequency, nom	50/60 Hz

**Outputs**

Attribute	2080-LC30-48AWB, 2080-LC30-48QWB	2080-LC30-48QVB, 2080-LC30-48QBB	
	Relay Output	Hi-Speed Output (Outputs 0...3)	Standard Output (Outputs 4 and higher)
Number of outputs	20	4	16
Output voltage, min	5V DC, 5V AC	10.8V DC	10V DC
Output voltage, max	125V DC, 265V AC	26.4V DC	26.4V DC
Load current, min	10 mA		
Load current, max	2.0 A	100 mA (high-speed operation) 1.0 A @ 30 °C 0.3 A @ 65 °C (standard operation)	1.0 A @ 30 °C 0.3 A @ 65 °C (standard operation)

**Outputs**

Attribute	2080-LC30-48AWB, 2080-LC30-48QWB	2080-LC30-48QVB, 2080-LC30-48QBB	
	Relay Output	Hi-Speed Output (Outputs 0...3)	Standard Output (Outputs 4 and higher)
Surge current, per point	Refer to Relay Contacts Ratings on page 219	4.0 A every 1 s @ 30 °C; every 2 s @ 65 °C <sup>(1)</sup>	
Current, per common, max	5 A	—	—
Turn on time/ Turn off time, max	10 ms	2.5 μs	ON: 0.1 ms OFF: 1 ms

(1) Applies for general purpose operation only. Does not apply for high-speed operation.

**Relay Contacts Ratings**

Maximum Volts	Amperes		Amperes Continuous	Volt-Amperes	
	Make	Break		Make	Break
120V AC	15 A	1.5 A	2.0 A	1800V A	180V A
240V AC	7.5 A	0.75 A			
24V DC	1.0 A		1.0 A	28V A	
125V DC	0.22 A				

For the Micro830 controller relay chart, see [Relay Chart for Micro830, Micro850, and Micro870 Controllers on page 234](#).

**Environmental Specifications****Environmental Specifications**

Attribute	Value
Temperature, operating	IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock): -20...65 °C (-4...149 °F)
Temperature, surrounding air, max	65 °C (149 °F)
Temperature, nonoperating	IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock): -40...85 °C (-40...185 °F)
Relative humidity	IEC 60068-2-30 (Test Db, Unpackaged Damp Heat): 5...95% non-condensing
Vibration	IEC 60068-2-6 (Test Fc, Operating): 2 g @ 10...500 Hz
Shock, operating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): 25 g
Shock, nonoperating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): DIN mount: 25 g PANEL mount: 35 g – 24-point and 48-point controllers 45 g – 10-point and 16-point controllers

### Environmental Specifications

Attribute	Value
Emissions	IEC 61000-6-4
ESD immunity	IEC 61000-4-2: 6 kV contact discharges 8 kV air discharges
Radiated RF immunity	IEC 61000-4-3: 10V/m with 1 kHz sine-wave 80% AM from 80...2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 10V/m with 1 kHz sine-wave 80% AM from 2000...2700 MHz
EFT/B immunity	IEC 61000-4-4: ±2 kV @ 5 kHz on power ports ±2 kV @ 5 kHz on signal ports
Surge transient immunity	IEC 61000-4-5: ±1 kV line-line(DM) and ±2 kV line-earth(CM) on signal ports
Conducted RF immunity	IEC 61000-4-6: 10V rms with 1 kHz sine-wave 80% AM from 150 kHz...80 MHz

### Certifications

#### Certifications

Certification (when product is marked) <sup>(1)</sup>	Value
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E322657.  UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E334470.
CE	European Union 2014/30/EU EMC Directive, compliant with: EN 61326-1; Meas./Control/Lab., Industrial Requirements EN 61000-6-2; Industrial Immunity EN 61000-6-4; Industrial Emissions EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)  European Union 2014/35/EU LVD, compliant with: EN 61131-2; Programmable Controllers (Clause 11)  European Union 2011/65/EU RoHS, compliant with: EN 50851; Technical Documentation
RCM	Australian Radiocommunications Act, compliant with: EN 61000-6-4; Industrial Emissions
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: Article 58-2 of Radio Waves Act, Clause 3
EAC	Russian Customs Union TR CU 020/2011 EMC Technical Regulation Russian Customs Union TR CU 004/2011 LV Technical Regulation

(1) See the Product Certification link at <http://www.rockwellautomation.com/global/certification/overview> page for Declaration of Conformity, Certificates, and other certification details.

## Micro850 Controllers

The following tables provide specifications, ratings, and certifications for the Micro850 controllers.

### Micro850 24-Point Controllers

#### General Specifications

Attribute	2080-LC50-24AWB	2080-LC50-24QWB	2080-LC50-24QVB	2080-LC50-24QBB
Number of I/O	24 (14 inputs, 10 outputs)			
Dimensions (HxWxD)	90 x 158 x 80 mm (3.54 x 6.22 x 3.15 in.)			
Shipping weight, approx.	0.423 kg (0.933 lb)			
Wire size	0.2...2.5 mm <sup>2</sup> (24...14 AWG) solid copper wire or 0.2...2.5 mm <sup>2</sup> (24...14 AWG) stranded copper wire rated @ 90 °C (194 °F) insulation max			
Wiring category <sup>(1)</sup>	2 – on signal ports 2 – on power ports 2 – on communication ports			
Wire type	Use Copper Conductors only			
Terminal screw torque	0.4...0.5 Nm (3.5...4.4 lb-in.) using a 0.6 x 3.5 mm flat-blade screwdriver. (Note: Use a handheld screwdriver to hold down the screws at the side.)			
Input circuit type	120V AC	12/24V sink/source (standard) 24V sink/source (high-speed)		
Output circuit type	Relay		24V DC sink (standard and high-speed)	24V DC source (standard and high-speed)
Power consumption, max	8 W – without plug-in modules and expansion I/O modules 28 W – with plug-in modules and expansion I/O modules			
Power supply voltage range	20.4...26.4V DC Class 2			
I/O rating	Input: 120V AC 16 mA Output: 2 A, 240V AC, 2 A, 24V DC	Input: 24V, 8.8 mA Output: 2 A, 240V AC 2 A, 24V DC	Input: 24V, 8.8 mA Output: 24V DC, Class 2, 1 A per point (Surrounding air temperature 30 °C) 24V DC, Class 2, 0.3 A per point (Surrounding air temperature 65 °C)	
Isolation voltage	250V (continuous), Reinforced Insulation Type, Output to Aux and Network, Inputs to Outputs. Type tested for 60 s @ 3250V DC Output to Aux and Network, Inputs to Outputs 150V (continuous), Reinforced Insulation Type, Input to Aux and Network. Type tested for 60 s @ 1950V DC Input to Aux and Network	250V (continuous), Reinforced Insulation Type, Output to Aux and Network, Inputs to Outputs. Type tested for 60 s @ 3250V DC Output to Aux and Network, Inputs to Outputs. 50V (continuous), Reinforced Insulation Type, Input to Aux and Network Type tested for 60 s @ 720V DC, Input to Aux and Network	50V (continuous), Reinforced Insulation Type, I/O to Aux and Network, Inputs to Outputs. Type tested for 60 s @ 720 V DC, I/O to Aux and Network, Inputs to Outputs.	
Pilot duty rating	C300, R150		–	
Insulation stripping length	7 mm (0.28 in.)			
Enclosure type rating	Meets IP20			
North American temp code	T4			

(1) Use this Conductor Category information for planning conductor routing. Refer to Industrial Automation Wiring and Grounding Guidelines, publication [1770-4.1](#).

### DC Input Specifications

Attribute	2080-LC50-24QBB, 2080-LC50-24QVB, 2080-LC50-24QWB	
	High-Speed DC Input (Inputs 0...7)	Standard DC Input (Inputs 8 and higher)
Number of Inputs	8	6
Voltage category	24V sink/source	
Input group to backplane isolation	Verified by one of the following dielectric tests: 720V DC for 2 s 50V DC working voltage (IEC Class 2 reinforced insulation)	
On-state voltage range	16.8...26.4V DC @ 65 °C (149 °F) 16.8...30.0V DC @ 30 °C (86 °F)	10...26.4V DC @ 65 °C (149 °F) 10...30.0V DC @ 30 °C (86 °F)
Off-state voltage, max	5V DC	
Off-state current, max	1.5 mA	
On-state current, min	5.0 mA @ 16.8V DC	1.8 mA @ 10V DC
On-state current, nom	7.6 mA @ 24V DC	6.15 mA @ 24V DC
On-state current, max	12.0 mA @ 30V DC	12.0 mA @ 30V DC
Nominal impedance	3 kΩ	3.74 kΩ
IEC input compatibility	Type 3	

### AC Input Specifications

Attribute	2080-LC50-24AWB
Number of Inputs	14
On-state voltage, min	79 V AC
On-state voltage, max	132V AC
On-state current, min	5 mA
On-state current, max	16 mA
Input frequency, min	47 Hz
Input frequency, nom	50/60 Hz
Input frequency, max	63 Hz
Off-state voltage, max	20V AC @ 120V AC
Off-state current, max	2.5 mA @ 120V AC
Inrush current, max	250 mA @ 120V AC
Inrush delay time constant max	22 ms
IEC input compatibility	Type 3



**Isolated AC Inputs**

Attribute	2080-LC50-24QWB, 2080-LC50-24QVB, 2080-LC50-24QBB (Inputs 0...7)
On-state voltage, nom	12/24V AC @ 50/60 Hz
Off-state voltage, min	4V AC @ 50/60Hz
Operating frequency, nom	50/60 Hz

**Output Specifications**

Attribute	2080-LC50-24QWB 2080-LC50-24AWB	2080-LC50-24QVB / 2080-LC50-24QBB	
	Relay Output	Hi-Speed Output (Outputs 0...1)	Standard Output (Outputs 2 and higher)
Number of outputs	10	2	8
Output voltage, min	5V DC, 5V AC	10.8V DC	10V DC
Output voltage, max	125V DC, 265V AC	26.4V DC	26.4V DC
Load current, min	10 mA		
Load current, continuous, max	2.0 A	100 mA (high-speed operation) 1.0 A @ 30 °C 0.3 A @ 65 °C (standard operation)	1.0 A @ 30 °C 0.3 A @ 65 °C (standard operation)
Surge current, per point	See Relay Contacts Ratings on page 216	4.0 A for 10 ms every 1 s @ 30 °C; every 2 s @ 65 °C <sup>(1)</sup>	
Current, per common, max	5 A	–	–
Turn on time/ Turn off time, max	10 ms	2.5 μs	0.1 ms 1 ms

(1) Applies for general purpose operation only; does not apply for high-speed operation.

**Relay Contacts Ratings**

Maximum Volts	Amperes		Amperes Continuous	Volt-Amperes	
	Make	Break		Make	Break
120V AC	15 A	1.5 A	2.0 A	1800V A	180V A
240V AC	7.5 A	0.75 A			
24V DC	1.0 A		1.0 A	28V A	
125V DC	0.22 A				

For the Micro850 controller relay chart, see [Relay Chart for Micro830, Micro850, and Micro870 Controllers on page 234](#).

## Micro850 48-Point Controllers

### General Specifications

Attribute	2080-LC50-48AWB	2080-LC50-48QWB	2080-LC50-48QVB	2080-LC50-48QBB
Number of I/O	48 (28 inputs, 20 outputs)			
Dimensions (HxWxD)	90 x 238 x 80 mm (3.54 x 9.37 x 3.15 in.)			
Shipping weight, approx.	0.725 kg (1.60 lb)			
Wire size	0.2...2.5 mm <sup>2</sup> (24...14 AWG) solid copper wire or 0.2...2.5 mm <sup>2</sup> (24...14 AWG) stranded copper wire rated @ 90 °C (194 °F) insulation max			
Wiring category <sup>(1)</sup>	2 – on signal ports 2 – on power ports 2 – on communication ports			
Wire type	Use Copper Conductors only			
Terminal screw torque	0.4...0.5 Nm (3.5...4.4 lb-in.) (using a 0.6 x 3.5 mm flat-blade screwdriver)			
Input circuit type	120V AC	12/24V sink/source (standard) 24V sink/source (high-speed)		
Output circuit type	Relay		24V DC sink (standard and high-speed)	24V DC source (standard and high-speed)
Power consumption, max	11 W – without plug-in modules and expansion I/O modules 33 W –with plug-in modules and expansion I/O modules			
Power supply voltage range	20.4...26.4V DC Class 2			
I/O rating	Input: 120V AC, 16 mA Output: 2 A, 240V AC, 2 A, 24V DC	Input: 24V, 8.8 mA Output: 2 A, 240V AC, 2 A, 24V DC	Input: 24V, 8.8 mA Output: 24V DC, 1 A per point (surrounding air temperature 30 °C) 24V DC, 0.3 A per point surrounding air temperature 65 °C)	
Insulation stripping length	7 mm (0.28 in)			
Enclosure type rating	Meets IP20			
Pilot duty rating	C300, R150		–	
Isolation voltage	250V (continuous), Reinforced Insulation Type, Output to Aux and Network, Inputs to Outputs. Type tested for 60 s @ 3250V DC Output to Aux and Network, Inputs to Outputs. 150V (continuous), Reinforced Insulation Type Input to Aux and Network Type tested for 60 s @ 1950V DC Input to Aux and Network.	250V (continuous), Reinforced Insulation Type, Output to Aux and Network, Inputs to Outputs Type tested for 60 s @ 3250V DC Output to Aux and Network, Inputs to Outputs 50V (continuous), Reinforced Insulation Type, Input to Aux and Network Type tested for 60 s @ 720V DC, Inputs to Aux and Network	50V (continuous), Reinforced Insulation Type, I/O to Aux and Network, Inputs to Outputs Type tested for 60 s @ 720V DC, I/O to Aux and Network, Inputs to Outputs.	
North American temp code	T4			

(1) Use this Conductor Category information for planning conductor routing. Refer to Industrial Automation Wiring and Grounding Guidelines, publication [1770-4.1](#).

**Input Specifications**

Attribute	2080-LC50-48AWB	2080-LC50-48QWB, 2080-LC50-48QVB, 2080-LC50-48QBB	
	120V AC Input	High-Speed DC Input (Inputs 0...11)	Standard DC Input (Inputs 12 and higher)
Number of Inputs	28	12	16
Input group to backplane isolation	Verified by the following dielectric tests: 1950V AC for 2 s 150V working voltage (IEC Class 2 reinforced insulation)	Verified by the following dielectric tests: 720V DC for 2 s 50V DC working voltage (IEC Class 2 reinforced insulation)	
Voltage category	110V AC	24V DC sink/source	
Operating voltage range	132V, 60Hz AC max	16.8...26.4V DC @ 65°C (149°F) 16.8...30.0V DC @ 30°C (86°F)	10...26.4V DC @ 65°C (149°F) 10...30.0V DC @ 30°C (86°F)
Off-state voltage, max	20V AC	5V DC	
Off-state current, max	1.5 mA	1.5 mA	
On-state current, min	5 mA @ 79V AC	5.0 mA @ 16.8V DC	1.8 mA @ 10V DC
On-state current, nom	12 mA @ 120V AC	7.6 mA @ 24V DC	6.15 mA @ 24V DC
On-state current, max	16 mA @ 132V AC	12.0 mA @ 30V DC	
Nominal impedance	12 kΩ @ 50 Hz 10 kΩ @ 60 Hz	3 kΩ	3.74 kΩ
IEC input compatibility	Type 3		
Inrush current, max	250 mA @ 120V AC	—	
Input frequency, max	63 Hz	—	

**Isolated AC Inputs**

Attribute	2080-LC50-48QWB, 2080-LC50-48QVB, 2080-LC50-48QBB (Inputs 0...11)
On-state voltage, nom	12/24V AC @ 50/60 Hz
Off-state voltage, min	4V AC @ 50/60Hz
Operating frequency, nom	50/60 Hz

**Output Specifications**

Attribute	2080-LC50-48AWB, 2080-LC50-48QWB	2080-LC50-48QVB, 2080-LC50-48QBB	
	Relay Output	Hi-Speed Output (Outputs 0...3)	Standard Output (Outputs 4 and higher)
Number of outputs	20	4	16
Output voltage, min	5V DC, 5V AC	10.8V DC	10V DC
Output voltage, max	125V DC, 265V AC	26.4V DC	26.4V DC
Load current, min	10 mA		
Load current, continuous, max	2.0 A	100 mA (high-speed operation) 1.0 A @ 30 °C 0.3 A @ 65 °C (standard operation)	1.0 A @ 30 °C 0.3 A @ 65 °C (standard operation)
Surge current, per point	See Relay Contacts Ratings on page 219	4.0 A for 10 ms every 1 s @ 30 °C; every 2 s @ 65 °C <sup>(1)</sup>	
Current, per common, max	5 A	–	–
Turn on time/ Turn off time, max	10 ms	2.5 μs	ON: 0.1 ms OFF: 1 ms

(1) Applies for general purpose operation only. Does not apply for high-speed operation

**Relay Contacts Ratings**

Maximum Volts	Amperes		Amperes Continuous	Volt-Amperes	
	Make	Break		Make	Break
120V AC	15 A	1.5 A	2.0 A	1800V A	180V A
240V AC	7.5 A	0.75 A			
24V DC	1.0 A		1.0 A	28V A	
125V DC	0.22 A				

For the Micro850 controller relay chart, see [Relay Chart for Micro830, Micro850, and Micro870 Controllers on page 234](#).

## Environmental Specifications

### Environmental Specifications

Attribute	Value
Temperature, operating	IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock): -20...65 °C (-4...149 °F)
Temperature, surrounding air, max	65 °C (149 °F)
Temperature, nonoperating	IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock): -40...85 °C (-40...185 °F)
Relative humidity	IEC 60068-2-30 (Test Db, Unpackaged Damp Heat): 5...95% non-condensing
Vibration	IEC 60068-2-6 (Test Fc, Operating): 2 g @ 10...500 Hz
Shock, operating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): 25 g
Shock, nonoperating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): DIN mount: 25 g PANEL mount: 35 g
Emissions	IEC 61000-6-4
ESD immunity	IEC 61000-4-2: 6 kV contact discharges 8 kV air discharges
Radiated RF immunity	IEC 61000-4-3: 10V/m with 1 kHz sine-wave 80% AM from 80...2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 10V/m with 1 kHz sine-wave 80% AM from 2000...2700 MHz
EFT/B immunity	IEC 61000-4-4: ±2 kV @ 5 kHz on power ports ±2 kV @ 5 kHz on signal ports ±1 kV @ 5 kHz on communication ports
Surge transient immunity	IEC 61000-4-5: ±1 kV line-line(DM) and ±2 kV line-earth(CM) on signal ports ±1 kV line-earth(CM) on communication ports
Conducted RF immunity	IEC 61000-4-6: 10V rms with 1 kHz sine-wave 80% AM from 150 kHz...80 MHz

## Certifications

### Certifications

Certification (when product is marked) <sup>(1)</sup>	Value
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E322657.  UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E334470.
CE	European Union 2014/30/EU EMC Directive, compliant with: EN 61326-1; Meas./Control/Lab., Industrial Requirements EN 61000-6-2; Industrial Immunity EN 61000-6-4; Industrial Emissions EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)  European Union 2014/35/EU LVD, compliant with: EN 61131-2; Programmable Controllers (Clause 11)  European Union 2011/65/EU RoHS, compliant with: EN 50581; Technical documentation
RCM	Australian Radiocommunications Act, compliant with: EN 61000-6-4; Industrial Emissions
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: Article 58-2 of Radio Waves Act, Clause 3.
EAC	Russian Customs Union TR CU 020/2011 EMC Technical Regulation Russian Customs Union TR CU 004/2011 LV Technical Regulation
EtherNet/IP	ODVA conformance tested to EtherNet/IP specifications.

(1) See the Product Certification link at <http://www.rockwellautomation.com/global/certification/overview>.page for Declaration of Conformity, Certificates, and other certification details.

## Micro870 Controllers

The following tables provide specifications, ratings, and certifications for the Micro870 controllers. Catalog numbers with the suffix 'K' are conformal coated and their specifications are the same as non-conformal coated catalogs.

### Micro870 24-Point Controllers

#### General Specifications

Attribute	2080-LC70-24AWB	2080-LC70-24QWB, 2080-LC70-24QWBK	2080-LC70-24QBB 2080-LC70-24QBBK
Number of I/O	24 (14 inputs, 10 outputs)		
Dimensions (HxWxD)	90 x 157 x 80 mm (3.54 x 6.18 x 3.15 in.)		
Shipping weight, approx.	0.47 kg (1.04 lb)		
Wire size	0.2...2.5 mm <sup>2</sup> (24...14 AWG) solid copper wire or 0.2...2.5 mm <sup>2</sup> (24...14 AWG) stranded copper wire rated @ 90 °C (194 °F) insulation max		
Wiring category <sup>(1)</sup>	2 – on signal ports 2 – on power ports 2 – on communication ports		
Wire type	Use copper conductors only		
Terminal screw torque	0.4...0.5 Nm (3.5...4.4 lb-in.) using a 0.6 x 3.5 mm flat-blade screwdriver. Note: Use a handheld screwdriver to hold down the screws at the side.		
Input circuit type	12/24V sink/source (standard) 24V sink/source (high-speed)		
Output circuit type	Relay		24V DC source (standard and high-speed)
Power consumption, max	8 W – without plug-in modules and expansion I/O modules 28 W – with plug-in modules and expansion I/O modules		
Power supply voltage range	21.4...26.4V DC Class 2, or Limited Voltage Limited Current Source (LVLC)		
I/O rating	Input: 120V AC, 16 mA Output: 2 A, 240V AC 2 A, 24V DC	Input: 24V, 8.8 mA Output: 2 A, 240V AC 2 A, 24V DC	Input: 24V, 8.8 mA Output: 24V DC, Class 2, 1 A per point (Surrounding air temperature 30 °C) 24V DC, Class 2, 0.3 A per point (Surrounding air temperature 65 °C)
Isolation voltage	250V (continuous), Reinforced Insulation Type, Output to Aux and Network, Inputs to Outputs. Type tested for 60 s @ 3250V DC Output to Aux and Network, Inputs to Outputs. 150V (continuous), Reinforced Insulation Type, Input to Aux and Network Type tested for 60 s @ 1950V DC, Inputs to Aux and Network	250V (continuous), Reinforced Insulation Type, Output to Aux and Network, Inputs to Outputs. Type tested for 60 s @ 3250V DC Output to Aux and Network, Inputs to Outputs. 50V (continuous), Reinforced Insulation Type, Input to Aux and Network Type tested for 60 s @ 720V DC, Inputs to Aux and Network	50V (continuous), Reinforced Insulation Type, I/O to Aux and Network, Inputs to Outputs. Type tested for 60 s @ 720 V DC, I/O to Aux and Network, Inputs to Outputs.
Pilot duty rating	C300, R150		–
Insulation stripping length	7 mm (0.28 in.)		
Enclosure type rating	Meets IP20		
North American temp code	T4		

(1) Use this Conductor Category information for planning conductor routing. Refer to Industrial Automation Wiring and Grounding Guidelines, publication [1770-4.1](#).

### DC Input Specifications

Attribute	2080-LC70-24QWB, 2080-LC70-24QWBK, 2080-LC70-24QBB, 2080-LC70-24QBBK	
	High-Speed DC Input (Inputs 0...7)	Standard DC Input (Inputs 8 and higher)
Number of Inputs	8	6
Voltage category	24V sink/source 24V AC, 50/60 Hz	
Input group to backplane isolation	Verified by one of the following dielectric tests: 720V DC for 2 s 50V DC working voltage (IEC Class 2 reinforced insulation)	
On-state voltage range	16.8...26.4V DC @ 65 °C (149 °F) 16.8...30.0V DC @ 30 °C (86 °F)	10...26.4V DC @ 65 °C (149 °F) 10...30.0V DC @ 30 °C (86 °F)
Off-state voltage, max	5V DC	
Off-state current, max	1.5 mA	
On-state current, min	5.0 mA @ 16.8V DC	1.8 mA @ 10V DC
On-state current, nom	7.6 mA @ 24V DC	6.15 mA @ 24V DC
On-state current, max	12.0 mA @ 30V DC	12.0 mA @ 30V DC
Nominal impedance	3 kΩ	3.74 kΩ
IEC input compatibility	Type 3	

### AC Input Specifications

Attribute	2080-LC70-24AWB
Number of Inputs	14
On-state voltage, min	79 V AC
On-state voltage, max	132V AC
On-state current, min	5 mA
On-state current, max	16 mA
Input frequency, min	47 Hz
Input frequency, nom	50/60 Hz
Input frequency, max	63 Hz
Off-state voltage, max	20V AC @ 120V AC
Off-state current, max	2.5 mA @ 120V AC
Inrush current, max	250 mA @ 120V AC
Inrush delay time constant max	22 ms
IEC input compatibility	Type 3



**Output Specifications**

Attribute	2080-LC70-24AWB, 2080-LC70-24QWB, 2080-LC70-24QWBK	2080-LC70-24QBB, 2080-LC70-24QBBK	
	Relay Output	Hi-Speed Output (Outputs 0...1)	Standard Output (Outputs 2 and higher)
Number of outputs	10	2	8
Output voltage, min	5V DC, 5V AC	10.8V DC	10V DC
Output voltage, max	125V DC, 265V AC	26.4V DC	26.4V DC
Load current, min	10 mA		
Load current, continuous, max	2.0 A	100 mA (high-speed operation) 1.0 A @ 30 °C 0.3 A @ 65 °C (standard operation)	1.0 A @ 30 °C 0.3 A @ 65 °C (standard operation)
Surge current, per point	See Relay Contacts Ratings on page 216	4.0 A for 10 ms every 1 s @ 30 °C; every 2 s @ 65 °C <sup>(1)</sup>	
Current, per common, max	5 A	–	–
Turn on time/ Turn off time, max	10 ms	2.5 μs	ON: 0.1 ms OFF: 1 ms

(1) Applies for general purpose operation only; does not apply for high-speed operation.

**Relay Contacts Ratings**

Maximum Volts	Amperes		Amperes Continuous	Volt-Amperes	
	Make	Break		Make	Break
120V AC	15 A	1.5 A	2.0 A	1800V A	180V A
240V AC	7.5 A	0.75 A			
24V DC	1.0 A		1.0 A	28V A	
125V DC	0.22 A		0.22 A		

For the Micro870 controller relay chart, see [Relay Chart for Micro830, Micro850, and Micro870 Controllers on page 234](#).

## Environmental Specifications

### Environmental Specifications

Attribute	Value
Temperature, operating	IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock): -20...65 °C (-4...149 °F)
Temperature, surrounding air, max	65 °C (149 °F)
Temperature, nonoperating	IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock): -40...85 °C (-40...185 °F)
Relative humidity	IEC 60068-2-30 (Test Db, Unpackaged Damp Heat): 5...95% non-condensing
Vibration	IEC 60068-2-6 (Test Fc, Operating): 2 g @ 10...500 Hz
Shock, operating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): 25 g
Shock, nonoperating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): DIN mount: 25 g PANEL mount: 35 g
Emissions	IEC 61000-6-4
ESD immunity	IEC 61000-4-2: 6 kV contact discharges 8 kV air discharges
Radiated RF immunity	IEC 61000-4-3: 10V/m with 1 kHz sine-wave 80% AM from 80...2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 10V/m with 1 kHz sine-wave 80% AM from 2000...2700 MHz
EFT/B immunity	IEC 61000-4-4: ±2 kV @ 5 kHz on power ports ±2 kV @ 5 kHz on signal ports ±1 kV @ 5 kHz on communication ports
Surge transient immunity	IEC 61000-4-5: ±1 kV line-line(DM) and ±2 kV line-earth(CM) on signal ports ±1 kV line-earth(CM) on communication ports
Conducted RF immunity	IEC 61000-4-6: 10V rms with 1 kHz sine-wave 80% AM from 150 kHz...80 MHz

## Certifications

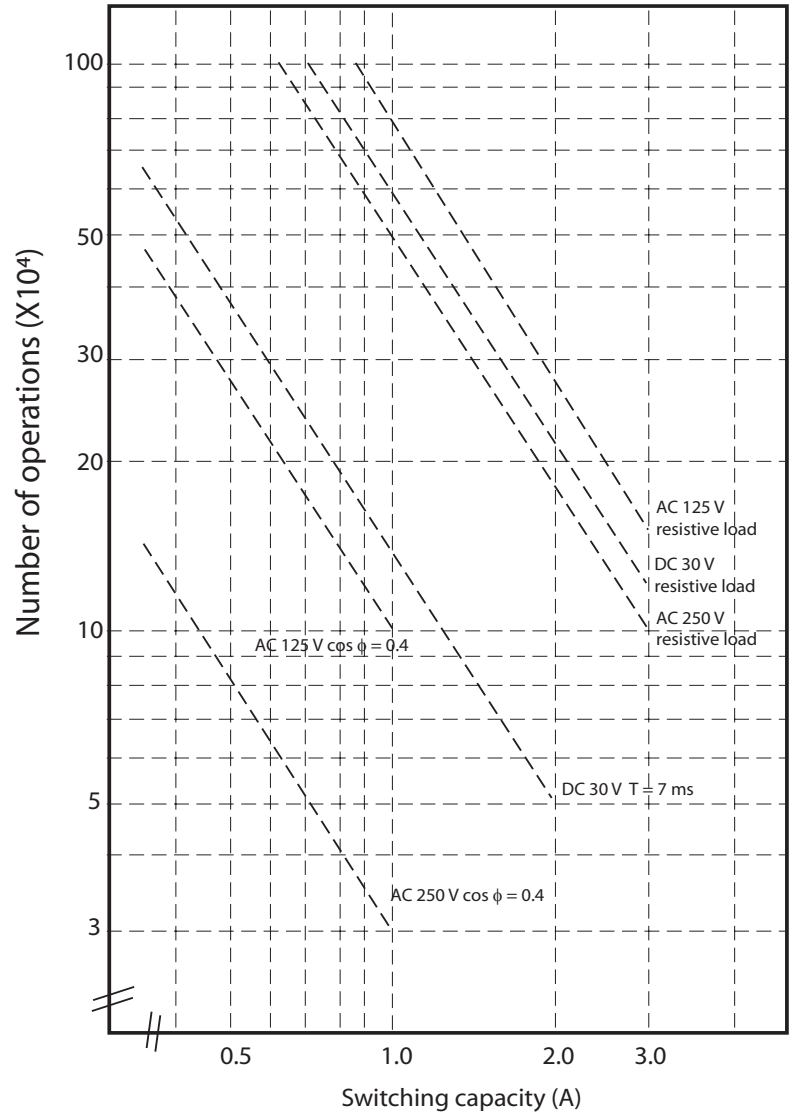
### Certifications

Certification (when product is marked) <sup>(1)</sup>	Value
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E322657.  UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E334470.
CE	European Union 2014/30/EU EMC Directive, compliant with: EN 61326-1; Meas./Control/Lab., Industrial Requirements EN 61000-6-2; Industrial Immunity EN 61000-6-4; Industrial Emissions EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)  European Union 2014/35/EU LVD, compliant with: EN 61131-2; Programmable Controllers (Clause 11)  European Union 2011/65/EU RoHS, compliant with: EN 50581; Technical Documentation
RCM	Australian Radiocommunications Act, compliant with: EN 61000-6-4; Industrial Emissions
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: Article 58-2 of Radio Waves Act, Clause 3.
EAC	Russian Customs Union TR CU 020/2011 EMC Technical Regulation Russian Customs Union TR CU 004/2011 LV Technical Regulation
EtherNet/IP	ODVA conformance tested to EtherNet/IP specifications.

(1) See the Product Certification link at <http://www.rockwellautomation.com/global/certification/overview.page> for Declaration of Conformity, Certificates, and other certification details.

# Relay Chart for Micro830, Micro850, and Micro870 Controllers

Relay life



45629

### PTO Output Duty Cycle Error

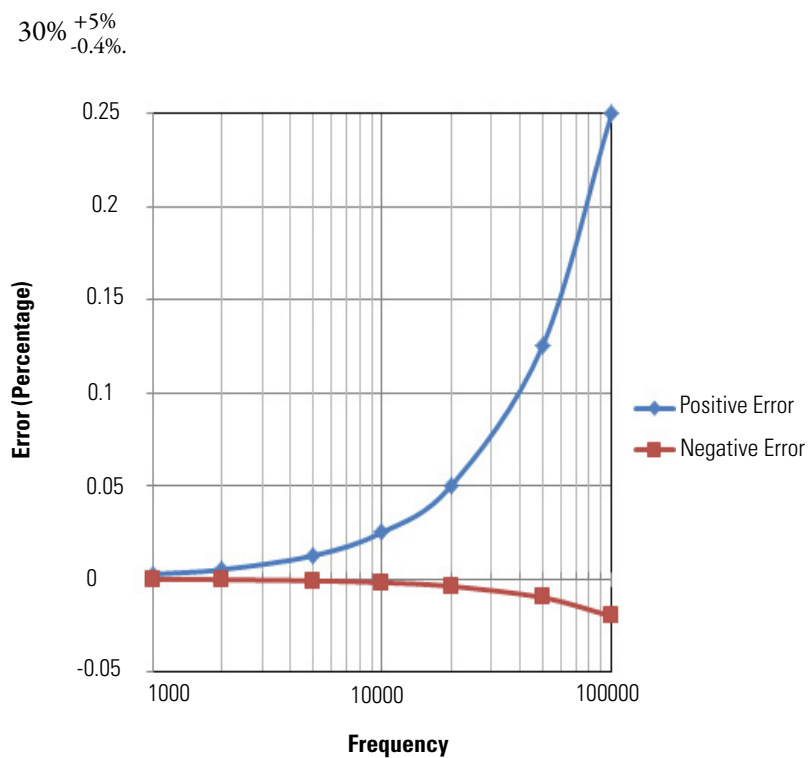
Turn On/Off time for the Micro830, Micro850, and Micro870 controllers for the PTO output port is 0.2  $\mu$ s and 2.5  $\mu$ s max, respectively. Duty cycle error is:

Positive error =  $2.5 \mu\text{s} * F$

Negative error =  $-0.2 \mu\text{s} * F$

The plot below shows duty cycle error vs. frequency.

To get the duty cycle error at a certain frequency, for example, the user sets frequency to 20 kHz, and sets duty cycle to 30% in Connected Components Workbench software, then actual duty cycle is



### PTO Typical Readings

#### PTO Typical Readings

		Expected Duty Cycle		Typical Duty Cycle (1.27 K $\Omega$ load)
Frequency (kHz)	%Duty Cycle	Minimum	Maximum	%Duty Cycle
5	5%	4.90%	6.25%	5.48
5	10%	9.90%	11.25%	10.5
5	20%	19.90%	21.25%	20.5
5	40%	39.90%	41.25%	40.5
5	55%	54.90%	56.25%	55.5

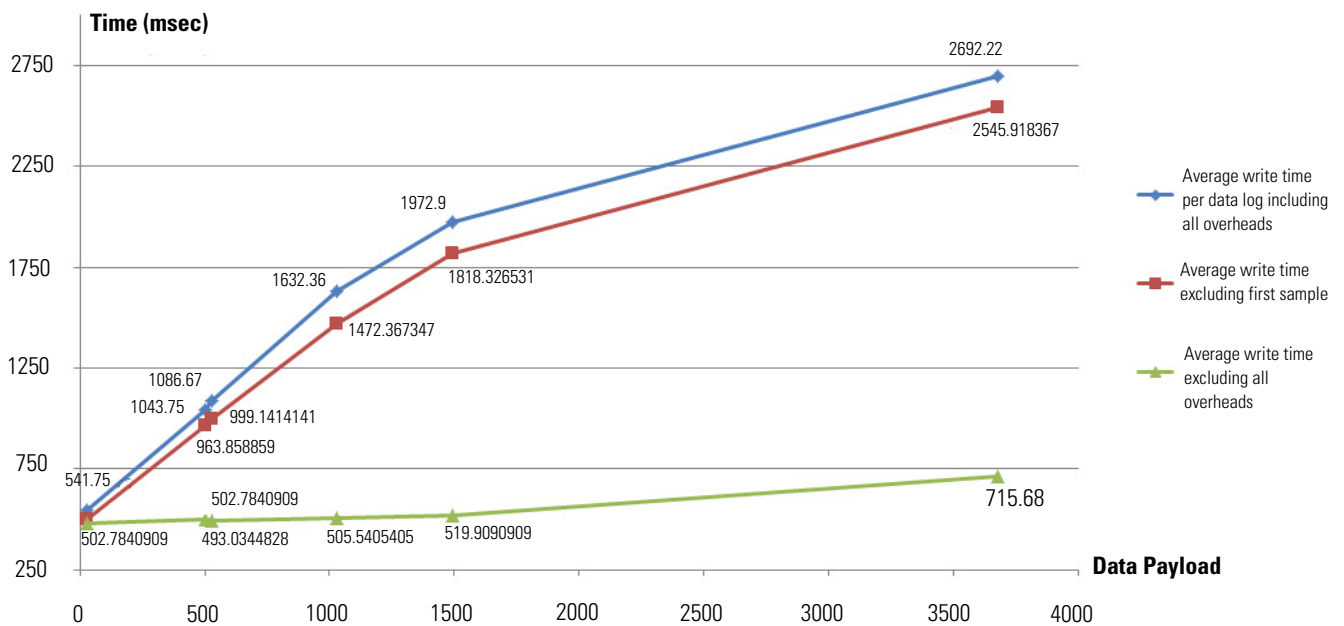
**PTO Typical Readings**

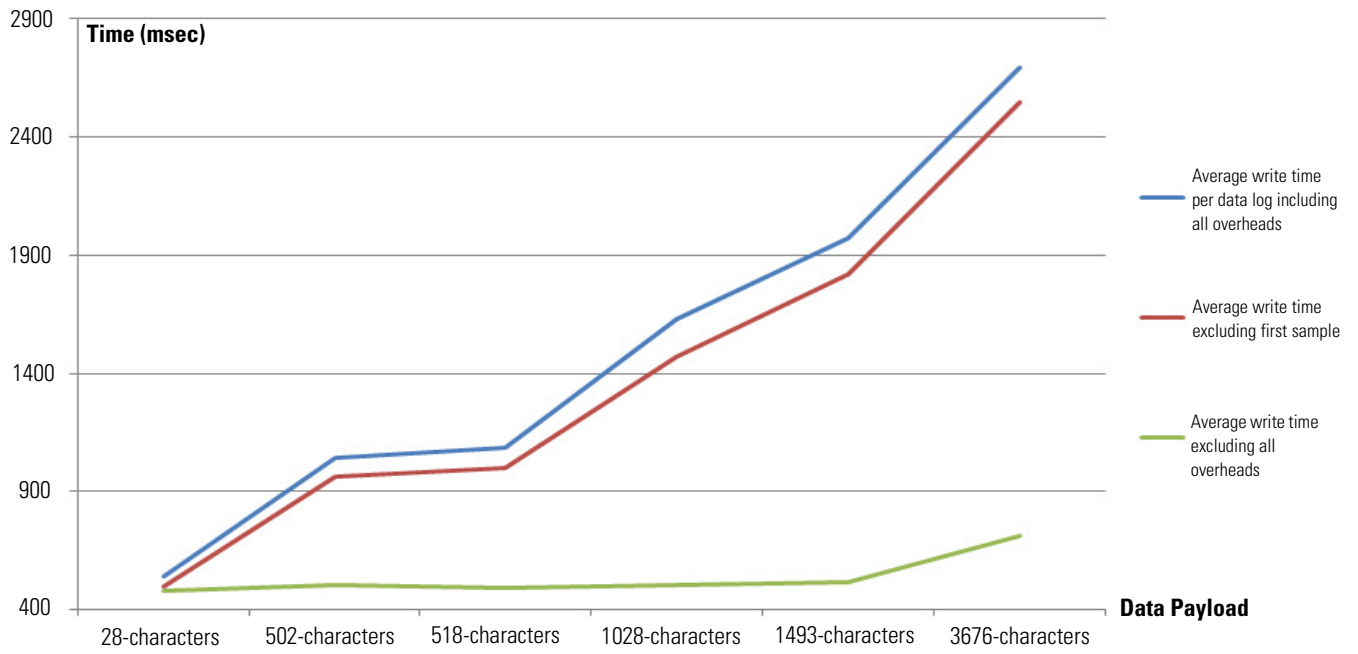
		Expected Duty Cycle		Typical Duty Cycle (1.27 K $\Omega$ load)
Frequency (kHz)	%Duty Cycle	Minimum	Maximum	%Duty Cycle
5	65%	64.90%	66.25%	65.5
5	75%	74.90%	76.25%	75.5
5	95%	94.90%	96.25%	95.5
10	5%	4.80%	7.50%	5.9
10	10%	9.80%	12.50%	11.0
10	20%	19.80%	22.50%	21.0
10	40%	39.80%	42.50%	40.9
10	55%	54.80%	57.50%	55.9
10	65%	64.80%	67.50%	65.9
10	85%	84.80%	87.50%	85.9
10	95%	94.90%	97.50%	95.9
25	5%	4.50%	11.25%	7.25
25	10%	9.50%	16.25%	12.3
25	20%	19.50%	26.25%	22.4
25	40%	39.50%	46.25%	42.3
25	55%	54.50%	61.25%	57.3
25	65%	64.50%	71.25%	67.3
25	85%	84.50%	91.25%	87.3
25	95%	94.50%	100.00%	97.0
50	5%	4.00%	17.50%	9.7
50	10%	9.00%	22.50%	14.8
50	20%	19.00%	32.50%	24.7
50	40%	39.00%	52.50%	44.7
50	55%	54.00%	67.50%	59.6
50	65%	64.00%	77.50%	69.6
50	85%	84.00%	97.50%	89.5
50	95%	94.00%	100.00%	98.1
100	5%	3.00%	30.00%	14.7
100	10%	8.00%	35.00%	19.5
100	20%	18.00%	45.00%	19.6
100	40%	38.00%	65.00%	49.3
100	55%	53.00%	80.00%	64.0
100	65%	63.00%	90.00%	73.8
100	85%	83.00%	100.00%	92.4
100	95%	93.00%	100.00%	98.0

### Data Log Performance

#### Data Log – Data Payload vs. Performance Time

Parameter	Number of Characters					
	28	502	518	1028	1493	3676
Average write time per data log file including all overheads	541.77 ms	1043.75 ms	1086.67 ms	1632.36 ms	1972.9 ms	2696.22 ms
Average write time excluding first sample	500.40 ms	963.86 ms	999.14 ms	1472.36 ms	1818.33 ms	2545.92 ms
Average write time excluding all overheads	479.10 ms	502.78 ms	493.03 ms	505.54 ms	519.91 ms	715.68 ms







## Micro800 Programmable Controller External AC Power Supply

### General Specifications

Attribute	Value
Dimensions (HxWxD)	90 x 45 x 80 mm (3.55 x 1.78 x 3.15 in.)
Shipping weight, approx	0.34 kg (0.75 lb)
Supply voltage range <sup>(1)</sup>	100V...120V AC, 1 A 200...240V AC, 0.5 A
Supply frequency	47...63 Hz
Supply power	24V DC, 1.6 A
Inrush current, max	24 A @ 132V for 10 ms 40 A @ 263V for 10 ms
Power consumption (Output power)	38.4 W @ 100V AC, 38.4 W @ 240V AC
Power dissipation (Input power)	45.1 W @ 100V AC, 44.0 W @ 240V AC
Isolation voltage	250V (continuous), Primary to Secondary: Reinforced Insulation Type Type tested for 60s @ 2300V AC primary to secondary and 1480V AC primary to earth ground.
Output ratings, max	24V DC, 1.6 A, 38.4 W
Enclosure type rating	Meets IP20
Wire size	0.32...2.1 mm <sup>2</sup> (22...14 AWG) solid copper wire or 0.32...1.3 mm <sup>2</sup> (22...16 AWG) stranded copper wire rated @ 90 °C (194 °F) insulation max
Terminal screw torque	0.5...0.6 Nm (4.4...5.3 lb-in.) (using a Phillips-head or 2.5 mm (0.10in.) flat-blade screwdriver)
Wiring category <sup>(2)</sup>	2 – on power ports
Insulation stripping length	7 mm (0.28 in.)
North American temp code	T4A

(1) Any fluctuation in voltage source must be within 85V...264V. Do not connect the adapter to a power source that has fluctuations outside of this range.

(2) Use this Conductor Category information for planning conductor routing. Refer to Industrial Automation Wiring and Grounding Guidelines, publication [1770-4.1](#).

**Notes:**

## Modbus Mapping for Micro800

### Modbus Mapping

All Micro800 controllers (except the Micro810 12-point models) support Modbus RTU over a serial port through the embedded, non-isolated serial port. The 2080-SERIALISOL isolated serial port plug-in module also supports Modbus RTU. Both Modbus RTU master and slave are supported. Although performance may be affected by the program scan time, the 48-point controllers can support up to six serial ports (one embedded and five plug-ins), and so consequently, six separate Modbus networks.

In addition, the Micro850 and Micro870 controller supports Modbus TCP Client/Server through the Ethernet port.

### Endian Configuration

Modbus protocol is big-endian in that the most significant byte of a 16-bit word is transmitted first. Micro800 is also big-endian, so byte ordering does not have to be reversed. For Micro800 data types larger than 16-bits (for example, DINT, LINT, REAL, LREAL), multiple Modbus addresses may be required but the most significant byte is always first.

### Mapping Address Space and supported Data Types

Since Micro800 uses symbolic variable names instead of physical memory addresses, a mapping from symbolic Variable name to physical Modbus addressing is supported in Connected Components Workbench software, for example, InputSensorA is mapped to Modbus address 100001.

By default Micro800 follows the six-digit addressing specified in the latest Modbus specification. For convenience, conceptually the Modbus address is mapped with the following address ranges. The Connected Components Workbench mapping screen follows this convention.

Variable Data Type	0 - Coils 000001 to 065536		1 - Discrete Inputs 100001 to 165536		3 - Input Registers 300001 to 365536		4 - Holding Registers 400001 to 465536	
	Supported	Modbus Address Used	Supported	Modbus Address Used	Supported	Modbus Address Used	Supported	Modbus Address Used
BOOL	Y	1	Y	1				
SINT	Y	8	Y	8				
BYTE	Y	8	Y	8				
USINT	Y	8	Y	8				
INT	Y	16	Y	16	Y	1	Y	1
UINT	Y	16	Y	16	Y	1	Y	1
WORD	Y	16	Y	16	Y	1	Y	1
REAL	Y	32	Y	32	Y	2	Y	2
DINT	Y	32	Y	32	Y	2	Y	2
UDINT	Y	32	Y	32	Y	2	Y	2
DWORD	Y	32	Y	32	Y	2	Y	2
LWORD	Y	64	Y	64	Y	4	Y	4
ULINT	Y	64	Y	64	Y	4	Y	4
LINT	Y	64	Y	64	Y	4	Y	4
LREAL	Y	64	Y	64	Y	4	Y	4

NOTE: Strings are not supported.

In order to make it easier to map variables to five-digit Modbus addresses, the Connected Components Workbench mapping tool checks the number of characters entered for the Modbus Address. If only five-digits are entered, the address is treated as a five-digit Modbus address. This means that the Coils are mapped from 00001...09999, Discrete Inputs are mapped from 10001...19999, Input Registers are mapped from 30001...39999, and Holding Registers are mapping from 40001...49999.

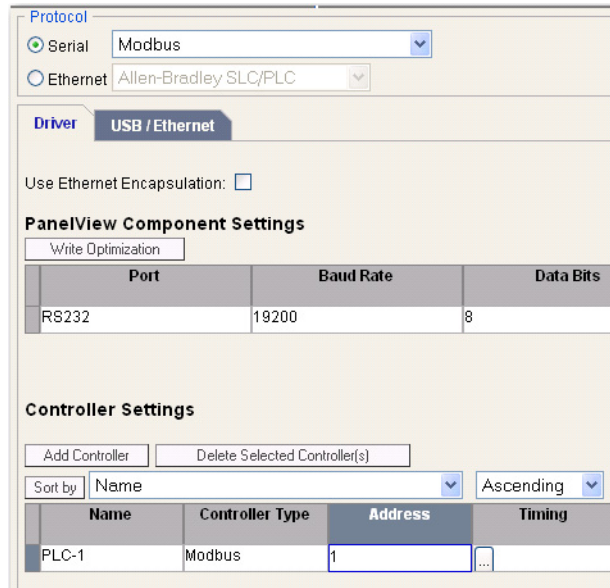
### Example 1, PanelView Component HMI (Master) to Micro800 (Slave)

The embedded serial port is targeted for use with HMIs using Modbus RTU. The maximum recommended cable distance is 3 meters. Use the 2080-SERIALISOL serial port plug-in module if longer distances or more noise immunity is needed.

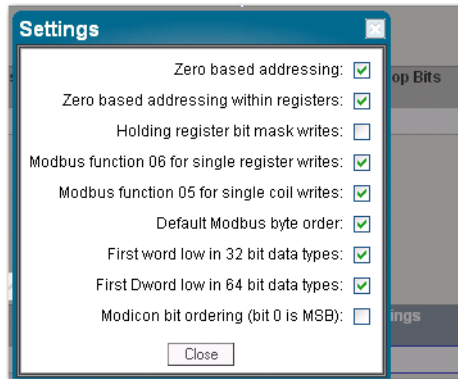
The HMI is typically configured for Master and the Micro800 embedded serial port is configured for Slave.

From the default Communications Settings for a PanelView Component HMI (PVC), there are three items that must be checked or modified in order to set up communications from PVC to Micro800.

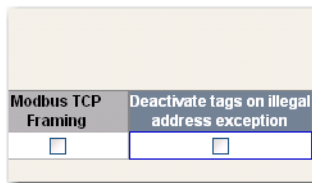
1. Change from DF1 to Modbus protocol.



2. Set the Address of Micro800 slave to match the serial port configuration for the controller.



3. Deactivate Tags on Error. This is to prevent the requirement of power cycling PVC when new Modbus Mappings are downloaded from Connected Components Workbench to Micro800 controller.



## Example 2, Micro800 (Master) to PowerFlex 4M Drive (Slave)

The following is the overview of the steps to be taken for configuring a PowerFlex 4M drive.

Parameter numbers listed in this section are for a PowerFlex 4M and will be different if you are using another PowerFlex 4- Class drive.

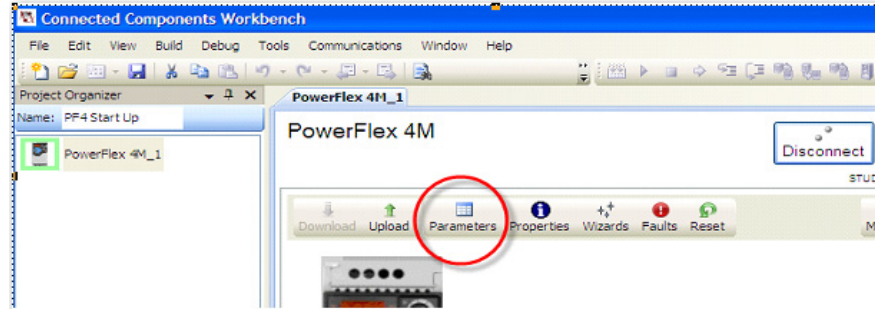
Parameter Name	Parameter Number						
	4M	4	40	40P	400	400N	400P
Start Source	P106	P36					
Speed Reference	P108	P38					
Comm Data Rate	C302	A103			C103		
Comm Node Addr	C303	A104			C104		
Comm Loss Action	C304	A105			C105		
Comm Loss Time	C305	A106			C106		
Comm Format	C306	A107			C102		

- Connect the 1203-USB to the PowerFlex Drive and to the Computer.
- Launch Connected Components Workbench, Connect to the Drive and set parameters.

To configure PowerFlex 4M, perform the following steps:

1. Double-click the PowerFlex 4M if it is not already open in Connected Components Workbench.
2. Click Connect.
3. In the Connection Browser, expand the AB\_DF1 DH+ Driver. Select the AB DSI (PF4 Port) and click OK.
4. Once the Drive has connected and been read in, select the Start up wizard and change the following items. Select Finish to save the changes to the drive.
  - Select the Comm Port as the Speed Reference. Set P108 [Speed Reference] to 5 (Comm Port).
  - Set Start Source to Comm Port. Set P106 [Start Source] to 5 (Comm Port).
  - Defaults for the remaining Inputs
  - Accept Defaults for the remainder and click Finish.

5. Select Parameters from the Connected Components Workbench window.



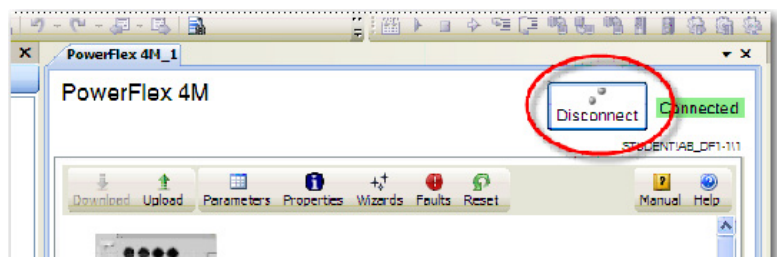
6. The Parameter window opens. Resize it to view the parameters. From this window, you can view and set data values of Parameters.

#	Name	Value	Units	Internal Value	Default	Min
1	Output Freq	0.0	Hz	0	0.0	0.0
2	Commanded Freq	0.0	Hz	0	0.0	0.0
3	Output Current	0.00	A	0	0.00	0.00
4	Output Voltage	0.0	V	0	0.0	0.0
5	DC Bus Voltage	314	V	314	0	0
6	Drive Status	0000000000000010		2	00000000000000...	00000000000000...

7. From the Parameter window, change the following Parameters to set the communications for Modbus RTU so that the PowerFlex 4M Drive will communicate with Micro830/850/870 via Modbus RTU communication.

Parameter	Description	Setting
C302	Comm. Data Rate (Baud Rate) 4 = 19200 bps	4
C303	Communication Node Address (address range is 1...127)	2
C304	Comm. Loss Action ( Action taken when loss communication) 0 = Fault with coast stop	0
C305	Comm. Loss Time (Time remain in communication before taking action set in C304) 5 sec ( Max. 60)	5
C306	Comm. Format (Data/Parity/Stop) RTU:8 Data Bit, Parity None, 1 Stop bit	0

8. Disconnect the Communications and save your project.



9. Turn off the power to the drive until the PowerFlex 4M display blanks out completely, then restore power to the PowerFlex 4M. The drive is now ready to be controlled by Modbus RTU communication commands initiated from the Micro830/850/870 controller.

Modbus devices can be 0-based (registers are numbered starting at 0), or 1-based (registers are numbered starting at 1). When PowerFlex 4-Class drives are used with Micro800 family controllers, the register addresses listed in the PowerFlex User Manuals need to be offset by n+1.

For example, the Logic Command word is located at address 8192, but your Micro800 program needs to use 8193 (8192+1) to access it.

**Modbus Address (n+1 value shown)**

8193	Logic Command word (Stop, Start, Jog, etc.)
8194	Speed Reference word xxx.x format for 4/4M/40, where "123" = 12.3 Hz xxx.xx format for 40P/400/400N/400P, where "123" = 1.23 Hz
8449	Logic Status word (Read, Active, Fault, and so on.)
8452	Speed Feedback word (uses same format as Speed Reference)
8450	Error Code word
(n+1)	To access Parameter 'n'

- TIP**
- If the respective PowerFlex drive supports Modbus Function Code 16 Preset (Write) Multiple Registers, use a single write message with a length of "2" to write the Logic Command (8193) and Speed reference (8194) at the same time.
  - Use a single Function Code 03 Read Holding Registers with a length of "4" to read the Logic status (8449), Error Code (8450), and Speed Feedback (8452) at the same time.

Refer to the respective PowerFlex 4-Class drive User Manual for additional information about Modbus addressing. (See Appendix E – Modbus RTU Protocol, on publication [22C-UM001G](#)).

**Performance**

The performance of MSG\_MODBUS (Micro800 is master) is affected by the Program Scan because messages are serviced when the message instruction is executed in a program. For example, if the program scan is 100 ms and six serial ports are used, then the theoretical maximum for serial ports is 60 messages/second total. This theoretical maximum may not be possible since MSG\_MODBUS is a master/slave request/response protocol, so performance is affected by several variables such as message size, baud rate, and slave response time.

The performance of Micro800 when receiving Modbus request messages (Micro800 is slave) is also affected by the Program Scan. Each serial port is serviced only once per program scan.



## Quickstarts

This chapter covers some common tasks and quickstart instructions that are aimed to make you familiar with the in Connected Component Workbench. The following quickstarts are included:

Topic	Page
Flash Upgrade Your Micro800 Firmware	247
Establish Communications Between RSLinx and a Micro830/Micro850/ Micro870 Controller through USB	254
Configure Controller Password	261
Use the High Speed Counter	264
Forcing I/Os	277
Using Run Mode Change	279

### Flash Upgrade Your Micro800 Firmware

This quick start will show you how to flash update the firmware for a Micro800 controller using Connected Components Workbench software release 10 or later.

From Connected Components Workbench software release 10 onwards, there are two options you can select when flash updating the firmware:

- Upgrade or Downgrade – This option retains the controller’s existing configuration, Ethernet settings, and password.
- Reset – This option clears the controller’s existing configuration, Ethernet settings, and password.

The procedure to flash update the controller is similar for both options.



**ATTENTION:** Retention of the controller’s existing configuration, Ethernet settings, and password is only available when flash updating from firmware revision 10 to the same or later revision. If updating from firmware revision 10 to 9 or earlier, or updating to firmware revision 10 from an earlier revision, the controller’s existing configuration, Ethernet settings, and password will be cleared.

**IMPORTANT** If you have forgotten the password for the controller, use the Reset option to clear the password.

On Micro850 and Micro870 controllers, users can use flash update their controllers through the Ethernet port, in addition to the USB.

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**IMPORTANT** To successfully flash update your controller over USB, connect only one controller to your computer, and do not perform the flash update in a virtual machine such as VMware.

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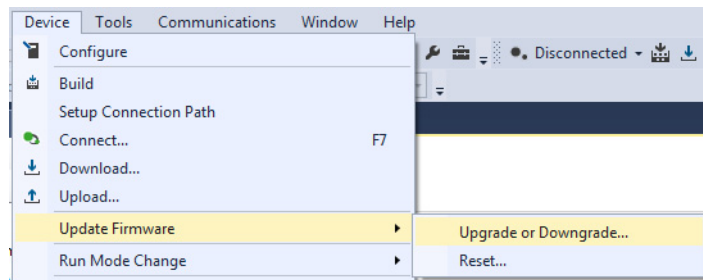
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**IMPORTANT** Flash update over USB using FTLinX software with a 32-bit operating system is not supported. Use either a 64-bit operating system or RSLinx Classic software.

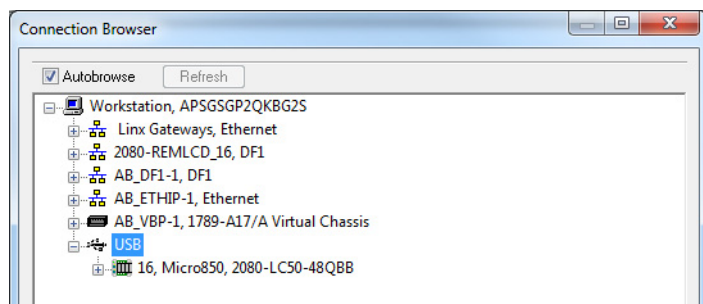
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To begin, launch the Connected Components Workbench software:

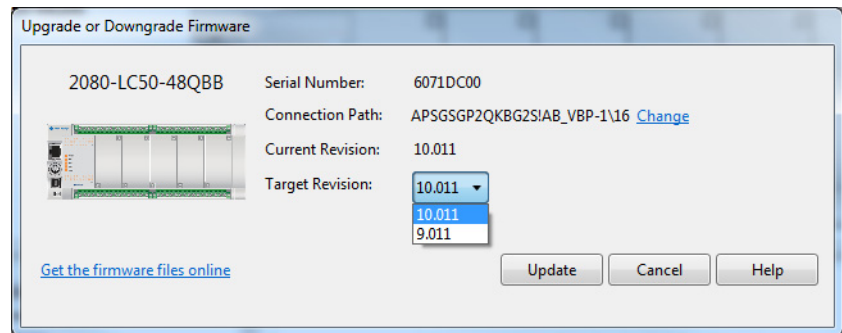
1. In the menu, select Device -> Update Firmware -> Upgrade or Downgrade...  
Alternatively, in the Project Organizer, right-click the controller and select Update Firmware -> Upgrade or Downgrade...



2. If your project does not have a connection path to the controller, the Connection Browser dialog appears. Select your controller, then click OK.



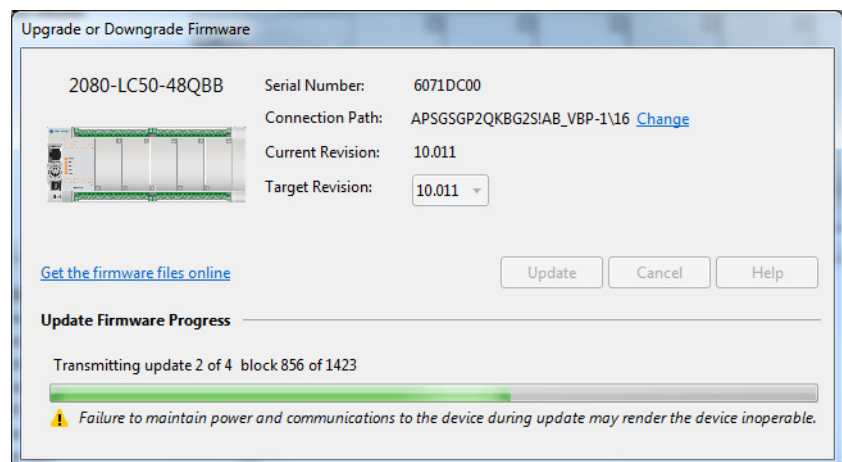
3. In the Upgrade or Downgrade Firmware dialog box, select the desired Target Revision to flash update the controller.



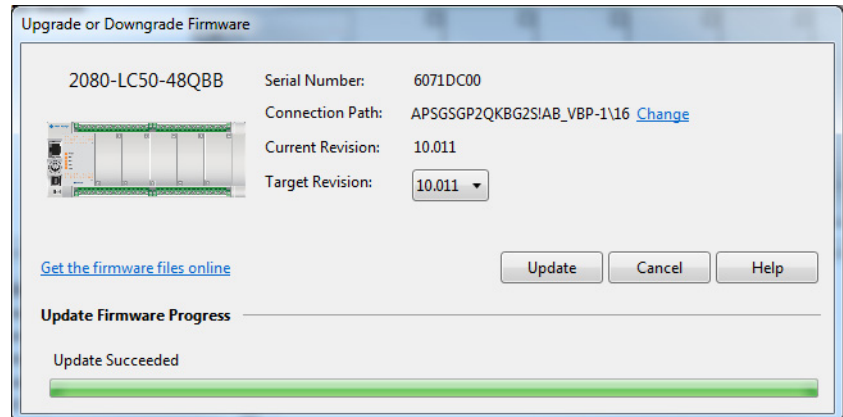
If the desired firmware revision is not shown in the drop-down list, you can download that firmware revision by clicking the “Get the firmware files online” link.

You can also change the Connection Path by clicking the “Change” link.

4. When you have confirmed the settings, click Update to begin flash updating the controller.  
The update progress is shown in the dialog box.



5. After the update is completed, the status is shown in the dialog box.



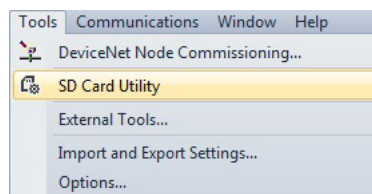
**IMPORTANT** After control flashing the controller, some microSD cards may not be detected. Remove and insert the microSD card, or power cycle the controller if this issue is encountered.

## Flash Upgrade From microSD Card

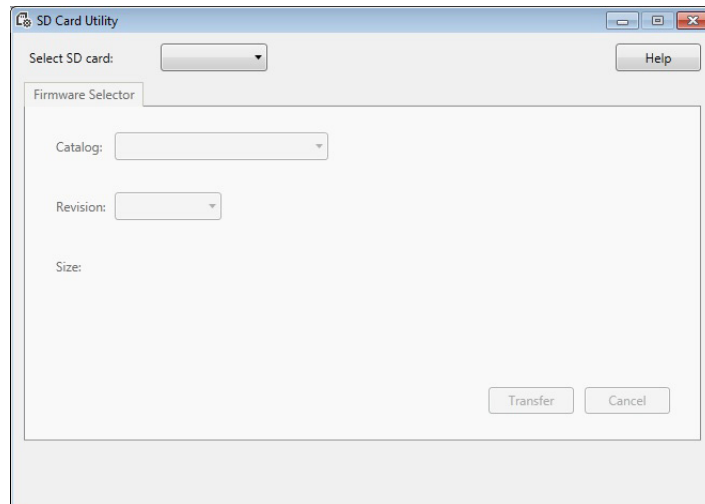
With Connected Components Workbench software version 12 or later, and the microSD card plug-in for Micro800 controllers, you can flash upgrade your Micro830, Micro850, and Micro870 controller from the microSD card in addition to using ControlFLASH. This is two-step process – first you have to transfer the firmware to the microSD card using the SD Card Utility, then you need to edit the ConfigMeFirst.txt file to initiate the flash upgrade process. See the following instructions for performing the flash upgrade from the microSD card.

### Step 1 – Transfer the Firmware to the microSD Card

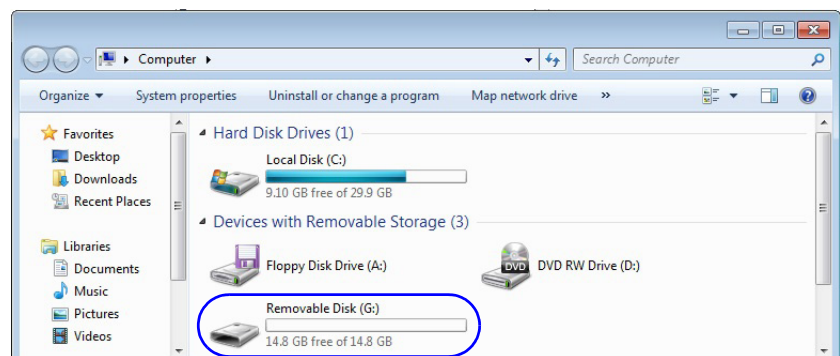
1. Launch Connected Components Workbench.
2. Click Tools -> SD Card Utility.



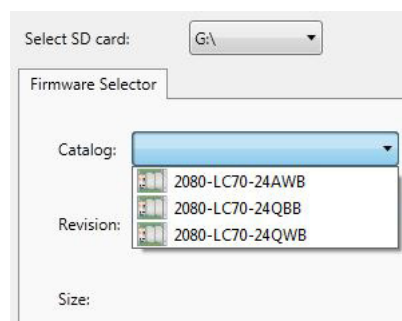
The SD Card Utility window appears.



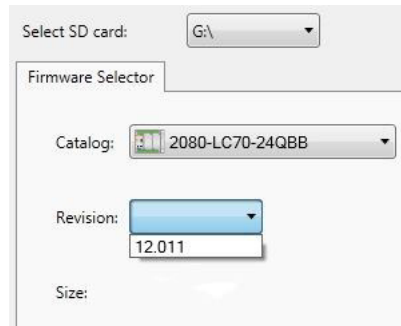
3. Select the drive letter that points to the microSD card on your computer from the pull-down list.  
You can check the drive letter by looking in Windows Explorer. For this example, the microSD card is using the drive letter “G”.



4. Select the catalog number of your Micro800 controller.



5. Select the firmware revision you want to flash your Micro800 controller with.



The list of firmware revisions are installed together with Connected Components Workbench. If you require a revision that is not listed, download the firmware from the Product Compatibility and Download Center (PCDC) at <http://www.rockwellautomation.com/rockwellautomation/support/pcdc.page> and install the included ControlFLASH kit.

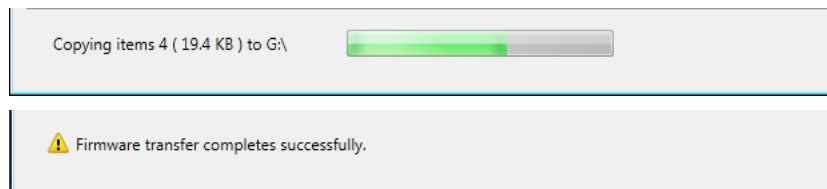
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**IMPORTANT** You must sign in to the Rockwell Automation website before downloading a firmware revision.

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Close and relaunch Connected Components Workbench, then open the SD Card Utility again. The revision should now appear in the list.

6. Click Transfer.  
The file is copied to the microSD card.



7. Close the SD Card Utility and proceed to the next step to edit the ConfigMeFirst.txt file.

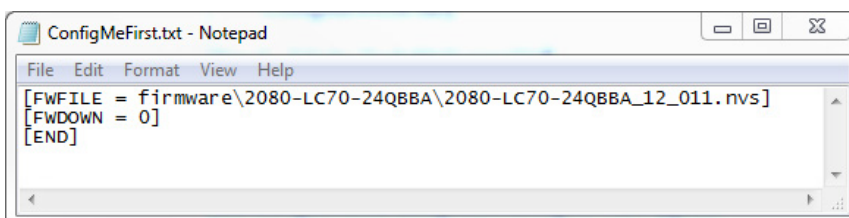
## Step 2 – Edit the ConfigMeFirst.txt File

To flash upgrade the controller with the firmware that you have transferred to the microSD card, you need to edit the ConfigMeFirst.txt file with the settings listed below. These settings must be added at the beginning of the file.

### New ConfigMeFirst.txt Configuration Settings for Flash Upgrade

Setting	Takes Effect On...	Description
<b>Firmware update settings</b>		
[FWFILE]	Powerup	File path location of the firmware revision on the microSD card. The default location is in the following format: firmware\ <catalog firmware&gt;<="" number&gt;\&lt;filename="" of="" td=""> </catalog>
[FWDOWN]	Powerup	Sets whether to upgrade or downgrade the controller firmware from the current revision. 0 = Upgrade firmware; 1 = Downgrade firmware  <b>IMPORTANT:</b> Firmware Upgrade will happen if [FWFILE] setting points to a newer version of firmware file compared to current firmware in the controller, irrespective of [FWDOWN] setting.

### Example of ConfigMeFirst.txt File for Flash Upgrade



After you have edited the file, insert the microSD card into the controller. Power cycle the controller and the flash upgrade process will begin. Note that the SD status LED will not blink when flash upgrading the firmware from the microSD card is in progress.

When using the ControlFLASH utility to downgrading the firmware of a Micro830 or Micro850 series B controller to firmware revision 10.011, the program reports an error and fails at the initial stage. However when upgrading a Micro800 controller using the microSD card with a firmware revision that is not compatible with the series, the controller hard faults. There is no error code reported after you have cycled power to the controller. The controller retains the old firmware.

### Fault Status Indicator Description

State	Indicates
Steady Red	Fault
Flashing Green	Run

For a list of firmware and series compatibility, see the release notes for firmware revision 11.011 or later, publication [2080-RN004](#).

## Establish Communications Between RSLinx and a Micro830/Micro850/Micro870 Controller through USB

This quick start shows you how to get RSLinx RSWho to communicate with a Micro830, Micro850, or Micro870 controller through USB. Micro830, Micro850, and Micro870 controllers use the AB\_VBP-x driver.

RSLinx Classic is installed as part of the Connected Components Workbench software installation process. The minimum version of RSLinx Classic with full Micro800 controller support is 2.57, build 15 (released March 2011).

1. Power up the Micro830/Micro850/Micro870 controller.
2. Plug USB A/B cable directly between your PC and the Micro830/Micro850/Micro870 controller.
3. Windows should discover the new hardware. Click No, not this time and then click Next.

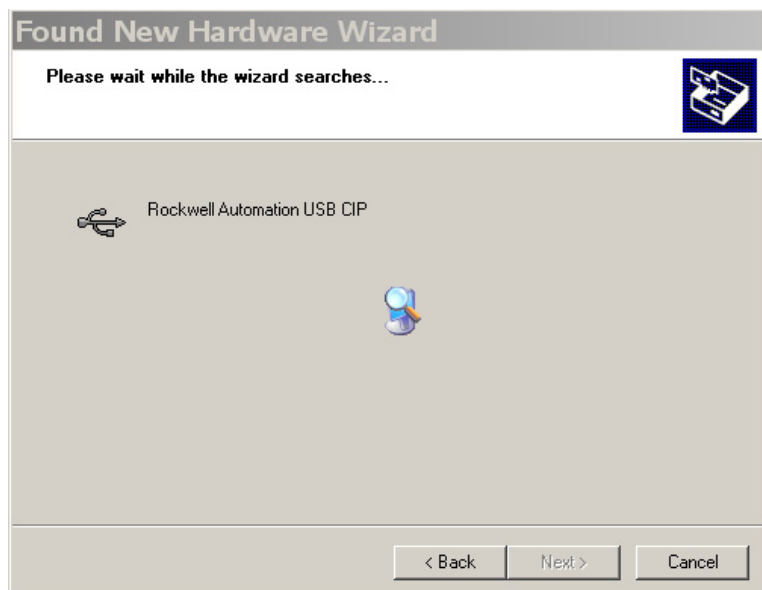




4. Click Install the software automatically (Recommended), and then click Next.



The Wizard searches for new hardware.

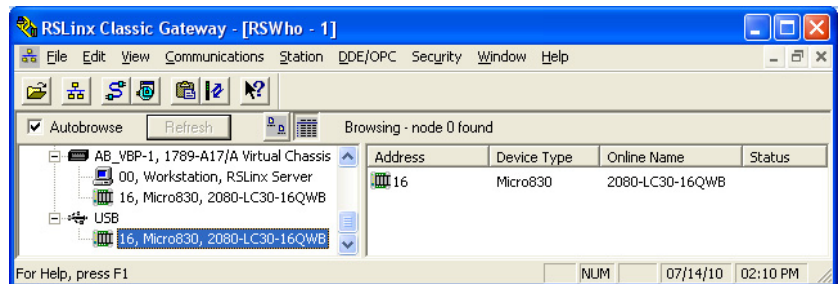


- Click Finish when the wizard completes the installation.

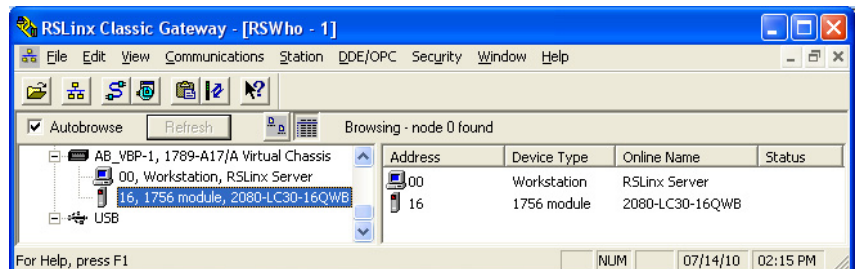


- Open RSLinx Classic and run RSWho by clicking the  icon.

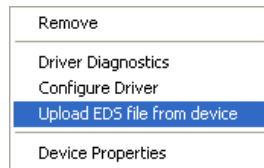
If the proper EDS file is installed, the Micro830/Micro850/Micro870 controller should be properly identified and show up under both the Virtual Backplane (VBP) driver and the USB driver, which was automatically created.



If instead the Micro830/Micro850/Micro870 shows up as a "1756 Module" under the AB\_VBP-1 Virtual Chassis driver, then the proper EDS file for this major revision of firmware has not yet been installed or the controller is running pre-release firmware (Major Revision=0).



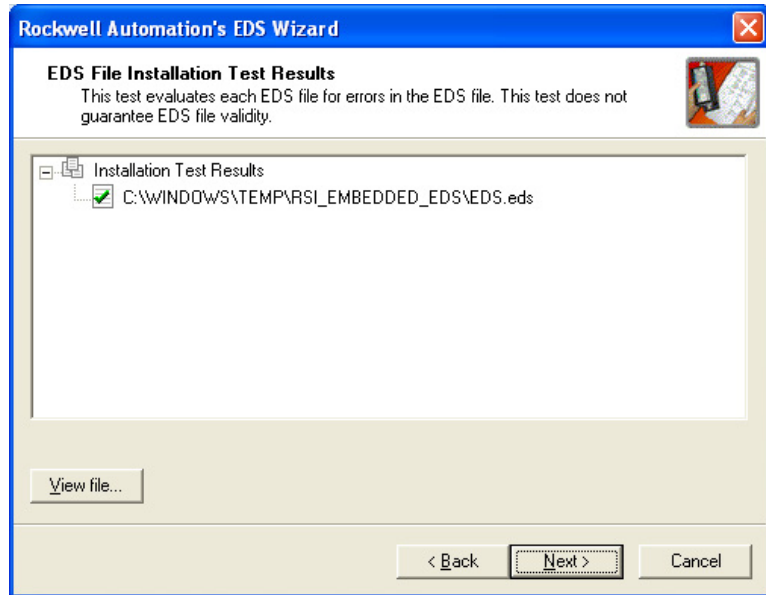
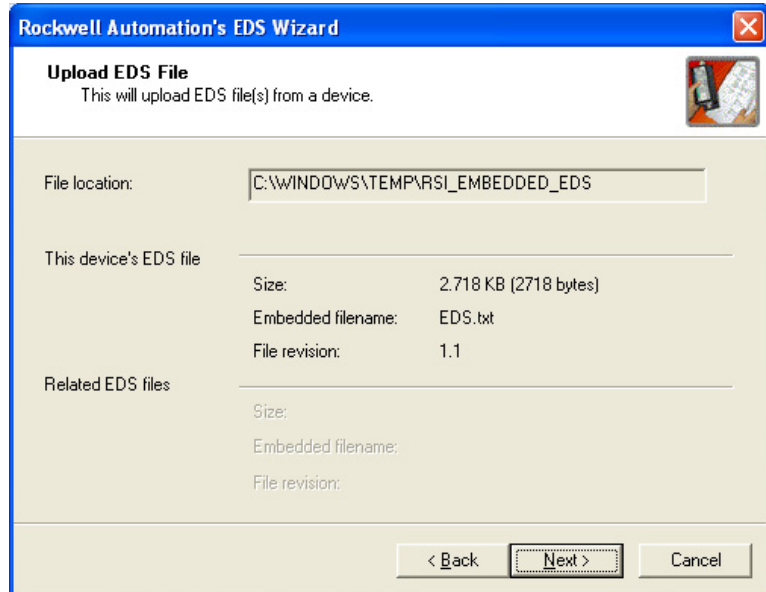
Since Micro830/Micro850/Micro870 controllers support embedded EDS files, right click this device and select Upload EDS file from device.

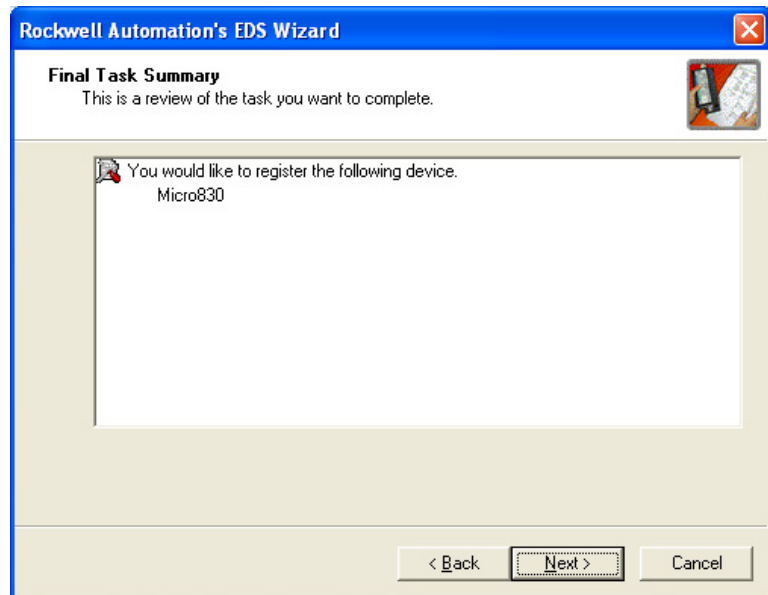
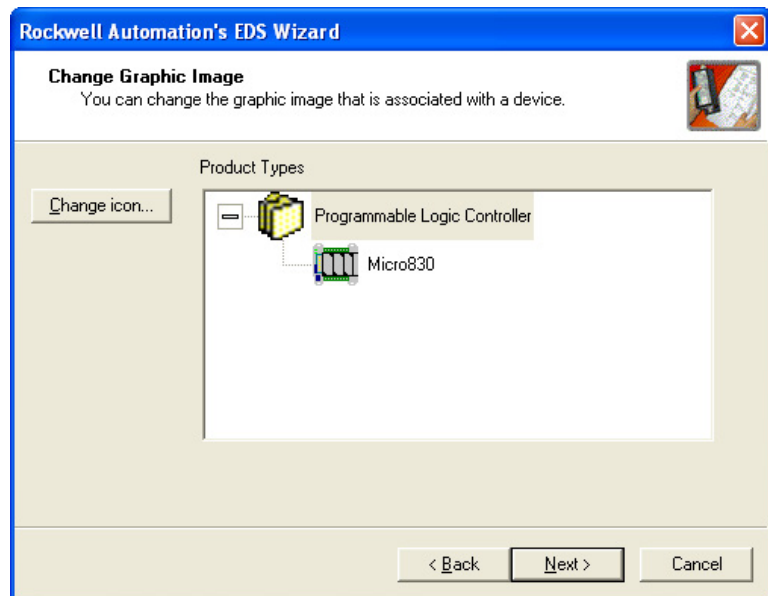


7. On the EDS wizard that appears, click Next to continue.

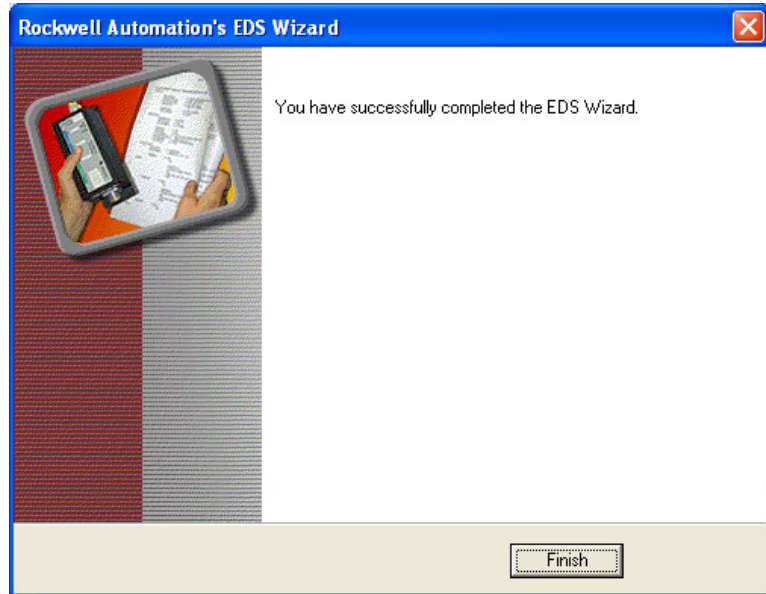


8. Follow the prompts to upload and install the EDS file.

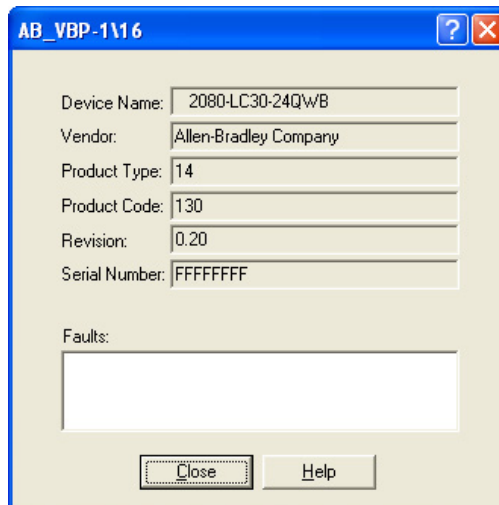




9. Click Finish to complete.



If the Micro830/Micro850/Micro870 still shows up as a 1756 Module, then you are probably running pre-release firmware which is reporting itself as Major Revision 0, which does not match the embedded EDS file. To confirm, right click the device and select Device Properties (firmware Revision is Major.Minor).



## Configure Controller Password

Set, change, and clear the password on a target controller through the Connected Components Workbench software.

---

**IMPORTANT** The following instructions are supported on Connected Components Workbench revision 2 and Micro800 controllers with firmware revision 2. For more information about the controller password feature on Micro800 controllers, see [Controller Security on page 167](#).

---

### Set Controller Password

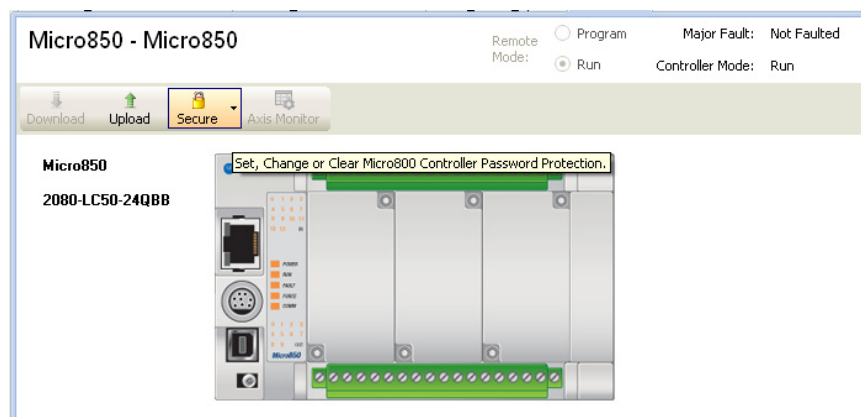
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**IMPORTANT** After creating or changing the controller password, you need to power down the controller in order for the password to be saved.

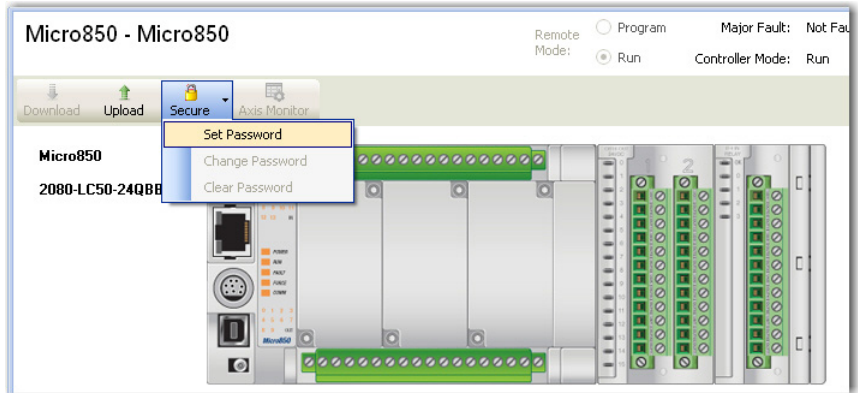
---

In the following instructions, the Connected Components Workbench software is connected to the Micro800 controller.

1. On the Connected Components Workbench software, open the project for the target controller.
2. Click Connect to connect to the target controller. On the Device Details toolbar, roll over the Secure button. The tooltip message “Set, Change, or Clear Micro800 Controller Password Protection” is displayed.



3. Click Secure button. Select Set Password.



4. The Set Controller Password dialog appears. Provide password. Confirm the password by providing it again in the Confirm field.



**TIP** Passwords must have at least eight characters to be valid.

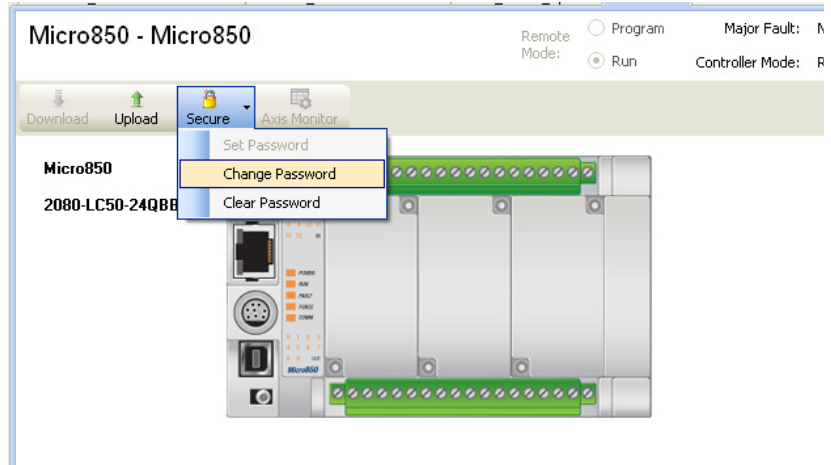
5. Click OK.  
Once a password is created, any new sessions that try to connect to the controller will have to supply the password to gain exclusive access to the target controller.



## Change Password

With an authorized session, you can change the password on a target controller through the Connected Components Workbench software. The target controller must be in Connected status.

1. On the Device Details toolbar, click Secure button. Select Change Password.



2. The Change Controller Password dialog appears. Enter Old Password, New Password and confirm the new password.



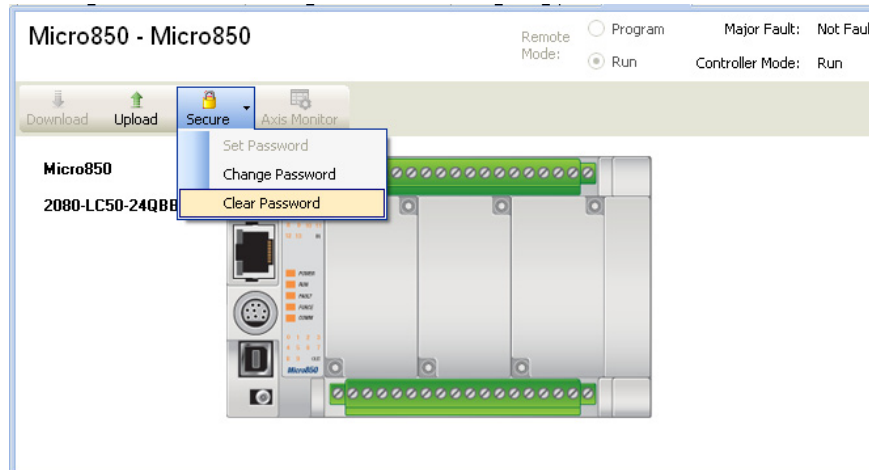
3. Click OK.

The controller requires the new password to grant access to any new session.

## Clear Password

With an authorized session, you can clear the password on a target controller through the Connected Components Workbench software.

1. On the Device Details toolbar, click Secure button. Select Clear Password.



2. The Clear Password dialog appears. Enter Password.
3. Click OK to clear the password.

The controller will require no password on any new session.

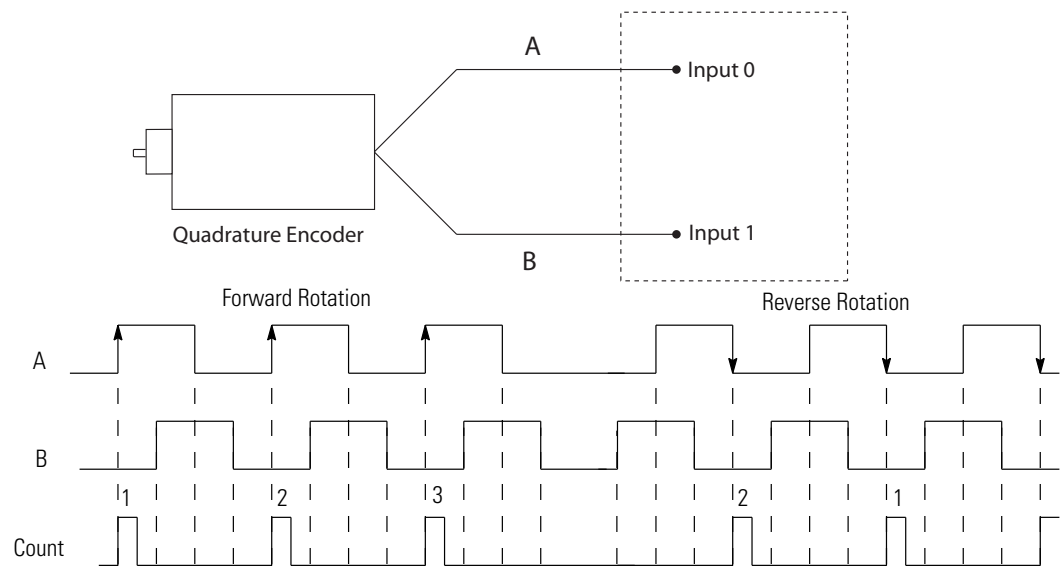
## Use the High Speed Counter

To use HSC, you first need to establish the HSC counting mode required by your application. See [HSC Mode \(HSCAPP.HSCMode\) on page 140](#) for available modes on Micro800 controllers.

The following sample project guides you through the creation of a project which uses HSC mode 6, a quadrature counter with phased inputs A and B. It shows you how to write a simple ladder program with the HSC function block, create variables, and assign variables and values to your function block. You will also be guided through a step-by-step process on how test your program, and enable a Programmable Light Switch (PLS).

This sample project makes use of a quadrature encoder. The quadrature encoder is used for determining direction of rotation and position for rotating, such as a lathe. The Bidirectional Counter counts the rotation of the Quadrature Encoder.

The figure below shows a quadrature encoder connected to inputs 0 and 1. The count direction is determined by the phase angle between A and B. If A leads B, the counter increments. If B leads A, the counter decrements.

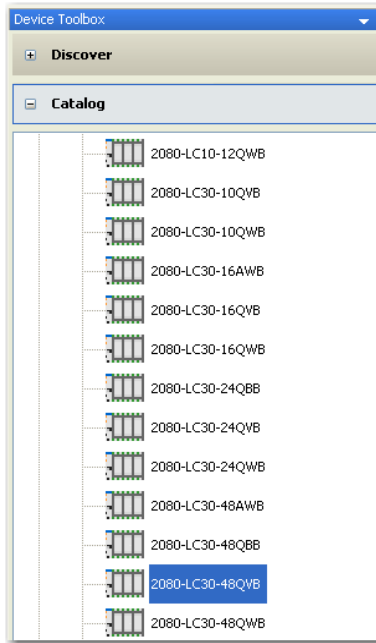


This quickstart includes the following sections:

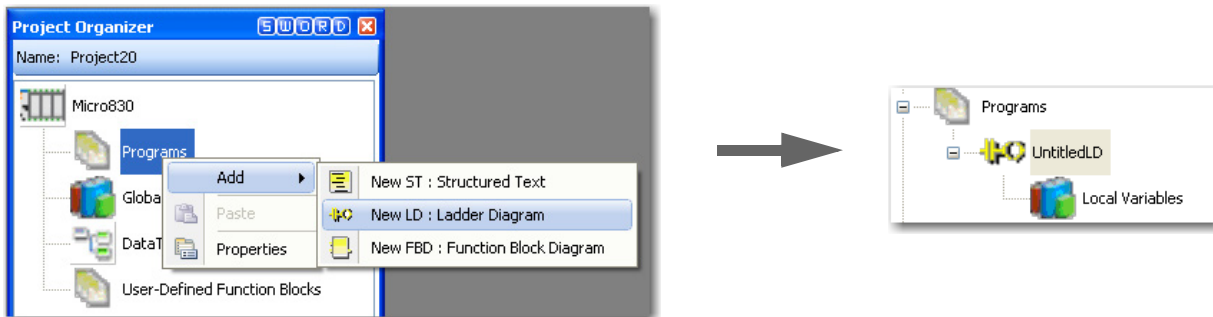
- [Create the HSC Project and Variables on page 266](#)
- [Assign Values to the HSC Variables on page 269](#)
- [Assign Variables to the Function Block on page 272](#)
- [Run the High Speed Counter on page 273](#)
- [Use the Programmable Limit Switch \(PLS\) Function on page 275](#)

## Create the HSC Project and Variables

1. Start Connected Components Workbench and open a new project. From the Device Toolbox, go to Catalog → Controllers. Double-click your controller<sup>(1)</sup> or drag and drop it onto the Project Organizer windows.

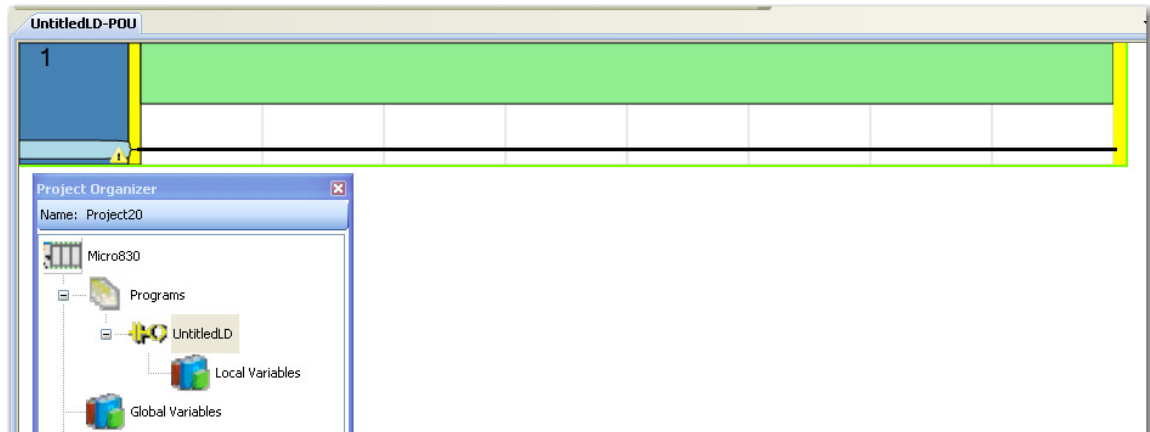


2. Under Project Organizer, right-click Programs. Click Add New LD: Ladder Diagram to add a new ladder logic program.

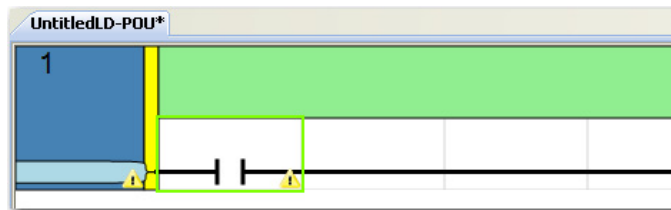


(1) The HSC is supported on all Micro830, Micro850, and Micro870 controllers, except on 2080-LCxx-xxAWB types.

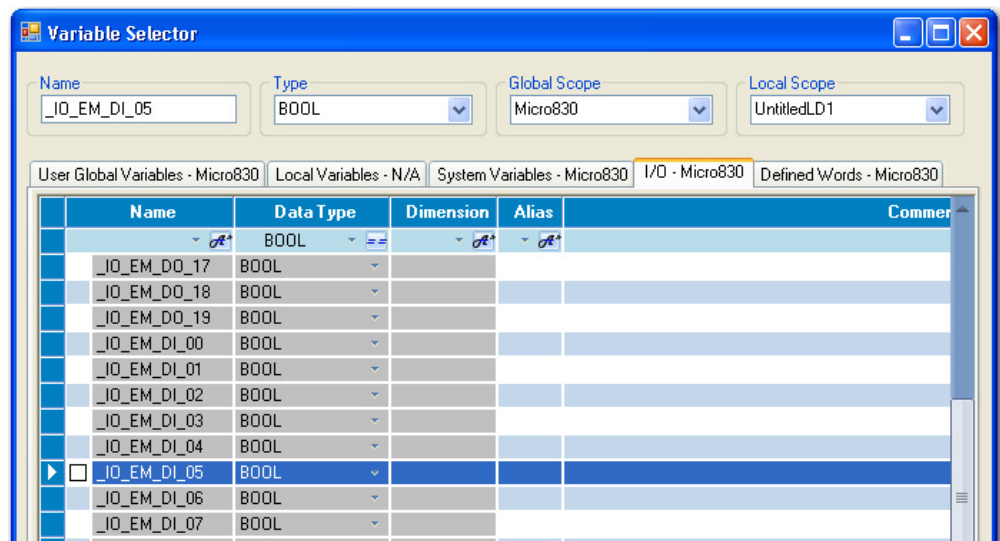
- Right-click UntitledLD and select Open.



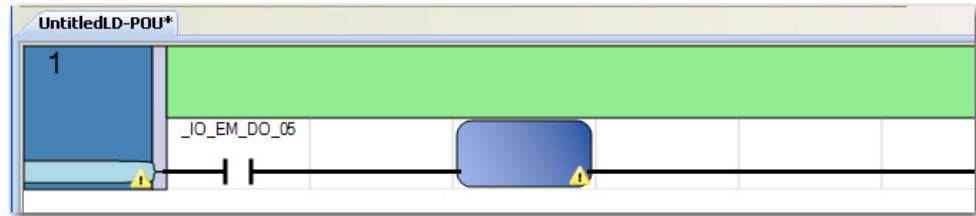
- From the Toolbox, double-click Direct Contact to add it to the rung or drag and drop Direct Contact onto the Rung.



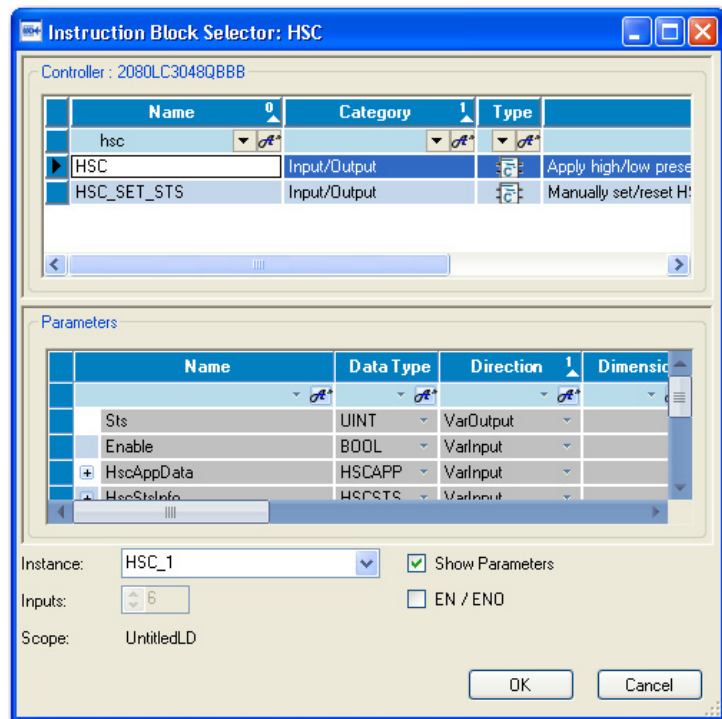
- Double-click the Direct Contact you have just added to bring up the Variable Selector dialog. Click I/O Micro830 tab. Assign the Direct Contact to input 5 by selecting `_IO_EM_DI_05`. Click OK.



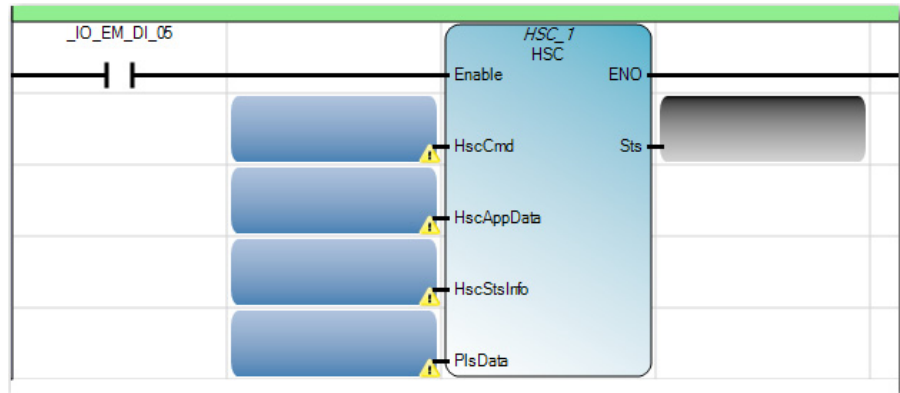
- To the right of the Direct Contact, add a function block by double-clicking function block from the Toolbox or dragging and dropping the function block onto the rung.



- Double-click the function block to open up Instruction Selector dialog. Choose HSC. You can do a quick search for HSC function block by typing "hsc" on the name field. Click OK.



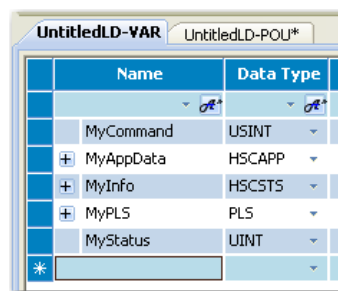
Your ladder rung should appear as shown below:



- On the Project Organizer pane, double-click Local Variables to bring up the Variables window. Add the following variables with the corresponding data types, as specified in the table.

Variable Name	Data Type
MyCommand	USINT
MyAppData	HSCAPP
MyInfo	HSCSTS
MyPLS	PLS
MyStatus	UINT

After adding the variables, your Local Variables table should look like this:



## Assign Values to the HSC Variables

Next, you need to assign values to the variables you have just created. Typically, a routine is used to assign values to your variables. For illustration purposes, this quickstart assigns values through the Initial Value column of the Local Variables table.

**TIP** In a real program, you should write a routine to assign values to your variable according to your application.

1. On the Initial Value field for the MyCommand variable, type 1.  
See [HSC Commands \(HScCmd\) on page 157](#) for more information on the description for each value.
2. Assign values to the MyAppData variables. Expand the list of MyAppData sub-variables clicking the + sign. Set the values of the different sub-variables as shown in the following screenshot.

Name	Data Type	Initial Value
HSC_1	HSC	...
MyAppData	HSCAPP	...
MyAppData.PlsEnable	BOOL	FALSE
MyAppData.HscID	UINT	0
MyAppData.HscMode	UINT	6
MyAppData.Accumulator	DINT	
MyAppData.HPSetting	DINT	40
MyAppData.LPSetting	DINT	-40
MyAppData.OFSetting	DINT	50
MyAppData.UFSetting	DINT	-50
MyAppData.OutputMask	UDINT	3
MyAppData.HPOutput	UDINT	1
MyAppData.LPOutput	UDINT	2
MyCommand	USINT	1
MyInfo	HSCSTS	...
MyPLS	PLS	...
MyStatus	UINT	

**IMPORTANT** MyAppData variable has sub-variables which determine the settings of the counter. It is **crucial** to know each one in order to determine how the counter will perform. A quick summary is provided below but you can also see [HSC APP Data Structure on page 139](#) for detailed information.

**MyAppData.PlsEnable** allows the user to either enable or disable the PLS settings. It should be set to FALSE (disabled) if the MyAppData variable is to be used.

**MyAppData.HscID** allows the user to specify which embedded inputs will be used depending on the mode and the type of application. See the table [HSC Inputs and Wiring Mapping on page 135](#) to know the different IDs that can be used as well as the embedded inputs and its characteristics.

If ID 0 is used, ID 1 cannot be used on the same controller since the inputs are being used by the Reset and Hold.

**MyAppData.HscMode** allows the user to specify the type of operation in which the HSC will use to count. See [HSC Mode \(HSCAPP.HSCMode\) on page 140](#) for more information about HSC modes. You can also quickly refer to the table below for the list of ten available modes.

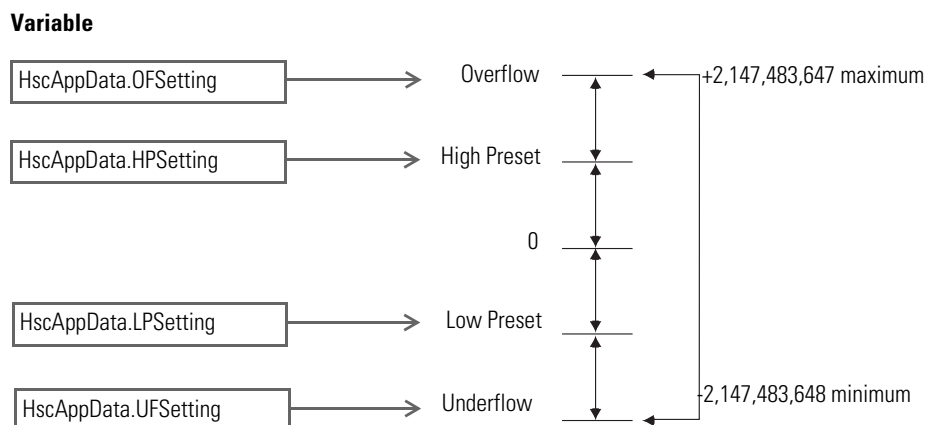


**HSC Operating Modes**

Mode Number	Type
0	Up Counter – The accumulator is immediately cleared (0) when it reaches the high preset. A low preset cannot be defined in this mode.
1	Up Counter with external reset and hold – The accumulator is immediately cleared (0) when it reaches the high preset. A low preset cannot be defined in this mode.
2	Counter with external direction
3	Counter with external direction, reset, and hold
4	Two input counter (up and down)
5	Two input counter (up and down) with external reset and hold
6	Quadrature counter (phased inputs A and B)
7	Quadrature counter (phased inputs A and B) with external reset and hold
8	Quadrature X4 counter (phased inputs A and B)
9	Quadrature X4 counter (phased inputs A and B) with external reset and hold

Modes 1, 3, 5, 7, and 9 will only work when an ID of 0, 2, or 4 is set due to the fact that these modes use reset and hold. Modes 0, 2, 4, 6, and 8 will work on any ID. Modes 6...9 will only work when an encoder is connected to the controller. Use the HSC ID chart as a reference to wire the encoder to the controller.

**MyAppData.HPSetting**, **MyAppData.LPSetting**, **MyAppData.OFSetting**, and **MyAppData.UFSetting** are all user-defined variables which represent the counting range of the HSC. The diagram below gives an example of a range of values that can be set for these variables.



**MyAppData.OutputMask** along with **MyAppData.HPOutput** and **MyAppData.LPOutput** allows the user to specify which embedded outputs can be turned on when a High Preset or Low Preset is reached.

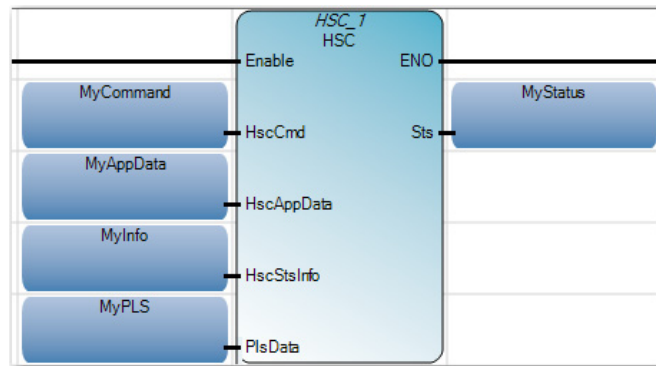
These variables use a combination of decimals and binary numbers to specify the embedded outputs that are able to turn on/off.

Thus, in our example, we first set the Output Mask to a decimal value of 3 which, when converted to binary, is equal to 0011. This means that now outputs O0 and O1 can be turned On/Off.

We have set the HPOutput to a decimal value of 1, which, when converted to binary, is equal to 0001. This means that when a High Preset is reached, output O0 will turn on and stay on until the HSC is reset or the counter counts back down to a Low Preset. The LPOutput works same way as the HPOutput except an output will be turned on when a Low Preset is reached.

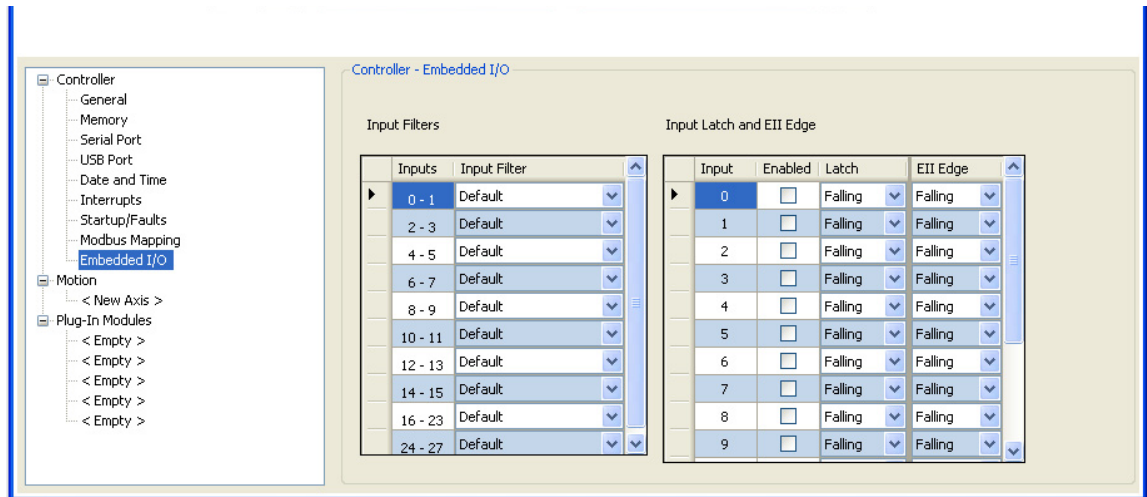
### Assign Variables to the Function Block

1. Go back to the ladder diagram and assign the variables you have just configured to the corresponding elements of the HSC function block. The HSC function block should appear as shown in the screenshot:



To assign a variable to a particular element in your function block, double click the empty variable block. On the Variable selector that appears, choose the variable you have just created. (For example, for the input element HSCAppData, select the variable MyAppData.)

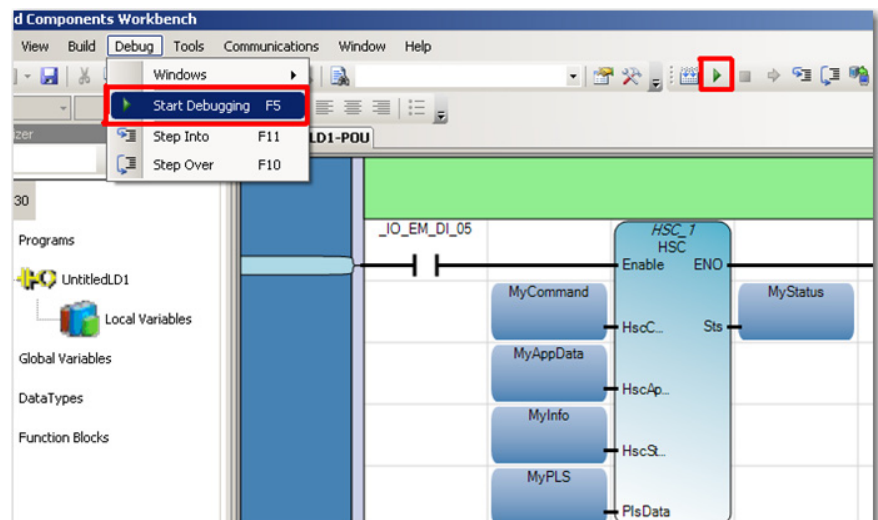
- Next, click the Micro830 controller under the Project Organizer pane to bring up the Micro830 Controller Properties pane. Under Controller Properties, click Embedded I/O. Set the input filters to a correct value depending on the characteristics of your encoder.



- Make sure that your encoder is connected to the Micro830 controller.
- Power up the Micro830 controller and connect it to your PC. Build the program in Connected Components Workbench and download it to the controller.

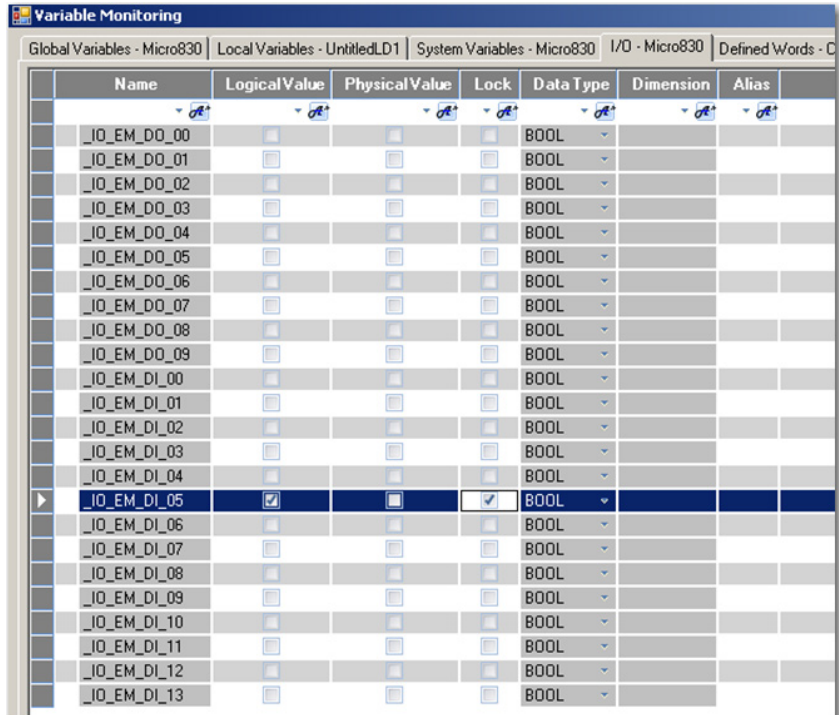
## Run the High Speed Counter

- To test the program, go into debug mode by doing any of the following:
  - Click Debug menu, then choose Start Debugging,
  - Click the green play button below the menu bar, or
  - Hit the F5 windows key.



Now that we are on debug mode we can see the values of the HSC output. The HSC function block has two outputs, one is the STS (MyStatus) and the other is the HSCSTS (MyInfo).

2. Double-click the Direct Contact labeled `_IO_EM_DI_05` to bring up the Variable Monitoring window.
3. Click the I/O Micro830 tab. Select the `_IO_EM_DI_05` row. Check the boxes Lock and Logical Value so that this input will be forced in the ON position.



4. Click the Local Variables tab to see any real time changes being made to the variables. Expand the MyAppData and MyInfo variable list by clicking the + sign.
5. Turn On the encoder to see the counter count up/down. For example, if the encoder is attached to a motor shaft then turn on the motor to trigger the HSC count. The counter value will be displayed on MyInfo.Accumulator. MyStatus variable should display a Logical Value of 1, which means that the HSC is running.

**TIP** See [HSC Function Block Status Codes on page 158](#) for the complete list of status codes. For example, if the MyStatus value is 04, a configuration error exists and the controller will fault. You need to check your parameters in this case.

Name	Logical Value	Physical Value	Initial Value
HSC_1	...	...	...
MyCommand	1	N/A	1
MyAppData	...	...	...
MyAppData.PlsEnable	<input type="checkbox"/>	N/A	FALSE
MyAppData.HscD	0	N/A	0
MyAppData.HscMode	7	N/A	5
MyAppData.Accumulator	40	N/A	...
MyAppData.HPSSetting	40	N/A	40
MyAppData.LPSSetting	-40	N/A	-40
MyAppData.OFSSetting	50	N/A	50
MyAppData.UFSSetting	-50	N/A	-50
MyAppData.OutputMask	3	N/A	3
MyAppData.HPOOutput	1	N/A	1
MyAppData.LPOOutput	2	N/A	2
MyInfo	...	...	...
MyInfo.CountEnable	<input checked="" type="checkbox"/>	N/A	...
MyInfo.ErrorDetected	<input type="checkbox"/>	N/A	...
MyInfo.CountUpFlag	<input checked="" type="checkbox"/>	N/A	...
MyInfo.CountDwnFlag	<input checked="" type="checkbox"/>	N/A	...
MyInfo.Mode1Done	<input type="checkbox"/>	N/A	...
MyInfo.OVF	<input type="checkbox"/>	N/A	...
MyInfo.UNF	<input type="checkbox"/>	N/A	...
MyInfo.CountDir	<input checked="" type="checkbox"/>	N/A	...
MyInfo.HPRReached	<input checked="" type="checkbox"/>	N/A	...
MyInfo.LPRReached	<input type="checkbox"/>	N/A	...
MyInfo.OFCauseInter	<input type="checkbox"/>	N/A	...
MyInfo.UFCauseInter	<input type="checkbox"/>	N/A	...
MyInfo.HPCauseInter	<input type="checkbox"/>	N/A	...
MyInfo.LPCauseInter	<input type="checkbox"/>	N/A	...
MyInfo.PlsPosition	0	N/A	...
MyInfo.ErrorCode	0	N/A	...
MyInfo.Accumulator	40	N/A	...
MyInfo.HP	40	N/A	...
MyInfo.LP	-40	N/A	...
MyInfo.HPOOutput	1	N/A	...
MyInfo.LPOOutput	2	N/A	...
MyPLS	...	...	...
MyStatus	1	N/A	...

For this example, once the Accumulator reaches a High Preset value of 40, output 0 turns on and the HPRReached flag turns on. Once the Accumulator reaches a Low Preset value of -40, output 1 turns on and the LPRReached flag turns on as well.

## Use the Programmable Limit Switch (PLS) Function

The Programmable Limit Switch function allows you to configure the High-Speed Counter to operate as a PLS (programmable limit switch) or rotary cam switch. The PLS is used when you need more than one pair of high and low presets (up to 255 pairs of high and low presets are supported by the PLS).

1. Start a new project following the same steps and values as the previous project. Set the values for the following variables as follows:
  - HSCAPP.PlsEnable variable should be set to TRUE
  - Set a value only for UFSetting and OFSetting (OutputMask is optional depending if an output is to be set or not). Your new values should follow the example below:

Name	Data Type	Dimension	Alias	Initial Value	Attribute
HSC_1	HSC			...	ReadWrite
MyCommand	USINT			1	ReadWrite
MyAppData	HSCAPP			...	ReadWrite
MyAppData.PlsEnable	BOOL			TRUE	ReadWrite
MyAppData.HscID	UINT			0	ReadWrite
MyAppData.HscMode	UINT			7	ReadWrite
MyAppData.Accumulator	DINT				ReadWrite
MyAppData.HPSetting	DINT				ReadWrite
MyAppData.LPSetting	DINT				ReadWrite
MyAppData.OFSetting	DINT			50	ReadWrite
MyAppData.UFSetting	DINT			-50	ReadWrite
MyAppData.OutputMask	UDINT			255	ReadWrite
MyAppData.HPOutput	UDINT				ReadWrite
MyAppData.LPOutput	UDINT				ReadWrite
MyInfo	HSCSTS			...	ReadWrite
MyPLS	PLS	[1..4]		...	ReadWrite
MyPLS[1]	PLS			...	ReadWrite
MyPLS[1].HscHP	DINT			10	ReadWrite
MyPLS[1].HscLP	DINT			-10	ReadWrite
MyPLS[1].HscHPOutPut	UDINT			1	ReadWrite
MyPLS[1].HscLPOutPut	UDINT			16	ReadWrite
MyPLS[2]	PLS			...	ReadWrite
MyPLS[2].HscHP	DINT			20	ReadWrite
MyPLS[2].HscLP	DINT			-20	ReadWrite
MyPLS[2].HscHPOutPut	UDINT			2	ReadWrite
MyPLS[2].HscLPOutPut	UDINT			32	ReadWrite
MyPLS[3]	PLS			...	ReadWrite
MyPLS[3].HscHP	DINT			30	ReadWrite
MyPLS[3].HscLP	DINT			-30	ReadWrite
MyPLS[3].HscHPOutPut	UDINT			4	ReadWrite
MyPLS[3].HscLPOutPut	UDINT			64	ReadWrite
MyPLS[4]	PLS			...	ReadWrite
MyPLS[4].HscHP	DINT			40	ReadWrite
MyPLS[4].HscLP	DINT			-40	ReadWrite
MyPLS[4].HscHPOutPut	UDINT			8	ReadWrite
MyPLS[4].HscLPOutPut	UDINT			128	ReadWrite
MyStatus	UINT				ReadWrite

In this example, the PLS variable is given a dimension of [1..4]. This means that the HSC can have four pairs of High and Low Presets.

Once again, your High Presets should be set lower than the OFSetting and the Low Preset should be greater than the UFSetting. The HscHPOutPut and HscLPOutPut values will determine which outputs will be turned on when a High Preset or Low Preset is reached.

2. You can now build and download the program into the controller then debug and test it following the instructions for the last project.

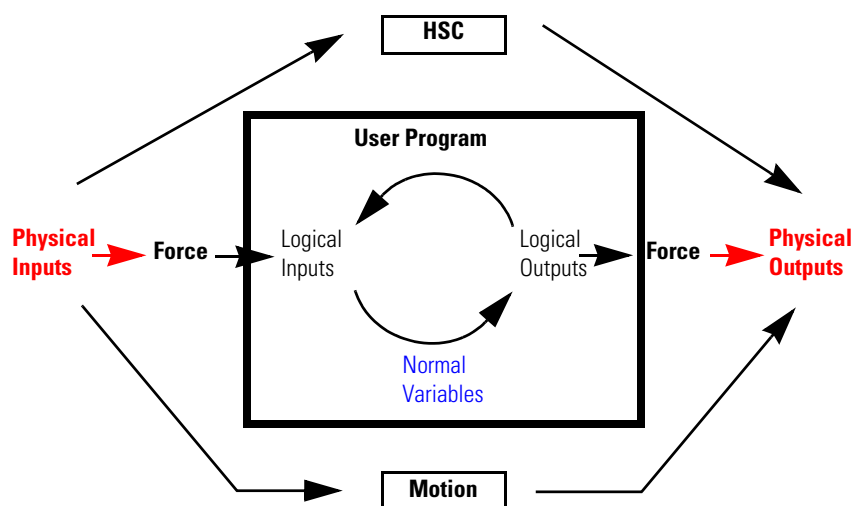
## Forcing I/Os

Inputs are logically forced. LED status indicators do not show forced values, but the inputs in the user program are forced.

Forcing is only possible with I/O and does not apply to user defined variables and non-I/O variables, and special functions such as HSC and Motion which execute independently from the User Program scan. For example, for motion, Drive Ready input cannot be forced.

Unlike inputs, outputs are physically forced. LED status indicators do show forced values and the user program does not use forced values.

The following diagram illustrates forcing behavior.



- LED status indicators always match the physical value of I/O
- Normal, non-physical internal variables cannot be forced
- Special functions such as HSC and Motion cannot be forced



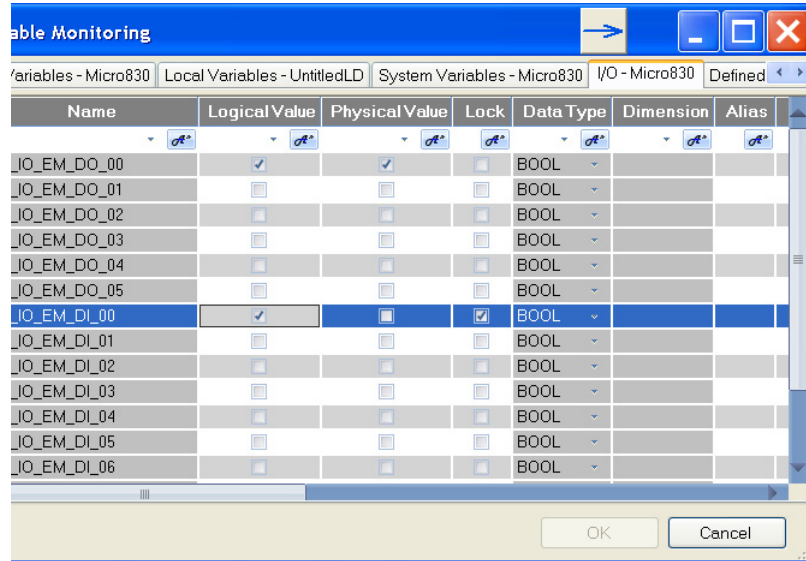
**ATTENTION:** Forcing variable can result in sudden machine movement, possibly injuring personnel or equipment. Use extreme caution when forcing variables.

## Checking if Forces (locks) are Enabled

If Connected Components Workbench is available, check the Variable Monitor while debugging online. Forcing is performed by first Locking an I/O variable and then setting the Logical Value for Inputs and Physical Value for Outputs.



Remember you cannot force a Physical Input and cannot force a Logical Output.



In many cases, the front of the controller is not visible to the operator and Connected Components Workbench is not online with the controller. If you want the force status to be visible to the operator, then the User Program must read the force status using the SYS\_INFO function block and then display the force status on something that the operator can see, such as the human machine interface (HMI), or stack light. The following is an example program in Structured Text.

```

1  (* Read System Information including Force Enable bit *)
2  SYS_INFO_1(TRUE);
3
4  (* Turn on Warning Light if Forces are Enabled *)
5  IF SYS_INFO_1.Sts.ForcesInstall = TRUE THEN
6    _IO_EM_DO_05 := TRUE;
7  ELSE
8    _IO_EM_DO_05 := FALSE;
9  END_IF;

```

If the front of the controller is visible, and not blocked by the cabinet enclosure, Micro830, Micro850, and Micro870 controllers have a Force LED indicator.

### I/O Forces After a Power Cycle

After a controller is power cycled, all I/O forces are cleared from memory.



## Using Run Mode Change

Run Mode Change allows the user to make small changes to the logic of a running project and immediately testing it out on the controller, without having to go into Program mode or disconnecting from the controller.

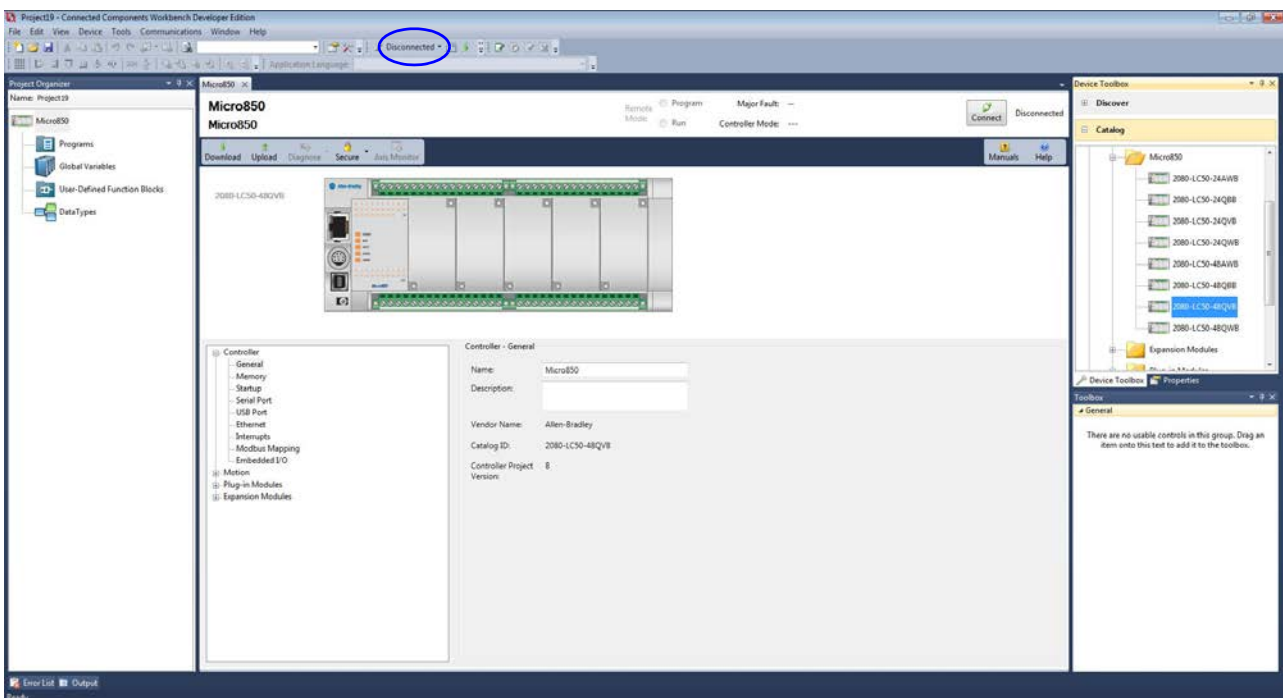
**IMPORTANT** The following requirements must be met to use Run Mode Change:

- Micro820/Micro830/Micro850 controller firmware revision 8.0 or higher, and
- Connected Components Workbench Developer Edition software, version 8.0 or higher.

The following sample project guides you through the creation of a simple application for a Micro850 controller without any plug-in modules, and how to use the Run Mode Change feature.

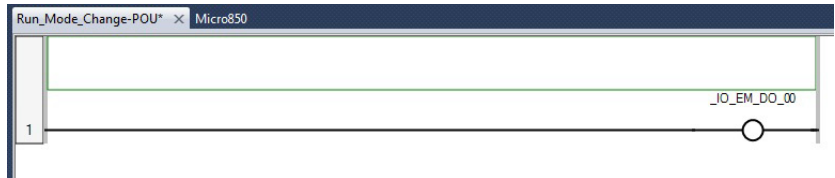
## Create the Project

1. Create a new project for a Micro830/Micro85/Micro8700 controller without any plug-ins.  
Observe that the controller is disconnected.

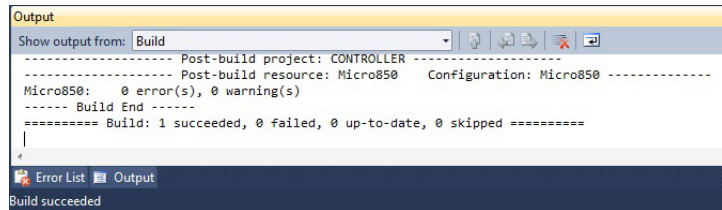


2. Right-click Programs and select Add -> New LD: Ladder Diagram.
3. From the Toolbox, double-click Direct Coil to add it to the rung, or drag and drop Direct Coil onto the rung.

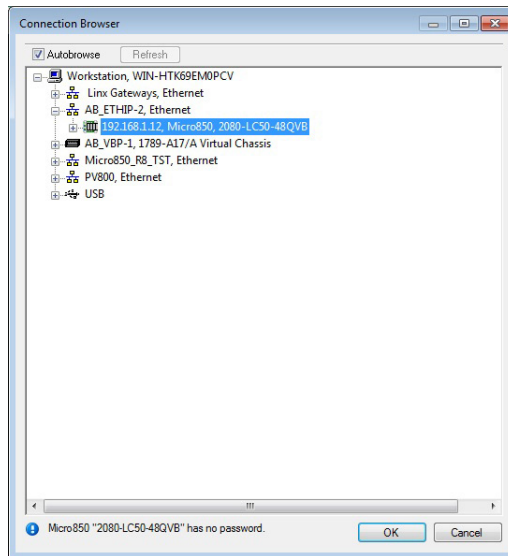
4. Double-click the newly added Direct Coil to bring up the Variable Selector dialog and select “\_IO\_EM\_DO\_00”.



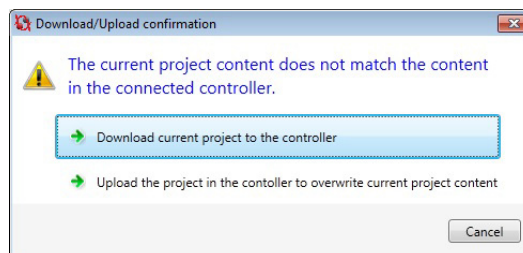
5. Build the project.



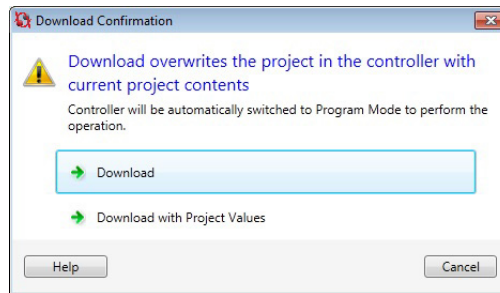
6. Download the project to the controller. In the Connection Browser dialog, select the Micro850 controller.



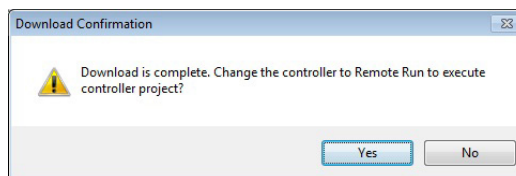
7. Select Download current project to the controller.



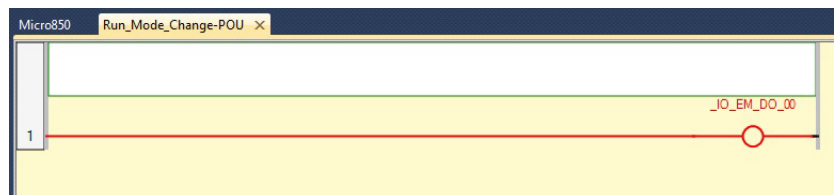
8. Select Download to confirm.



9. When the project has been downloaded to the controller, a prompt asking to change the controller to Remote Run mode appears. Click Yes.



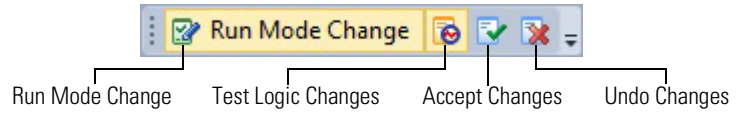
10. Observe that the controller is now in Debug mode.




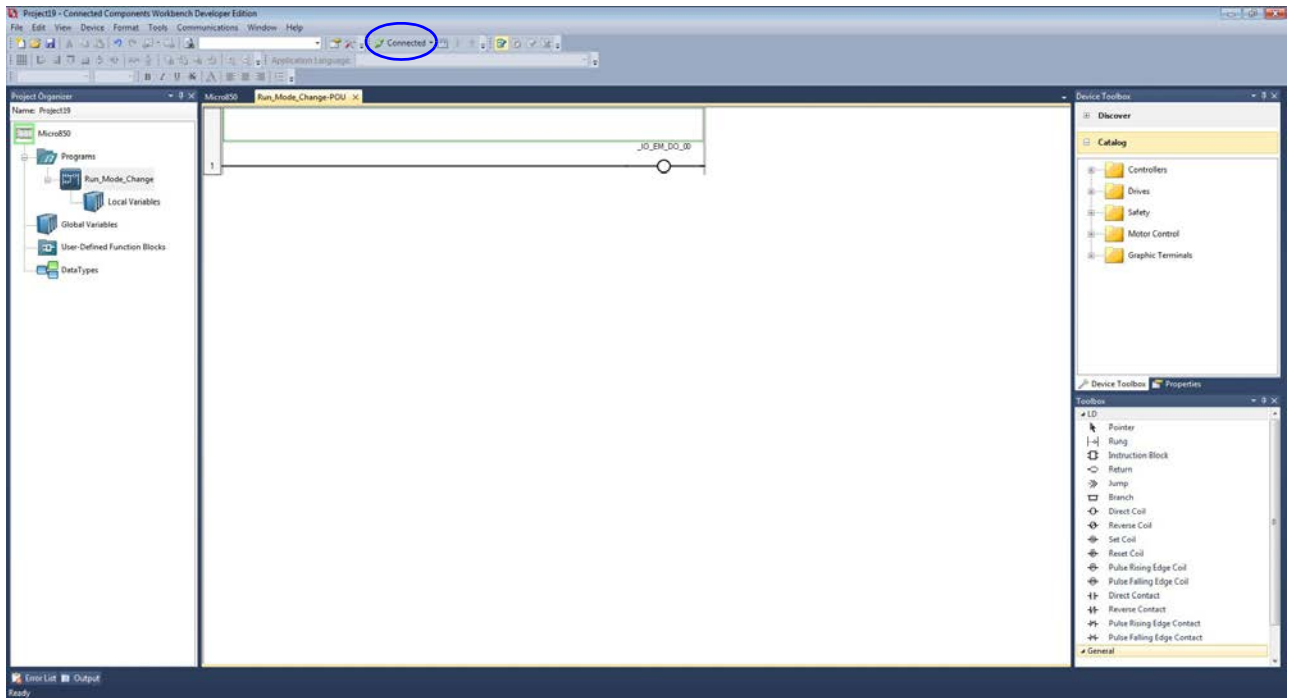
**IMPORTANT** From Connected Components Workbench version 8.0 onwards, selecting "Yes" to change the controller to Remote Run mode after a downloading a project automatically switches it to Debug mode.

## Edit the Project Using Run Mode Change

### Run Mode Change Toolbar



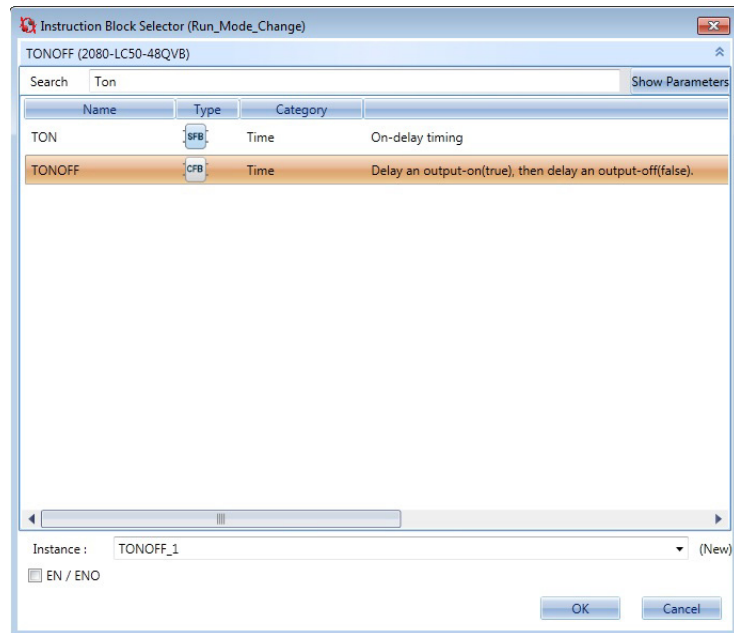
1. Click the Run Mode Change  icon.  
Observe that the controller goes into Edit mode and is still connected.



If you add a new variable during RMC, external data access and changing the access type (default is Read/Write) of this new variable is not available until you have chosen to Accept or Undo the Test Logic changes.

2. From the Toolbox, double-click Instruction Block to add it to the rung, or drag and drop Instruction Block onto the rung.

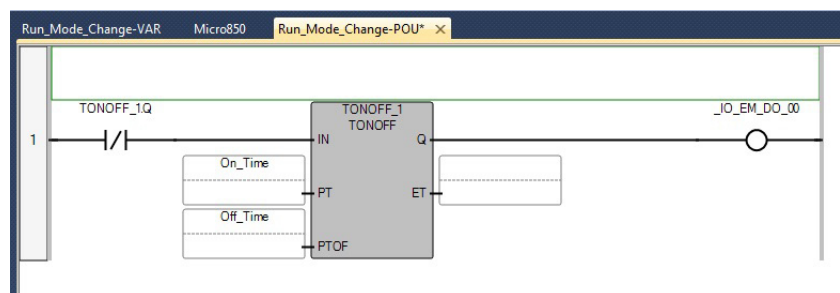
3. Double-click the newly added Instruction Block and select “Timer On/Off“(TONOFF).



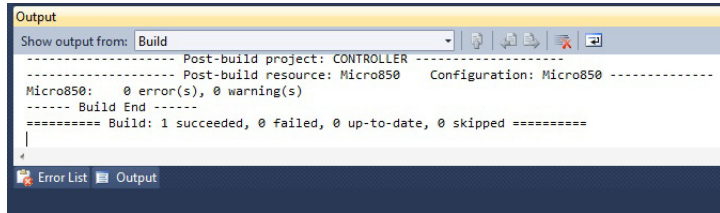
Configure the Instruction Block to trigger every one second.

Name	Alias	Data Type	Dimension	Project Value	Initial Value	Comment	String Size
TONOFF_1		TONOFF		...	...		
On_Time		TIME			T=1s		
Off_Time		TIME			T=1s		

4. From the Toolbox, double-click Reverse Contact to add it to the rung, or drag and drop Reverse Contact onto the run. Place it to left of the recently added Instruction Block.

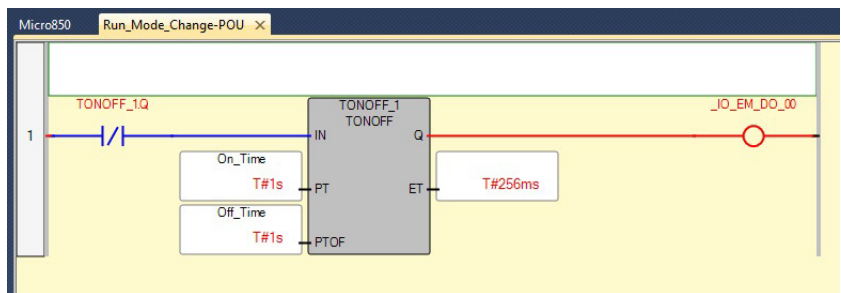


- Click the Test Logic Changes  icon to build the project and download it to the controller.




**IMPORTANT** When a Test Logic is performed, or undoing changes after the Test Logic is completed, any active communication instructions will be aborted while the changes are downloaded to the controller.

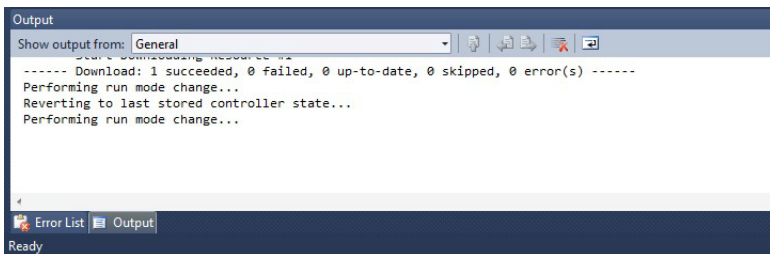
- The controller will automatically go into Debug mode and display the updated project.



- You can now choose to either Undo or Accept the changes to the project.

*To Undo the Changes*

- Click the Undo Changes  icon.
- The changes will be discarded and the original project will be restored to the controller.



**IMPORTANT** When a Test Logic is performed, or undoing changes after the Test Logic is completed, any active communication instructions will be aborted while the changes are downloaded to the controller.

Observe that original project is shown and the controller is in Debug mode.



### *To Accept the Changes*

1. Click the Accept Changes  icon.
2. Observe that only the Run Mode Change icon is now enabled and the controller remains in Debug mode.



**Notes:**



## User Interrupts

Interrupts allow you to interrupt your program based on defined events. This chapter contains information about using interrupts, the interrupt instructions, and interrupt configuration. The chapter covers the following topics:

Topic	Page
Information About Using Interrupts	287
User Interrupt Instructions	291
Using the Selectable Timed Interrupt (STI) Function	297
Selectable Time Interrupt (STI) Function Configuration and Status	298
Using the Event Input Interrupt (EII) Function	300

For more information on HSC Interrupt, see Use the High-Speed Counter and Programmable Limit Switch on page 133.

### Information About Using Interrupts

The purpose of this section is to explain some fundamental properties of the User Interrupts, including:

- What is an interrupt?
- When can the controller operation be interrupted?
- Priority of User Interrupts
- Interrupt Configuration
- User Fault Routine

### What is an Interrupt?

An interrupt is an event that causes the controller to suspend the Program Organization Unit (POU) it is currently performing, perform a different POU, and then return to the suspended POU at the point where it suspended. The Micro830, Micro850, and Micro870 controllers support the following User Interrupts:

- User Fault Routine
- Event Interrupts (8)
- High-Speed Counter Interrupts (6)
- Selectable Timed Interrupts (4)
- Plug-in Module Interrupts (5)

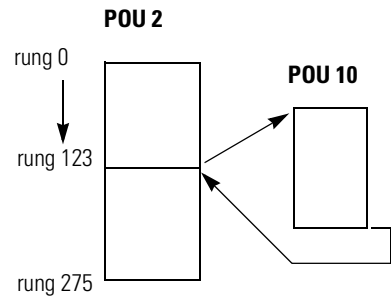
An interrupt must be configured and enabled to execute. When any one of the interrupts is configured (and enabled) and subsequently occurs, the user program:

1. suspends its execution of the current POU,
2. performs a predefined POU based upon which interrupt occurred, and
3. returns to the suspended operation.

**Interrupt Operation Example**

POU 2 is the main control program.  
POU 10 is the interrupt routine.

- An Interrupt Event occurs at rung 123.
- POU 10 is executed.
- POU 2 execution resumes immediately after POU 10 is scanned.



Specifically, if the controller program is executing normally and an interrupt event occurs:

1. the controller stops its normal execution.
2. determines which interrupt occurred.
3. goes immediately to the beginning of the POU specified for that User Interrupt.
4. begins executing the User Interrupt POU (or set of POU/function blocks if the specified POU calls a subsequent function block).
5. completes the POU.
6. resumes normal execution from the point where the controller program was interrupted

**When Can the Controller Operation be Interrupted?**

The Micro830 controllers allow interrupts to be serviced at any point of a program scan. Use UID/ UIE instructions to protect program block which should not be interrupted.

**Priority of User Interrupts**

When multiple interrupts occur, the interrupts are serviced based upon their individual priority.

When an interrupt occurs and another interrupt(s) has already occurred but has not been serviced, the new interrupt is scheduled for execution based on its priority relative to the other pending interrupts. At the next point in time when an interrupt can be serviced, all the interrupts are executed in the sequence of highest priority to lowest priority.

If an interrupt occurs while a lower priority interrupt is being serviced (executed), the currently executing interrupt routine is suspended, and the higher priority interrupt is serviced. Then the lower priority interrupt is allowed to complete before returning to normal processing.

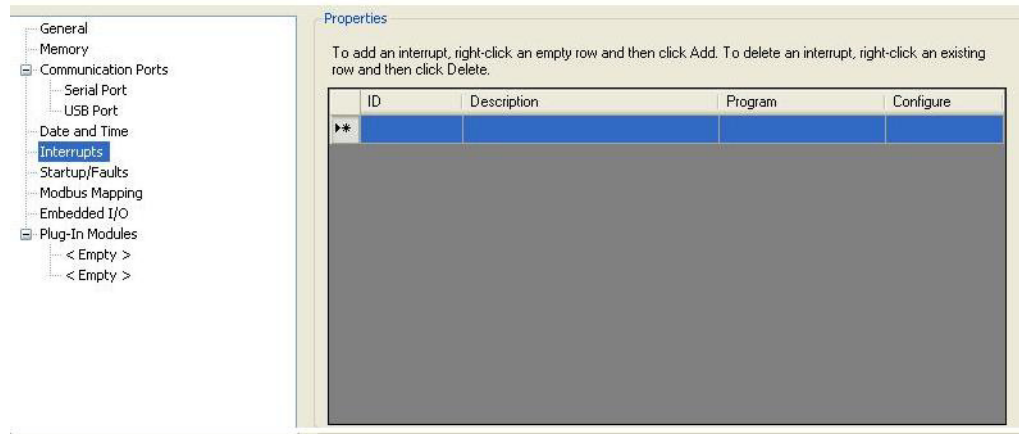
If an interrupt occurs while a higher priority interrupt is being serviced (executed), and the pending bit has been set for the lower priority interrupt, the currently executing interrupt routine continues to completion. Then the lower priority interrupt runs before returning to normal processing.

The priorities from highest to lowest are:

User Fault Routine	<b>highest priority</b>
Event Interrupt0	
Event Interrupt1	
Event Interrupt2	
Event Interrupt3	
High-Speed Counter Interrupt0	
High-Speed Counter Interrupt1	
High-Speed Counter Interrupt2	
High-Speed Counter Interrupt3	
High-Speed Counter Interrupt4	
High-Speed Counter Interrupt5	
Event Interrupt4	
Event Interrupt5	
Event Interrupt6	
Event Interrupt7	
Selectable Timed Interrupt0	
Selectable Timed Interrupt1	
Selectable Timed Interrupt2	
Selectable Timed Interrupt3	
Plug-In Module Interrupt0, 1, 2, 3, 4	<b>lowest priority</b>

## User Interrupt Configuration

User interrupts can be configured and set as AutoStart from the Interrupts window.



## User Fault Routine

The user fault routine gives you the option of doing the cleanup before a controller shutdown, when a specific user fault occurs. The fault routine is executed when any user fault occurs. The fault routine is not executed for non-user faults.

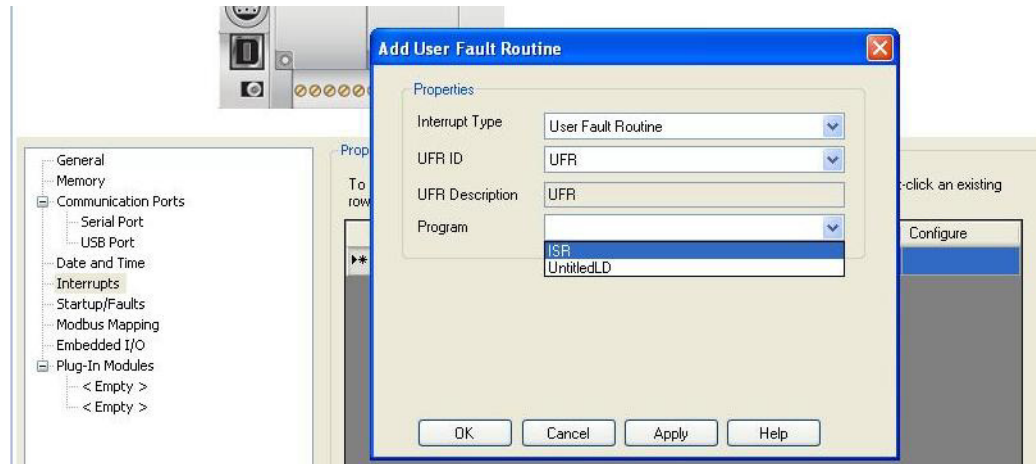
The controller goes to Fault mode after a User Fault Routine is executed, and the User Program execution stops.

### *Creating a User Fault Subroutine*

To use the user fault subroutine:

1. Create a POU.

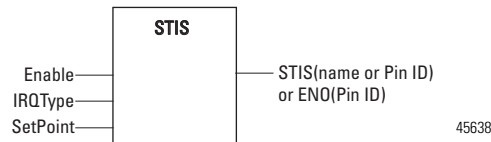
- In the User Interrupt Configuration window, configure this POU as a User Fault routine.



## User Interrupt Instructions

Instruction	Used To:	Page
STIS – Selectable Timed Start	Use the STIS (Selectable Timed Interrupt Start) instruction to the start the STI timer from the control program, rather than starting automatically.	291
UID – User Interrupt Disable	Use the User Interrupt Disable (UID) and the User Interrupt Enable (UIE) instructions to create zones in which user interrupts cannot occur.	292
UIE – User Interrupt Enable		294
UIF – User Interrupt Flush	Use the UIF instruction to remove selected pending interrupts from the system.	295
UIC – User Interrupt Clear	Use this function to clear Interrupt Lost bit for the selected User Interrupt(s).	296

### STIS - Selectable Timed Start



STI0 is used in this document to define how STIS works.

**STIS Parameters**

Parameter	Parameter Type	Data Type	Parameter Description
Enable	Input	BOOL	Enable Function. When Enable = TRUE, function is performed. When Enable = FALSE, function is not performed.
IRQType	Input	UDINT	Use the STI defined DWORD IRQ_STI0, IRQ_STI1, IRQ_STI2, IRQ_STI3
SetPoint	Input	UINT	The user timer interrupt interval time value in milliseconds. When SetPoint = 0, STI is disabled. When SetPoint = 1...65535, STI is enabled.
STIS or ENO	Output	BOOL	Rung Status (same as Enable)

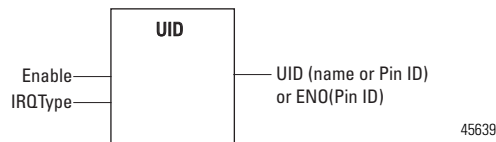
The STIS instruction can be used to start and stop the STI function or to change the time interval between STI user interrupts. The STI instruction has two operands:

- **IRQType** — This is the STI ID that a user wants to drive.
- **SetPoint** — This is the amount of time (in milliseconds) which must expire prior to executing the selectable timed user interrupt. A value of zero disables the STI function. The time range is from 0...65,535 milliseconds.

The STIS instruction applies the specified set point to the STI function as follows (STI0 is used here as an example):

- If a zero set point is specified, the STI is disabled and STI0.Enable is cleared (0).
- If the STI is disabled (not timing) and a value greater than 0 is entered into the set point, the STI starts timing to the new set point and STI0.Enable is set (1).
- If the STI is currently timing and the set point is changed, the new setting takes effect immediately, restarting from zero. The STI continues to time until it reaches the new set point.

**UID - User Interrupt Disable**



The UID instruction is used to disable selected user interrupts. The table below shows the types of interrupts with their corresponding disable bits:

**Types of Interrupts Disabled by the UID Instruction**

<b>Interrupt Type</b>	<b>Element</b>	<b>Decimal Value</b>	<b>Corresponding Bit</b>
Plug-In Module	UPM4	8388608	bit 23
Plug-In Module	UPM3	4194304	bit 22
Plug-In Module	UPM2	2097152	bit 21
Plug-In Module	UPM1	1048576	bit 20
Plug-In Module	UPM0	524288	bit 19
STI - Selectable Timed Interrupt	STI3	262144	bit 18
STI - Selectable Timed Interrupt	STI2	131072	bit 17
STI - Selectable Timed Interrupt	STI1	65536	bit 16
STI - Selectable Timed Interrupt	STI0	32768	bit 15
EII - Event Input Interrupt	Event 7	16384	bit 14
EII - Event Input Interrupt	Event 6	8192	bit 13
EII - Event Input Interrupt	Event 5	4096	bit 12
EII - Event Input Interrupt	Event 4	2048	bit 11
HSC - High-Speed Counter	HSC5	1024	bit 10
HSC - High-Speed Counter	HSC4	512	bit 9
HSC - High-Speed Counter	HSC3	256	bit 8
HSC - High-Speed Counter	HSC2	128	bit 7
HSC - High-Speed Counter	HSC1	64	bit 6
HSC - High-Speed Counter	HSC0	32	bit 5
EII - Event Input Interrupt	Event 3	16	bit 4
EII - Event Input Interrupt	Event 2	8	bit 3
EII - Event Input Interrupt	Event 1	4	bit 2
EII - Event Input Interrupt	Event 0	2	bit 1
UFR - User Fault Routine Interrupt	UFR	1	bit 0 (reserved)

To disable interrupt(s):

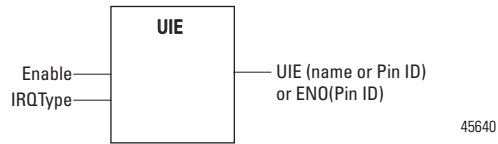
1. Select which interrupts you want to disable.
2. Find the Decimal Value for the interrupt(s) you selected.
3. Add the Decimal Values if you selected more than one type of interrupt.
4. Enter the sum into the UID instruction.

For example, to disable EII Event 1 and EII Event 3:

EII Event 1 = 4, EII Event 3 = 16

4 + 16 = 20 (enter this value)

## UIE - User Interrupt Enable



The UIE instruction is used to enable selected user interrupts. The table below shows the types of interrupts with their corresponding enable bits:

### Types of Interrupts Enabled by the UIE Instruction

Interrupt Type	Element	Decimal Value	Corresponding Bit
Plug-In Module	UPM4	8388608	bit 23
Plug-In Module	UPM3	4194304	bit 22
Plug-In Module	UPM2	2097152	bit 21
Plug-In Module	UPM1	1048576	bit 20
Plug-In Module	UPM0	524288	bit 19
STI - Selectable Timed Interrupt	STI3	262144	bit 18
STI - Selectable Timed Interrupt	STI2	131072	bit 17
STI - Selectable Timed Interrupt	STI1	65536	bit 16
STI - Selectable Timed Interrupt	STI0	32768	bit 15
EII - Event Input Interrupt	Event 7	16384	bit 14
EII - Event Input Interrupt	Event 6	8192	bit 13
EII - Event Input Interrupt	Event 5	4096	bit 12
EII - Event Input Interrupt	Event 4	2048	bit 11
HSC - High-Speed Counter	HSC5	1024	bit 10
HSC - High-Speed Counter	HSC4	512	bit 9
HSC - High-Speed Counter	HSC3	256	bit 8
HSC - High-Speed Counter	HSC2	128	bit 7
HSC - High-Speed Counter	HSC1	64	bit 6
HSC - High-Speed Counter	HSC0	32	bit 5
EII - Event Input Interrupt	Event 3	16	bit 4
EII - Event Input Interrupt	Event 2	8	bit 3
EII - Event Input Interrupt	Event 1	4	bit 2
EII - Event Input Interrupt	Event 0	2	bit 1
		1	bit 0 (reserved)

To enable interrupt(s):

1. Select which interrupts you want to enable.
2. Find the Decimal Value for the interrupt(s) you selected.
3. Add the Decimal Values if you selected more than one type of interrupt.
4. Enter the sum into the UIE instruction.

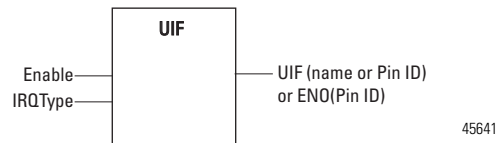


For example, to enable EII Event 1 and EII Event 3:

EII Event 1 = 4, EII Event 3 = 16

$4 + 16 = 20$  (enter this value)

## UIF - User Interrupt Flush



The UIF instruction is used to flush (remove pending interrupts from the system) selected user interrupts. The table below shows the types of interrupts with their corresponding flush bits:

### Types of Interrupts Disabled by the UIF Instruction

Interrupt Type	Element	Decimal Value	Corresponding Bit
Plug-In Module	UPM4	8388608	bit 23
Plug-In Module	UPM3	4194304	bit 22
Plug-In Module	UPM2	2097152	bit 21
Plug-In Module	UPM1	1048576	bit 20
Plug-In Module	UPM0	524288	bit 19
STI - Selectable Timed Interrupt	STI3	262144	bit 18
STI - Selectable Timed Interrupt	STI2	131072	bit 17
STI - Selectable Timed Interrupt	STI1	65536	bit 16
STI - Selectable Timed Interrupt	STI0	32768	bit 15
EII - Event Input Interrupt	Event 7	16384	bit 14
EII - Event Input Interrupt	Event 6	8192	bit 13
EII - Event Input Interrupt	Event 5	4096	bit 12
EII - Event Input Interrupt	Event 4	2048	bit 11
HSC - High-Speed Counter	HSC5	1024	bit 10
HSC - High-Speed Counter	HSC4	512	bit 9
HSC - High-Speed Counter	HSC3	256	bit 8
HSC - High-Speed Counter	HSC2	128	bit 7
HSC - High-Speed Counter	HSC1	64	bit 6
HSC - High-Speed Counter	HSC0	32	bit 5
EII - Event Input Interrupt	Event 3	16	bit 4
EII - Event Input Interrupt	Event 2	8	bit 3
EII - Event Input Interrupt	Event 1	4	bit 2
EII - Event Input Interrupt	Event 0	2	bit 1
UFR - User Fault Routine Interrupt	UFR	1	bit 0 (reserved)

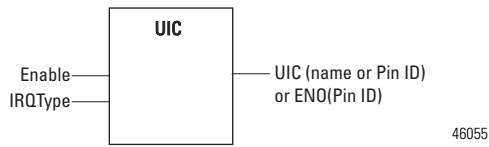
To flush interrupt(s):

1. Select which interrupts you want to flush.

2. Find the Decimal Value for the interrupt(s) you selected.
3. Add the Decimal Values if you selected more than one type of interrupt.
4. Enter the sum into the UIF instruction.

For example, to disable EII Event 1 and EII Event 3:  
 EII Event 1 = 4, EII Event 3 = 16  
 4 + 16 = 20 (enter this value)

### UIC – User Interrupt Clear



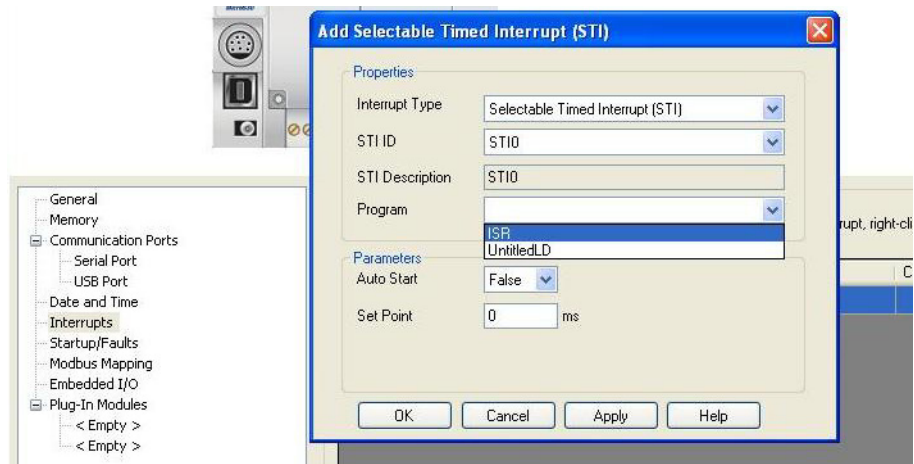
This C function clears Interrupt Lost bit for the selected User Interrupt(s).

#### Types of Interrupts Disabled by the UIC Instruction

Interrupt Type	Element	Decimal Value	Corresponding Bit
Plug-In Module	UPM4	8388608	bit 23
Plug-In Module	UPM3	4194304	bit 22
Plug-In Module	UPM2	2097152	bit 21
Plug-In Module	UPM1	1048576	bit 20
Plug-In Module	UPM0	524288	bit 19
STI - Selectable Timed Interrupt	STI3	262144	bit 18
STI - Selectable Timed Interrupt	STI2	131072	bit 17
STI - Selectable Timed Interrupt	STI1	65536	bit 16
STI - Selectable Timed Interrupt	STI0	32768	bit 15
EII - Event Input Interrupt	Event 7	16384	bit 14
EII - Event Input Interrupt	Event 6	8192	bit 13
EII - Event Input Interrupt	Event 5	4096	bit 12
EII - Event Input Interrupt	Event 4	2048	bit 11
HSC - High-Speed Counter	HSC5	1024	bit 10
HSC - High-Speed Counter	HSC4	512	bit 9
HSC - High-Speed Counter	HSC3	256	bit 8
HSC - High-Speed Counter	HSC2	128	bit 7
HSC - High-Speed Counter	HSC1	64	bit 6
HSC - High-Speed Counter	HSC0	32	bit 5
EII - Event Input Interrupt	Event 3	16	bit 4
EII - Event Input Interrupt	Event 2	8	bit 3
EII - Event Input Interrupt	Event 1	4	bit 2
EII - Event Input Interrupt	Event 0	2	bit 1
UFR - User Fault Routine Interrupt	UFR	1	bit 0 (reserved)

## Using the Selectable Timed Interrupt (STI) Function

Configure the STI function from the Interrupt Configuration window.



The Selectable Timed Interrupt (STI) provides a mechanism to solve time critical control requirements. The STI is a trigger mechanism that allows you to scan or solve control program logic that is time sensitive.

Example of where you would use the STI are:

- PID type applications, where a calculation must be performed at a specific time interval.
- A block of logic that needs to be scanned more often.

How an STI is used is typically driven by the demands/requirements of the application. It operates using the following sequence:

1. The user selects a time interval.
2. When a valid interval is set and the STI is properly configured, the controller monitors the STI value.
3. When the time period has elapsed, the controller's normal operation is interrupted.
4. The controller then scans the logic in the STI POU.
5. When the STI POU is completed, the controller returns to where it was prior to the interrupt and continues normal operation.

## Selectable Time Interrupt (STI) Function Configuration and Status

This section covers the configuration and status management of the STI function.

### STI Function Configuration

#### *STI Program POU*

This is the name of the Program Organizational Unit (POU) which is executed immediately when this STI Interrupt occurs. You can choose any pre-programmed POU from the drop-down list.

#### *STI Auto Start (STI0.AS)*

Sub-Element Description	Data Format	User Program Access
AS - Auto Start	binary (bit)	read only

The AS (Auto Start) is a control bit that can be used in the control program. The auto start bit is configured with the programming device and stored as part of the user program. The auto start bit automatically sets the STI Timed Interrupt Enable (STI0.Enabled) bit when the controller enters any executing mode.

#### *STI Set Point Milliseconds Between Interrupts (STI0.SP)*

Sub-Element Description	Data Format	Range	User Program Access
SP - Set Point Msec	word (INT)	0...65,535	read/write

When the controller transitions to an executing mode, the SP (set point in milliseconds) value is loaded into the STI. If the STI is configured correctly, and enabled, the POU in the STI configuration is executed at this interval. This value can be changed from the control program by using the STIS instruction.

#### TIP

The minimum value cannot be less than the time required to scan the STI POU plus the Interrupt Latency.

### STI Function Status Information

STI Function status bits can be monitored either in the User Program, or in Connected Components Workbench, in Debug mode.

*STI User Interrupt Executing (STIO.EX)*

Sub-Element Description	Data Format	User Program Access
EX - User Interrupt Executing	binary (bit)	read only

The EX (User Interrupt Executing) bit is set whenever the STI mechanism completes timing and the controller is scanning the STI POU. The EX bit is cleared when the controller completes processing the STI subroutine.

The STI EX bit can be used in the control program as conditional logic to detect if an STI interrupt is executing.

*STI User Interrupt Enable (STIO.Enabled)*

Sub-Element Description	Data Format	User Program Access
Enabled - User Interrupt Enable	binary (bit)	read only

The User Interrupt Enable bit is used to indicate STI enable or disable status.

*STI User Interrupt Lost (STIO.LS)*

Sub-Element Description	Data Format	User Program Access
LS - User Interrupt Lost	binary (bit)	read/write

The LS is a status flag that indicates an interrupt was lost. The controller can process 1 active and maintain up to 1 pending user interrupt conditions before it sets the lost bit.

This bit is set by the controller. It is up to the control program to utilize, track, the lost condition if necessary.

*STI User Interrupt Pending (STIO.PE)*

Sub-Element Description	Data Format	User Program Access
PE - User Interrupt Pending	binary (bit)	read only

The PE is a status flag that represents an interrupt is pending. This status bit can be monitored or used for logic purposes in the control program if you need to determine when a subroutine cannot execute immediately.

This bit is automatically set and cleared by the controller. The controller can process 1 active and maintain up to 1 pending user interrupt conditions before it sets the lost bit.

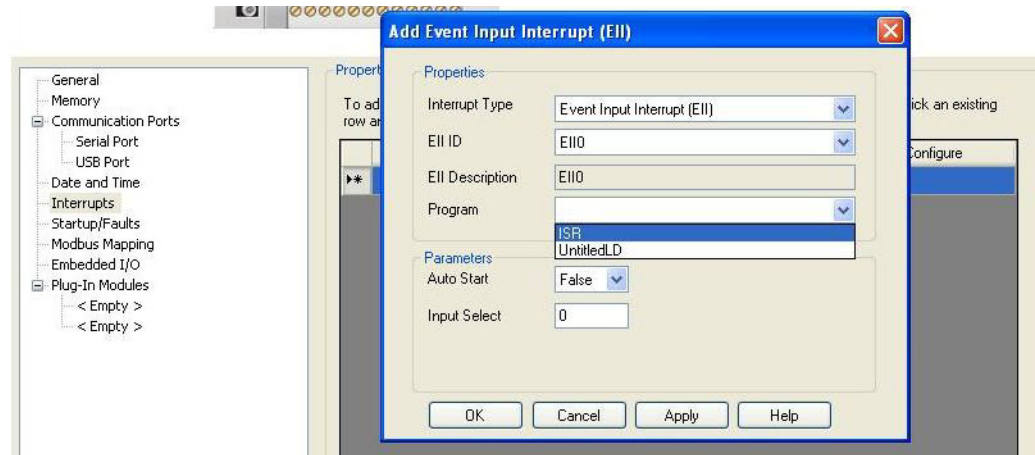
## Using the Event Input Interrupt (EII) Function

The EII (Event Input Interrupt) is a feature that allows the user to scan a specific POU when an input condition is detected from a field device.

EII0 is used in this document to define how EII works.

Configure EII Input Edge from the Embedded I/O configuration window.

Configure the EII from the Interrupt Configuration window.



## Event Input Interrupt (EII) Function Configuration and Status

### EII Function Configuration

The Event Input Interrupt Function has the following related configuration parameters.

#### *EII Program POU*

This is the name of the Program Organizational Unit (POU) which is executed immediately when this EII Interrupt occurs. You can choose any pre-programmed POU from the drop-down list.

#### *EII Auto Start (EII0.AS)*

Sub-Element Description	Data Format	User Program Access
AS - Auto Start	binary (bit)	read only

AS (Auto Start) is a control bit that can be used in the control program. The auto start bit is configured with the programming device and stored as part of the user program. The auto start bit automatically sets the Event User Interrupt Enable bit when the controller enters any executing mode.

*EII Input Select (EII.IS)*

Sub-Element Description	Data Format	User Program Access
IS - Input Select	word (INT)	read only

The IS (Input Select) parameter is used to configure each EII to a specific input on the controller. Valid inputs are 0...N, where N is either 15, or the maximum input ID, whichever is smaller.

This parameter is configured with the programming device and cannot be changed from the control program.

**EII Function Status Information**

EII Function status bits can be monitored either in the User Program, or in Connected Components Workbench, in Debug mode.

*EII User Interrupt Executing (EII.EX)*

Sub-Element Description	Data Format	User Program Access
EX - User Interrupt Executing	binary (bit)	read only

The EX (User Interrupt Executing) bit is set whenever the EII mechanism detects a valid input and the controller is scanning the EII POU. The EII mechanism clears the EX bit when the controller completes its processing of the EII subroutine.

The EII EX bit can be used in the control program as conditional logic to detect if an EII interrupt is executing.

*EII User Interrupt Enable (EII.Enabled)*

Sub-Element Description	Data Format	User Program Access
Enabled - User Interrupt Enable	binary (bit)	read only

The Enabled (User Interrupt Enable) bit is used to indicate the EII enable or disable status.

*EII User Interrupt Lost (EII.LS)*

Sub-Element Description	Data Format	User Program Access
LS - User Interrupt Lost	binary (bit)	read/write

LS (User Interrupt Lost) is a status flag that represents an interrupt has been lost. The controller can process 1 active and maintain up to 1 pending user interrupt conditions before it sets the lost bit.

This bit is set by the controller. It is up to the control program to utilize or track, the lost condition if necessary.

*EII User Interrupt Pending (EII0.PE)*

<b>Sub-Element Description</b>	<b>Data Format</b>	<b>User Program Access</b>
PE - User Interrupt Pending	binary (bit)	read only

PE (User Interrupt Pending) is a status flag that represents an interrupt is pending. This status bit can be monitored, or used for logic purposes, in the control program if you need to determine when a subroutine cannot execute immediately.

This bit is automatically set and cleared by the controller. The controller can process 1 active and maintain up to 1 pending user interrupt conditions before it sets the lost bit.

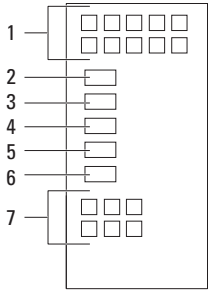


# Troubleshooting

## Status Indicators on the Controller

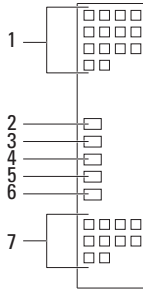
### Micro830 Controllers

10/16 Point Controllers



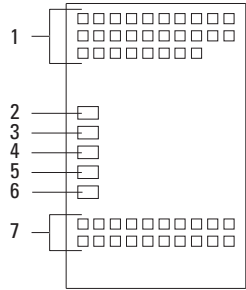
45031a

24 Point Controllers



45017a

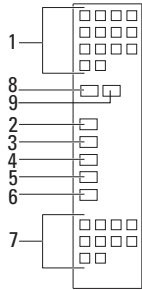
48 Point Controllers



45037a

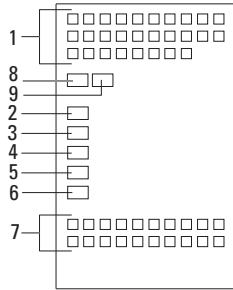
### Micro850 Controllers

24 Point Controllers



45934

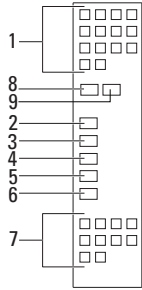
48 Point Controllers



45935

### Micro870 Controllers

24 Point Controllers



45934

**Status Indicator Description**

	<b>Description</b>	<b>State</b>	<b>Indicates</b>
1	Input status	Off	Input is not energized
		On	Input is energized (terminal status)
2	Power status	Off	No input power, or power error condition
		Green	Power on
3	Run status	Off	Not executing the user program
		Green	Executing the user program in run mode
		Flashing green	Memory backup/restore in progress
4	Fault status	Off	No fault detected.
		Red	Non-recoverable fault that requires a power cycle.
		Flashing Red	Recoverable fault.
5	Force status	Off	No force conditions are active.
		Amber	Force conditions are active.
6	Serial communications status	Off	No traffic for RS-232/RS-485.
		Green	Traffic through RS-232/RS-485. The indicator only blinks when transmitting data. It does not blink when receiving data.
7	Output status	Off	Output is not energized.
		On	Output is energized (logic status).
8	Module status	Steady Off	No power.
		Flashing Green	Standby.
		Steady Green	Device operational.
		Flashing Red	Minor fault (minor and major recoverable faults).
		Steady Red	Major Fault (non-recoverable fault).
		Flashing Green and Red	Self-test. The device is performing power-on self-test (POST). During POST, the network status indicator alternates flashing green and red. The duration of the self-test depends on the size of the project in the controller.

### Status Indicator Description

	Description	State	Indicates
9	Network status	Steady Off	Not powered, no IP address. The device is powered off, or is powered on but with no IP address.
		Flashing Green	No connections. An IP address is configured, but no Ethernet application is connected.
		Steady Green	Connected. At least one EtherNet/IP session is established.
		Flashing Red	Connection timeout (not implemented).
		Steady Red	Duplicate IP. The device has detected that its IP address is being used by another device in the network. This status is applicable only if the device's duplicate IP address detection (ACD) feature is enabled.
		Flashing Green and Red	Self-test. The device is performing power-on self-test (POST). During POST, the network status indicator alternates flashing green and red. The duration of the self-test depends on the size of the project in the controller.

### Normal Operation

The POWER and RUN indicators are on. If a force condition is active, the FORCE indicator turns on and remains on until all forces are removed.

## Error codes

This section lists possible error codes for your controller, as well as recommended actions for recovery. Information about the fault is stored in a fault log, which can be accessed from the Diagnostics page in Connected Components Workbench software. The fault log contains brief information about the last fault, and detailed information about the last 10 non-recoverable faults that occurred.

If an error persists after performing the recommended action, contact your local Rockwell Automation technical support representative. For contact information, go to <http://support.rockwellautomation.com/MySupport.asp>

### Fault Types

There are two basic types of faults that can occur:

- Recoverable – A recoverable fault can be cleared without having to power cycle the controller. The fault LED flashes red when a recoverable fault occurs.

- Non-recoverable – A non-recoverable fault requires the controller to be power cycled before clearing the fault. After the controller has been power cycled or reset, check the fault log in the Diagnostic page of the Connected Components Workbench software, then clear the fault. The fault LED is solid red when a non-recoverable fault occurs.

**List of Error Codes for Micro800 controllers**

Error Code	Fault Type	Description	Recommended Action
0xF000	Recoverable	The controller was unexpectedly reset due to a noisy environment or an internal hardware failure. If the system variable <code>_SYSVA_USER_DATA_LOST</code> is set, the controller is able to recover the user program but the user data is cleared. If not, the Micro800 controller program is cleared.	Perform one of the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Check wiring to eliminate any noise, refer to <a href="#">Wiring Requirements and Recommendation on page 41</a>.</li> </ul>
0xF001	Recoverable	The controller program has been cleared. This happened because: <ul style="list-style-type: none"> <li>• a power-down occurred during program download or data transfer from the memory module</li> <li>• the cable was removed from the controller during program download.</li> <li>• the RAM integrity test failed.</li> </ul>	Perform one of the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Transfer the program using the memory module restore utility.</li> </ul>
0xF002	Non-recoverable	The controller hardware watchdog was activated. The controller hardware watchdog timeout happens if program scan is more than three seconds. If the system variable <code>_SYSVA_USER_DATA_LOST</code> is set, the controller is able to recover the user program but the user data is cleared. If not, the Micro800 controller program is cleared.	See <a href="#">Corrective Actions for Non-recoverable Faults on page 313</a> .
0xF003	Recoverable	One of the following occurred: <ul style="list-style-type: none"> <li>• The memory module hardware faulted.</li> <li>• The memory module connection faulted.</li> <li>• The memory module was incompatible with the Micro800 controller’s firmware revision.</li> </ul>	Perform one of the following: <ul style="list-style-type: none"> <li>• Remove the memory module and plug it in again.</li> <li>• Obtain a new memory module.</li> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Upgrade the Micro800 controller’s firmware revision to be compatible with the memory module. For more information on firmware revision compatibility, go to <a href="http://www.rockwellautomation.com/support/firmware.html">http://www.rockwellautomation.com/support/firmware.html</a></li> </ul>
0xF004	Recoverable	A failure occurred during the memory module data transfer.	Perform one of the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Attempt the data transfer again. If the error persists, replace the memory module.</li> <li>• For Embedded RTC failure, restart the controller.</li> </ul>
0xF005	Recoverable	The user program failed an integrity check while the Micro800 controller was in Run mode.	Perform one of the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Refer to the <a href="#">Wire Your Controller on page 41</a>.</li> </ul>

**List of Error Codes for Micro800 controllers**

<b>Error Code</b>	<b>Fault Type</b>	<b>Description</b>	<b>Recommended Action</b>
0xF006	Recoverable	The user program is incompatible with the Micro800 controller's firmware revision.	Perform one of the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Contact your local Rockwell Automation technical support representative.</li> </ul>
0xF010	Recoverable	The user program contains a function/function block that is not supported by the Micro800 controller.	Perform one of the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Contact your local Rockwell Automation technical support representative.</li> </ul>
0xF014	Recoverable	A memory module memory error occurred.	<ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Reprogram the memory module. If the error persists, replace the memory module.</li> </ul>
0xF015	Non-recoverable	An unexpected software error occurred.	Perform one of the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Non-recoverable Faults on page 313</a>.</li> <li>• Refer to <a href="#">Wiring Requirements and Recommendation on page 41</a>.</li> </ul>
0xF016	Non-recoverable	An unexpected hardware error occurred.	Perform one of the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Non-recoverable Faults on page 313</a>.</li> <li>• Refer to <a href="#">Wiring Requirements and Recommendation on page 41</a>.</li> </ul>
0xF017	Non-recoverable	An unexpected software error occurred due to unexpected hardware interrupt. If the system variable <code>_SYSVA_USER_DATA_LOST</code> is set, the controller is able to recover the user program but the user data is cleared. If not, the Micro800 controller program is cleared.	Perform one of the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Non-recoverable Faults on page 313</a>.</li> <li>• Refer to <a href="#">Wiring Requirements and Recommendation on page 41</a>.</li> </ul>
0xF018	Non-recoverable	An unexpected software error occurred due to SPI communication failure. If the system variable <code>_SYSVA_USER_DATA_LOST</code> is set, the controller is able to recover the user program but the user data is cleared. If not, the Micro800 controller program is cleared.	Perform one of the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Non-recoverable Faults on page 313</a>.</li> <li>• Refer to <a href="#">Wiring Requirements and Recommendation on page 41</a>.</li> </ul>
0xF019	Non-recoverable	An unexpected software error occurred due to memory or other controller resource issue.	See <a href="#">Corrective Actions for Non-recoverable Faults on page 313</a> .
0xF01A	Recoverable	The controller was unexpectedly reset during Run Mode Change (RMC) due to a noisy environment or an internal hardware failure. If the system variable <code>_SYSVA_USER_DATA_LOST</code> is set, the controller is able to recover the user program but the user data is cleared. If not, the Micro800 controller program is cleared.	See <a href="#">Corrective Actions for Recoverable Faults on page 313</a> .
0xF020	Recoverable	The base hardware faulted or is incompatible with the Micro800 controller's firmware revision.	See <a href="#">Corrective Actions for Recoverable Faults on page 313</a> .
0xF021	Recoverable	The I/O configuration in the user program is invalid or does not exist in the Micro800 controller.	See <a href="#">Corrective Actions for Recoverable Faults on page 313</a> .
0xF022	Recoverable	The user program in the memory module is incompatible with the Micro800 controller's firmware revision.	Perform one of the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Replace the memory module.</li> </ul>

**List of Error Codes for Micro800 controllers**

<b>Error Code</b>	<b>Fault Type</b>	<b>Description</b>	<b>Recommended Action</b>
0xF023	Non-recoverable	The controller program has been cleared. This happened because: <ul style="list-style-type: none"> <li>• a power down occurred during program download or transfer from the memory module.</li> <li>• the Flash Integrity Test failed (Micro810 only).</li> </ul>	Perform one of the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Non-recoverable Faults on page 313</a>.</li> <li>• Download or transfer the program.</li> </ul>
0xF030 0xF031 0xF032 0xF033	Recoverable	Power down information in persistent memory may not be written properly due to a noisy environment or an internal hardware failure. If the system variable <code>_SYSVA_USER_DATA_LOST</code> is set, the controller is able to recover the user program but the user data is cleared. If not, the Micro800 controller program is cleared.	See <a href="#">Corrective Actions for Recoverable Faults on page 313</a> .
0xF050	Recoverable	The embedded I/O configuration in the user program is invalid.	See <a href="#">Corrective Actions for Recoverable Faults on page 313</a> .
0xF100	Recoverable	There is general configuration error detected in the motion configuration downloaded from the Connected Components Workbench software, such as number of axis, or motion execution interval being configured out of range.	Perform the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Correct the axes configuration in the user program.</li> </ul>
0xF110	Recoverable	There is motion resource missing, such as <code>Motion_DIAG</code> variable not defined.	Perform the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Correct the axes configuration in the user program.</li> </ul>
0xF12z <sup>(1)</sup>	Recoverable	Motion configuration for axis z cannot be supported by this controller model, or the axis configuration has some resource conflict with some other motion axis, which has been configured earlier.	Perform the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Remove all axes and re-configure motion with the guidance from the User Manual.</li> </ul>
0xF15z <sup>(1)</sup>	Recoverable	There is a motion engine logic error (firmware logic issue or memory crash) for one axis detected during motion engine cyclic operation. One possible reason can be motion engine data/memory crash.	See <a href="#">Corrective Actions for Recoverable Faults on page 313</a> .
0xF210	Recoverable	The expansion I/O terminator is missing.	Perform the following: <ol style="list-style-type: none"> <li>1. Power off the controller.</li> <li>2. Attach the expansion I/O terminator on the last expansion I/O module on the system.</li> <li>3. Power on the controller.</li> <li>4. See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> </ol>
0xF230	Recoverable	The maximum number of expansion I/O modules has been exceeded.	Perform the following: <ol style="list-style-type: none"> <li>1. Power off the controller.</li> <li>2. Check that the number of expansion I/O modules is not more than four.</li> <li>3. Power on the controller.</li> <li>4. See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> </ol>
0xF250	Recoverable	There is a non-recoverable error and the expansion I/O module(s) could not be detected.	See <a href="#">Corrective Actions for Recoverable Faults on page 313</a> .
0xF26z <sup>(2)</sup>	Recoverable	An expansion I/O master fault is detected on the system.	See <a href="#">Corrective Actions for Recoverable Faults on page 313</a> .

**List of Error Codes for Micro800 controllers**

<b>Error Code</b>	<b>Fault Type</b>	<b>Description</b>	<b>Recommended Action</b>
0xF27z <sup>(2)</sup>	Recoverable	A non-recoverable communication fault has occurred on the expansion I/O module.	Perform one of the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Replace the slot number z module.</li> </ul>
0xF28z <sup>(2)</sup>	Recoverable	Expansion I/O baudrate error.	Perform one of the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Replace the slot number z module.</li> </ul>
0xF29z <sup>(2)</sup>	Recoverable	A module fault is detected on your expansion I/O module.	Perform one of the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Replace the slot number z module.</li> </ul>
0xF2Az <sup>(2)</sup>	Recoverable	Expansion I/O power failure	Perform one of the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Replace the slot number z module.</li> </ul>
0xF2Bz <sup>(2)</sup>	Recoverable	Expansion I/O configuration fault.	Perform one of the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Correct the expansion IO module configuration in the user program to match that of the actual hardware configuration.</li> <li>• Check the expansion I/O module operation and condition.</li> <li>• Replace the expansion I/O module.</li> </ul>
0xF300	Recoverable	The memory module is present but memory module is empty and restore operation is requested.	Perform the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Check to make sure there is a valid project in the memory module.</li> <li>• Download a user program and use the backup function to the memory module.</li> </ul>
0xF301	Recoverable	The memory module's project is not compatible with the controller.	Perform one of the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Check to make sure there is a user program with a controller that has the correct controller catalog configured.</li> <li>• Download a user program and use the backup function to the memory module.</li> </ul>
0xF302	Recoverable	The password is mismatched between memory module and controller. Only applies to Micro820 controller when Remote LCD performs the restore operation. This fault does not apply to Micro800 controller firmware revision 10 and later.	Perform one of the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Check to make sure that the user program in the memory module has the correct password.</li> <li>• Download a user program with a password and use the backup function to the memory module.</li> <li>• Use Connected Components Workbench to enter the correct password into the controller and perform the restore operation again.</li> </ul>
0xF303	Recoverable	The memory module is not present and restore operation is requested.	Check to make sure the memory module is present.

**List of Error Codes for Micro800 controllers**

<b>Error Code</b>	<b>Fault Type</b>	<b>Description</b>	<b>Recommended Action</b>
0xF0Az <sup>(3)</sup>	Recoverable	The plug-in I/O module experienced an error during operation.	Perform the following: <ul style="list-style-type: none"> <li>• Check the condition and operation of the plug-in I/O module.</li> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> </ul>
0xF0Bz <sup>(3)</sup>	Recoverable	The plug-in I/O module configuration does not match the actual I/O configuration detected.	Perform one of the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Correct the plug-in I/O module configuration in the user program to match that of the actual hardware configuration.</li> <li>• Check the condition and operation of the plug-in I/O module.</li> <li>• Replace the plug-in I/O module.</li> </ul>
0xF0Dz <sup>(3)</sup>	Recoverable	When power was applied to the plug-in I/O module or the plug-in I/O module was removed, a hardware error occurred.	Perform the following: <ol style="list-style-type: none"> <li>1. See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>2. Correct the plug-in I/O module configuration in the user program.</li> <li>3. Build and download the program using Connected Components Workbench.</li> <li>4. Put the Micro800 controller into Run mode.</li> </ol>
0xF0Ez <sup>(3)</sup>	Recoverable	The plug-in I/O module configuration does not match the actual I/O configuration detected.	Perform the following: <ol style="list-style-type: none"> <li>1. See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>2. Correct the plug-in I/O module configuration in the user program.</li> <li>3. Build and download the program using Connected Components Workbench.</li> <li>4. Put the Micro800 controller into Run mode.</li> </ol>
0xF830	Recoverable	An error occurred in the EII configuration.	Perform the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Review and change the EII configuration in the Micro800 controller properties.</li> </ul>
0xF840	Recoverable	An error occurred in the HSC configuration.	Perform the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Review and change the EII configuration in the Micro800 controller properties.</li> </ul>
0xF850	Recoverable	An error occurred in the STI configuration.	Perform the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Review and change the EII configuration in the Micro800 controller properties.</li> </ul>
0xF860	Recoverable	A data overflow occurred. A data overflow error is generated when the ladder, structured text or function block diagram execution encounters a divide-by-zero.	Perform the following: <ol style="list-style-type: none"> <li>1. See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>2. Correct the program to ensure that there is no data overflow.</li> <li>3. Build and download the program using Connected Components Workbench.</li> <li>4. Put the Micro800 controller into Run mode.</li> </ol>
0xF870	Recoverable	An index address was out of data space.	Perform the following: <ol style="list-style-type: none"> <li>1. See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>2. Correct the program to ensure that there is no index used to access an array element beyond the array boundaries.</li> <li>3. Build and download the program using Connected Components Workbench.</li> <li>4. Put the Micro800 controller into Run mode.</li> </ol>



**List of Error Codes for Micro800 controllers**

<b>Error Code</b>	<b>Fault Type</b>	<b>Description</b>	<b>Recommended Action</b>
0xF0878	Recoverable	An index used to access a bit is beyond the boundaries of the data type it is used on.	Perform the following: <ol style="list-style-type: none"> <li>1. See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>2. Correct the program to ensure that there is no index used to access a bit beyond the boundaries of the data type.</li> <li>3. Build and download the program using Connected Components Workbench.</li> <li>4. Put the Micro800 controller into Run mode.</li> </ol>
0xF880	Recoverable	A data conversion error occurred.	Perform the following: <ol style="list-style-type: none"> <li>1. See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>2. Correct the program to ensure that there is no data conversion error.</li> <li>3. Build and download the program using Connected Components Workbench.</li> <li>4. Put the Micro800 controller into Run mode.</li> </ol>
0xF888	Recoverable	The call stack of the controller cannot support the sequence of calls to function blocks in the current project. Too many blocks are within another block.	Perform the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Change the project to reduce the quantity of blocks being called within a block.</li> </ul>
0xF898	Recoverable	An error occurred in the user interrupt configuration for the plug-in I/O module.	Perform the following: <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Correct the user interrupt configuration for plug-in I/O module in the user program to match that of the actual hardware configuration.</li> </ul>
0xF8A0	Recoverable	The TOW parameters are invalid.	Perform the following: <ol style="list-style-type: none"> <li>1. See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>2. Correct the program to ensure that there are no invalid parameters.</li> <li>3. Build and download the program using Connected Components Workbench.</li> <li>4. Put the Micro800 controller into Run mode.</li> </ol>
0xF8A1	Recoverable	The DOY parameters are invalid.	Perform the following: <ol style="list-style-type: none"> <li>1. See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>2. Correct the program to ensure that there are no invalid parameters.</li> <li>3. Build and download the program using Connected Components Workbench.</li> <li>4. Put the Micro800 controller into Run mode.</li> </ol>

**List of Error Codes for Micro800 controllers**

<b>Error Code</b>	<b>Fault Type</b>	<b>Description</b>	<b>Recommended Action</b>
0xFFzz <sup>(4)</sup>	Recoverable	A user-created fault from Connected Components Workbench has occurred.	See <a href="#">Corrective Actions for Recoverable Faults on page 313</a> .
0xD00F	Recoverable	A particular hardware type (for example, embedded I/O) was selected in the user program configuration, but did not match the actual hardware base.	See <a href="#">Corrective Actions for Recoverable Faults on page 313</a> .
0xD011	Recoverable	The program scan time exceeded the watchdog timeout value.	<p>Perform the following:</p> <ul style="list-style-type: none"> <li>• See <a href="#">Corrective Actions for Recoverable Faults on page 313</a>.</li> <li>• Determine if the program is caught in a loop and correct the problem.</li> </ul> <p>Fault may occur if your Structured Text program contains a For loop with the upper limit set to the maximum value of the variable. For example, the variable is a USINT and the limit is set to 255, or the variable is a UINT and the limit is set to 65535.</p> <p>To correct the fault, perform the following:</p> <ol style="list-style-type: none"> <li>1. Correct the program to ensure that the upper limit is not reached. One method is to use a data type with a larger maximum value.</li> <li>2. Build and download the program using Connected Components Workbench.</li> <li>3. Put the Micro800 controller into Run mode.</li> </ol> <p>If your program is designed to have a scan time of longer than three seconds, in the user program, increase the watchdog timeout value that is set in the system variable <code>_SYSVA_TCYWDG</code> and then build and download the program using Connected Components Workbench.</p>

(1) z indicates the logic axis ID. (0...3)

(2) z indicates the slot number of the expansion I/O. If z=0, then the slot number cannot be identified.

(3) z is the slot number of the plug-in module. If z = 0, then the slot number cannot be identified.

(4) zz indicates the last byte of the program number. Only program numbers up to 0xFF can be displayed. For program numbers 01x00 to 0xFFFF, only the last byte is displayed.)

## Corrective Action for Recoverable and Non-recoverable Faults

### *Corrective Actions for Recoverable Faults*

Perform the following:

1. Optionally save the fault log from Connected Components Workbench software.
2. Clear the recoverable fault using Connected Components Workbench software.
3. If problem persists, contact technical support with the fault log.

### *Corrective Actions for Non-recoverable Faults*

Perform the following:

1. Power cycle your Micro800 controller.
2. Controller will go to recoverable fault. Optionally save the fault log from Connected Components Workbench software.
3. Clear the recoverable fault using Connected Components Workbench software.
4. If program is lost, build and download your program using Connected Components Workbench software.
5. If problem persists, contact technical support with the fault log.

## Retrieve a Fault Log

You can retrieve a fault log for your controller by using the Connected Components Workbench software, version 9 or later.

Perform the following:

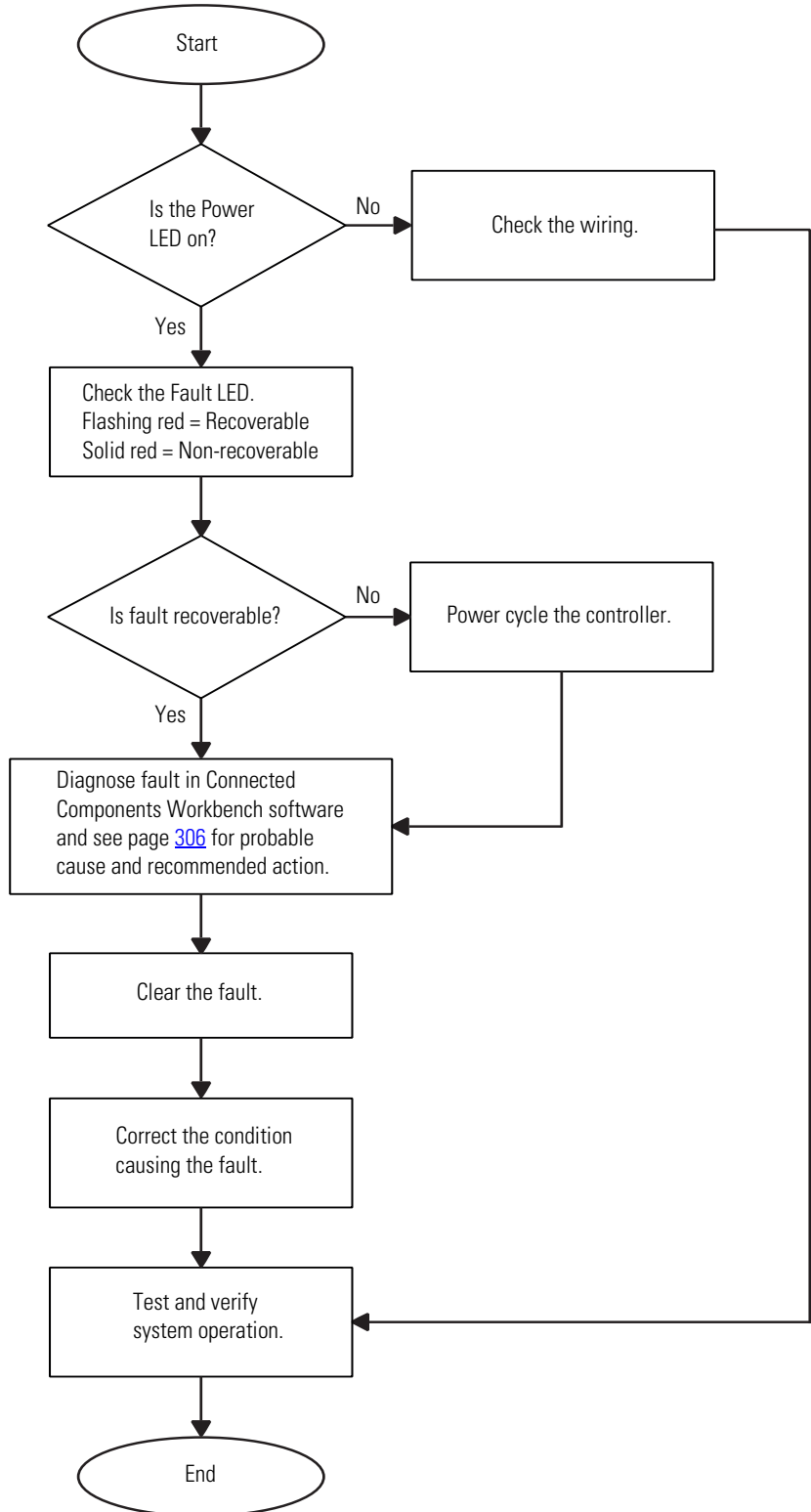
1. Launch the Connected Component Workbench software.
2. Connect to your Micro800 controller.
3. In Project Organizer, right-click the Micro800 controller.
4. Select Diagnose > Fault.

The Fault Diagnostics tab displays.

5. Click the Get Fault Log button.
6. Save the fault log (.txt) file.

## Controller Error Recovery Model

Use the following error recovery model to help you diagnose software and hardware problems in the micro controller. The model provides common questions you might ask to help troubleshoot your system. Refer to the recommended pages within the model for further help.



## **Calling Rockwell Automation for Assistance**

If you need to contact Rockwell Automation or local distributor for assistance, it is helpful to obtain the following (prior to calling):

- controller type, series letter, revision letter, and firmware (FRN) number of the controller
- controller indicator status

**Notes:**

## PID Function Blocks

The PID function block has parameter naming similar to RSLogix 500 and is recommended for users who are already familiar with programming in RSLogix 500. The IPIDCONTROLLER function block has the advantage of supporting auto tune.

### Comparison Between IPIDCONTROLLER and PID

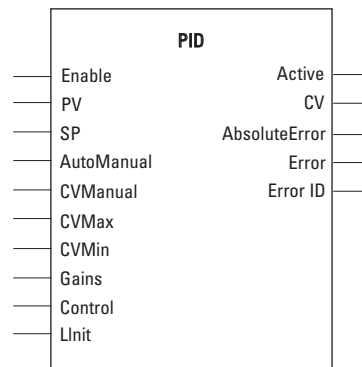
IPIDCONTROLLER	PID	Description
<b>Common parameters</b>		
Process	PV	Process Variable feedback
Setpoint	SP	Set Point input
Output	CV	CV output
Gains.DirectActing	Control	Control direction of process (cooling versus heating).
Gains.ProportionalGain	Gains.Kc	Controller gain for both P and I
Gains.TimeIntegral	Gains.Ti	Time integral value for I
Gains.TimeDerivative	Gains.Td	Time derivative value for D
Gains.DerivativeGain	Gains.FC	A higher filter constant makes CV output more responsive to error. Acts like a derivative gain.
AbsoluteError	AbsoluteError	Absolute value of error
<b>PID specific parameters</b>		
–	CVMin	For limiting CV
–	CVMax	For limiting CV
–	AutoManual	TRUE = Normal operation of PID. FALSE = Manual operation using CVManual.
–	CVManual	CV when in manual mode
–	Enable	TRUE = Start execution with current input parameters. FALSE = CV equals zero.
–	Active	TRUE = PID state is running. FALSE = PID state is stopped.
–	Error	TRUE = PID has an error. FALSE = PID has no errors.
–	ErrorID	PID Error ID

**Comparison Between IPIDCONTROLLER and PID**

IPIDCONTROLLER	PID	Description
<b>IPIDCONTROLLER specific parameters</b>		
Auto	–	TRUE = Normal operation of PID. FALSE = Output tracks Feedback.
Feedback		Feedback of the control being applied to the process. Usually it's the PID's CV after any limits or manual control has been applied.
AutoTune		TRUE = Autotune. FALSE = No Autotune.
ATParameters		Autotune parameters
ATWarning		Autotune warning
OutGains		Gains from Autotune
Initialize		Used for AutoTune

**PID Function Block**

This function block diagram shows the arguments in the PID function block.



The following table explains the arguments used in this function block.

**PID Arguments**

Parameter	Parameter Type	Data Type	Description
Enable	Input	BOOL	Enable instruction. TRUE = Start execution with current input parameters. FALSE = CV equals zero.
PV	Input	REAL	Process Value. This value is typically read from an analog input module. The SI unit must be the same as Setpoint.
SP	Input	REAL	The set point value for the process.
AutoManual	Input	BOOL	Auto or manual mode selection: TRUE = Normal operation of PID. FALSE = Manual operation using CVManual.
CVManual	Input	REAL	Control value input defined for manual mode operation. The valid range for CVManual is: CVMMin < CVManual < CVMMax



**PID Arguments**

<b>Parameter</b>	<b>Parameter Type</b>	<b>Data Type</b>	<b>Description</b>
CVMin	Input	REAL	Control value minimum limit. If CV < CVMin, then CV = CVMin. If CVMin > CVMax, and error occurs.
CVMax	Input	REAL	Control value maximum limit. If CV > CVMax, then CV = CVMax. If CVMax < CVMin, an error occurs.
Gains	Input	PID_GAIN S	Gains of PID for controller. Use the PID_GAINS data type to configure the Gains parameter.
Control	Input	BOOL	Control direction of the process: TRUE = Direct acting, such as Cooling. FALSE = Reverse acting, such as Heating.
Linit	Input	BOOL	Reserved for future use.
Active	Output	BOOL	Status of the PID controller: TRUE = PID state is running. FALSE = PID state is stopped.
CV	Output	REAL	The control value output. If any error occurred, CV is 0.
AbsoluteError	Output	REAL	Absolute error is the difference between process value (PV) and setpoint (SV) value.
Error	Output	BOOL	Indicates the existence of an error condition. TRUE = PID has an error. FALSE = PID has no errors.
ErrorID	Output	USINT	A unique numeric that identifies the error. The errors are defined in PID error codes.

**GAIN\_PID Data Type**

<b>Parameter</b>	<b>Parameter Type</b>	<b>Data Type</b>	<b>Description</b>
Kc	Input	REAL	Controller gain for PID. Proportional and Integral are dependent on this gain (>= 0.0001). Increasing Kc improves response time but also increases overshoot and oscillation of the PID. If Kc is invalid, an error occurs.

**GAIN\_PID Data Type**

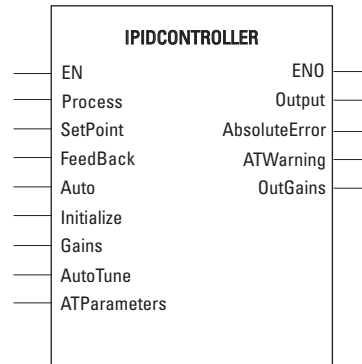
Parameter	Parameter Type	Data Type	Description
Ti	Input	REAL	Time integral constant in seconds ( $\geq 0.0001$ ). Increasing Ti decreases overshoot and oscillation of the PID. If Ti is invalid, an error occurs.
Td	Input	REAL	Time derivative constant in seconds ( $\geq 0.0$ ). When Td equals 0, then there is no derivative action and PID becomes a PI controller. Increasing Td reduces the overshoot and removes the oscillation of the PID controller. If Td is invalid, an error occurs.
FC	Input	REAL	Filter constant ( $\geq 0.0$ ). Recommended range for FC is 0...20. Increasing FC smooths the response of the PID controller. If FC is invalid, an error occurs.

**PID Error Codes**

Error Code	Description
0	PID is working normally.
1	Kc is invalid.
2	Ti is invalid.
3	Td is invalid.
4	FC is invalid.
5	CVMin > CVMax, or CVMax < CVMin
6	CVManual < CVMin CVManual is invalid.
7	CVManual > CVMax CVManual is invalid.

## IPIDCONTROLLER Function Block

This function block diagram shows the arguments in the IPIDCONTROLLER function block.



The following table explains the arguments used in this function block.

### IPIDCONTROLLER Arguments

Parameter	Parameter Type	Data Type	Description
EN	Input	BOOL	Function block enable TRUE = Execute function. FALSE = Do not execute function. Applicable to Ladder Diagram programs.
Process	Input	REAL	Process value, which is the value measured from the process output.
SetPoint	Input	REAL	The set point value for the process.
Feedback	Input	REAL	Feedback signal, which is the value of the control variable applied to the process. For example, the feedback can be IPIDCONTROLLER output.
Auto	Input	BOOL	Operating modes of PID controller: TRUE = Normal operation of PID. FALSE = Output tracks Feedback.
Initialize	Input	BOOL	A change in value (TRUE to FALSE or FALSE to TRUE) causes the controller to eliminate any proportional gain during that cycle. It also initializes AutoTune sequences.
Gains	Input	GAIN_PID	Gains PID for IPIDCONTROLLER. Use the GAIN_PID data type to define the parameters for the Gains input.
AutoTune	Input	BOOL	TRUE = Autotune. FALSE = No Autotune.
ATParameters	Input	AT_Param	AutoTune parameters Use AT_Param data type to define the parameters for the ATParameters input.
Output	Output	Real	Output value from the controller.
AbsoluteError	Output	Real	Absolute error (Process - SetPoint) from the controller.

### IPIDCONTROLLER Arguments

Parameter	Parameter Type	Data Type	Description
ATWarnings	Output	DINT	Warning for the AutoTune sequence. Possible value are: 0 = No auto tune done. 1 = In auto tune mode. 2 = Auto tune done. -1 = Error 1: Input automatically set to TRUE, no auto tune possible. -2 = Error 2: Auto tune error, the ATDynamSet expired.
OutGains	Output	GAIN_PID	Gains calculated from AutoTune Sequences. Use GAIN_PID data type to define the OutGains output.
ENO	Output	BOOL	Enable output. Applicable to Ladder Diagram programs.

### GAIN\_PID Data Type

Parameter	Type	Description
DirectActing	BOOL	Types of acting: TRUE = Direct acting, output moves same direction as error. That is, the actual process value is greater than the SetPoint and the appropriate controller action is to increase the output. For example, Chilling. FALSE = Reverse acting, output moves opposite direction as error. That is, the actual process value is greater than the Setpoint and the appropriate controller action is to decrease the output. For example, Heating.
ProportionalGain	REAL	Proportional gain for PID ( $\geq 0.0001$ ). <b>Proportional gain for PID (P_Gain)</b> A higher proportional gain causes a larger change in the output based upon the difference between the PV (measured process value) and SV (set point value). The higher the gain, the faster the error is decreased, but this may result in instability such as oscillations. The lower the gain, the slower the error is decreased, but the system is more stable and less sensitive to large errors. The P_Gain usually is the most important gain to adjust and the first gain to adjust while tuning.

**GAIN\_PID Data Type**

Parameter	Type	Description
TimeIntegral	REAL	Time integral value for PID ( $\geq 0.0001$ ). <b>Time integral value for PID</b> A smaller integral time constant causes a faster change in the output based upon the difference between the PV (measured process value) and SV (set point value) integrated over this time. A smaller integral time constant decreases the steady state error (error when SV is not being changed) but increases the chances of instability such as oscillations. A larger integral time constant slows down the response of the system and make it more stable, but PV approaches the SV at a slower rate.
TimeDerivative	REAL	Time derivative value for PID ( $> 0.0$ ). <b>Time derivative value for PID (Td)</b> A smaller derivative time constant causes a faster change in the output based upon the rate of change of the difference between PV (measured process value) and SV (set point value). A smaller derivative time constant makes a system more responsive to sudden changes in error (SV is changed) but increases the chances of instability such as oscillations. A larger time constant makes a system less responsive to sudden changes in error and the system is less susceptible to noise and step changes in PV. TimeDerivative (Td) is related to the derivative gain but allows the derivative contribution to PID to be tuned using time so the sample time must be taken into consideration.
DerivativeGain	REAL	Derivative gain for PID ( $\geq 0.0$ ). <b>Derivative gain for PID (D_Gain)</b> A higher derivative gain causes a larger change in the output based upon the rate of change of the difference between the PV (measured process value) and SV (set point value). A higher gain makes a system more responsive to sudden changes in error but increases the chances of instability such as oscillations. A lower gain makes a system less responsive to sudden changes in error and makes the system less susceptible to noise and step changes in the PV. <b>If derivative gain is set to zero, it disables the derivative portion of the PID.</b>

**AT\_Param Data Type**

Parameter	Type	Description
Load	REAL	Load parameter for auto tuning. This is the output value when starting AutoTune.
Deviation	REAL	Deviation for auto tuning. This is the standard deviation used to evaluate the noise band needed for AutoTune (noise band = $3 * \text{Deviation}$ ) <sup>(1)</sup>
Step	REAL	Step value for AutoTune. Must be greater than noise band and less than $\frac{1}{2}$ load.
ATDynamSet	REAL	Waiting time in seconds before abandoning auto tune.
ATReset	BOOL	Determines whether the output value is reset to zero after an AutoTune sequence: TRUE = Reset output to zero. FALSE = Leaves output at Load value.

(1) The application engineer can estimate the value of ATParams.Deviation by observing the value of Proces input. For example, in a project that involves the control of temperature, if the temperature stabilizes around 22 °C, and a fluctuation of 21.7...22.5 °C is observed, the value of ATParams.Deviation will be  $(22.5-21.7)/2=0.4$ .

## How to Autotune

Before you autotune, you need to:

- Verify that your system is constant when there is no control. For example, for temperature control, process value should remain at room temperature when there is no control output.
- Configure the set point to 0.
- Set Auto Input to False.
- Set the Gain parameter as follows:

### GAIN Parameter Values

GAIN Parameter	Value
DirectActing	According to operation: TRUE (for example, Cooling), or FALSE (for example, Heating)
DerivativeGain	0.5
ProportionalGain	0.0001
TimeIntegral	0.0001
TimeDerivative	0.0

- Set the AT\_Parameter as follows:

### AT\_Parameter Values

AT Parameter	Recommendation
Load	Every 'Load' provides a saturated process value over a period of time. Adjust the load to the value for the saturated process value you want.  <b>IMPORTANT:</b> If a load of 40 gives you a process value of 30 °C over a period of time, and you want to tune your system to 30 °C, you should set the load to 40.
Deviation	This parameter plays a significant role in the autotune process. The method of deriving this value is explained later in this section. It is not necessary to set this parameter prior to autotuning. However, if you already know the deviation, it is fine to set it first.
Step	Step value should be between 3*Deviation and ½ load. The step provides an offset for the load during autotuning. It should be set to a value high enough to create a significant change in process value.
ATDynamSet	Set this value to a reasonably long time for the autotune process. Every system is different, so allow more time to a system with a process value that takes longer to react to change.
ATReset	Set this parameter to TRUE to reset the output to zero after the autotune process completes. Set this parameter to FALSE to leave the output at load value after the autotune process completes.

During autotune, the controller will automatically set the process value to zero. To autotune, perform the following steps:

1. Set the Initialize input to TRUE.
2. Set the AutoTune input to TRUE.
3. Wait for the Process input to stabilize or reach a steady state.

4. Note the temperature fluctuation of the process value.
5. Calculate deviation value with reference to the fluctuation. For example, if the temperature stabilizes around 22 °C (72 °F) with a fluctuation of 21.7...22.5 °C (71...72.5 °F), the value of 'ATParams.Deviation' is:

$$\text{For } ^\circ\text{C: } \frac{22.5 - 21.7}{2} = 0.4 \quad \text{For } ^\circ\text{F: } \frac{72.5 - 71}{2} = 0.75$$

6. Set the deviation value, if you have not set it yet.
7. Change the initialize input to FALSE.
8. Wait until the 'AT\_Warning' shows 2. The autotune process is successful.
9. Get the tuned value from the 'OutGains'.

## How Autotune Works

The auto tune process begins when the 'Initialize' is set to FALSE (Step 7.) At this moment, the control output increases by the amount of 'Step' and the process waits for the process value to reach or exceeds 'first peak'.

First peak is defined as:

*For Direct Operation: First peak = PV1 - (12 x Deviation)*

*For Reverse Operation: First peak = PV1 + (12 x Deviation)*

Where PV1 is the process value when Initialize is set to FALSE.

Once the process value reaches first peak, the control output reduces by the amount of Step and waits for the process value to drop to the second peak.

Second peak is defined as:

*For Direct Operation: Second peak = PV1 - (3 x Deviation)*

*For Reverse Operation: Second peak = PV1 + (3 x Deviation)*

Once the process value reaches or falls below second peak, calculations commence and a set of gain will be generated to parameter OutGains.

## Troubleshooting an Autotune Process

You can tell what is going on behind the autotune process from the sequences of control output. Here are some known sequences of control output and what it means if autotune fails. For the ease of illustrating the sequence of control output, we define:

Load: 50

Step: 20

### Output Sequence 1: 50 -> 70 -> 30

Sequence Condition	Autotune Result	Action for Autotune Fail
Process value reached 'first peak' and 'second' peak in time	Likely successful	NA

### Output Sequence 2: 50 -> 70 -> 50

Sequence Condition	Autotune Result	Action for Autotune Fail
Process value not able to reach 'first peak'	Likely unsuccessful	Reduce Deviation or Increase Step

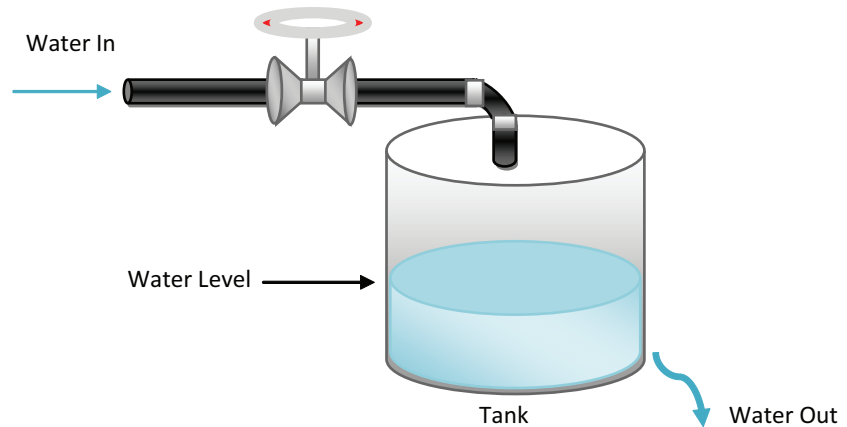
### Output Sequence 3: 50 -> 70 -> 30 -> 50

Sequence Condition	Autotune Result	Action for Autotune Fail
Process value not able to reach second peak	Likely unsuccessful	Increase Deviation or increase Step

### Output Sequence 4: 50 -> 70

Sequence Condition	Autotune Result	Action for Autotune Fail
Process value not able to reach First peak in time	Likely unsuccessful	Increase ATDynamSet

## PID Application Example



The illustration above shows a basic water level control system, to maintain a preset water level in the tank. A solenoid valve is used to control incoming water, filling the tank at a preset rate. Similarly, outflowing water is controlled at a measurable rate.



### *IPID Autotuning for First and Second Order Systems*

Autotune of IPID can only work on first and second order systems.

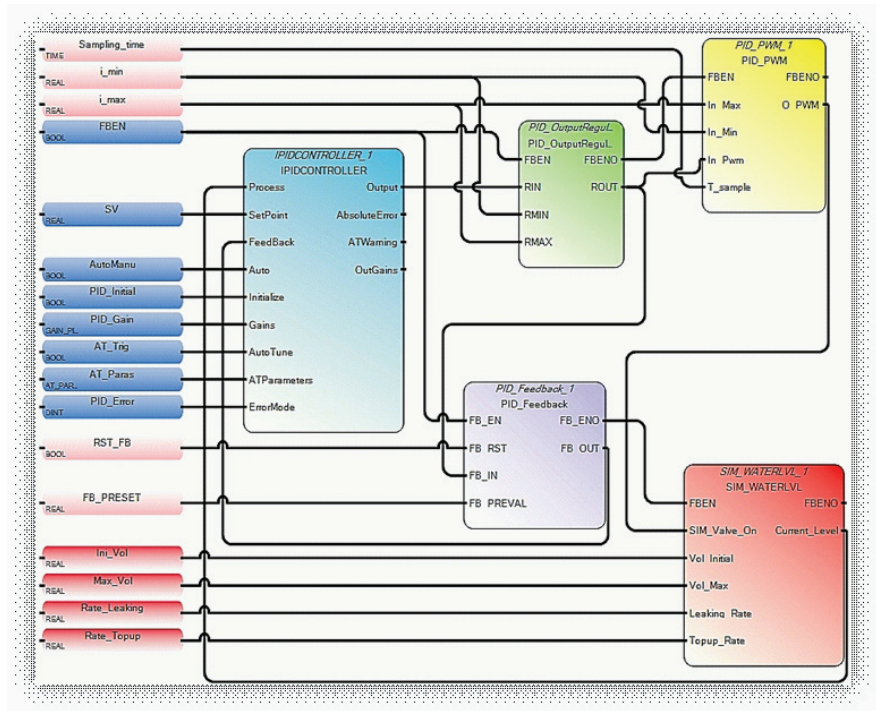
A first order system can be described by a single independent energy storage element. Examples of first order systems are the cooling of a fluid tank, the flow of fluid from a tank, a motor with constant torque driving a disk flywheel or an electric RC lead network. The energy storage element for these systems are heat energy, potential energy, rotational kinetic energy and capacitive storage energy, respectively.

This may be written in a standard form such as  $f(\tau) = \tau dy/dt + y(\tau)$ , where  $\tau$  is the system time constant,  $f$  is the forcing function and  $y$  is the system state variable.

In the cooling of a fluid tank example, it can be modeled by the thermal capacitance  $C$  of the fluid and thermal resistance  $R$  of the walls of the tank. The system time constant will be  $RC$ , the forcing function will be the ambient temperature and the system state variable will be the fluid temperature.

A second order system can be described by two independent energy storage elements which exchange stored energy. Examples of second order systems are a motor driving a disk flywheel with the motor coupled to the flywheel via a shaft with torsional stiffness or an electric circuit composed of a current source driving a series LR (inductor and resistor) with a shunt C (capacitor). The energy storage elements for these systems are the rotational kinetic energy and torsion spring energy for the former and the inductive and capacitive storage energy for the latter. Motor drive systems and heating systems can be typically modeled by the LR and C electric circuit.

## PID Code Sample



The illustration PID Code Sample shows sample code for controlling the PID application example shown before. Developed using Function Block Diagrams, it consists of a pre-defined function block, IPIDCONTROLLER, and four user-defined function blocks. These four are:

- PID\_OutputRegulator**  
 This user-defined function block regulates the output of IPIDCONTROLLER within a safe range to ensure that there is no damage to the hardware used in the process.

IF  $RMIN \leq RIN \leq RMAX$ , then  $ROUT = RIN$ ,  
 IF  $RIN < RMIN$ , then  $ROUT = RMIN$ ,  
 IF  $RIN > RMAX$ , then  $ROUT = RMAX$ .

- PID\_Feedback**  
 This user defined function block acts as a multiplexer.

IF "FB\_RST" is false,  $FB\_OUT = FB\_IN$ ;  
 If "FB\_RST" is true, then  $FB\_OUT = FB\_PREVAL$ .

- PID\_PWM**  
 This user defined function block provides a PWM function, converting a real value to a time related ON/OFF output.
- SIM\_WATERLVL**  
 This user defined function block simulates the process depicted in the application example shown before.

---

**IMPORTANT** User Program Scan Time is Important

The autotuning method needs to cause the output of the control loop to oscillate. In order to identify the oscillation period, the IPID must be called frequently enough to be able to sample the oscillation adequately. The scan time of the user program must be less than half the oscillation period. In essence the Shannon, or Nyquist-Shannon, or the sampling theorem must be adhered to.

In addition, it is important that the function block is executed at a relatively constant time interval. One can typically achieve this using STI interrupt.

---

**Notes:**

## System Loading

### Micro830, Micro850, and Micro870 Power Requirements

Controller/Module	Power Requirement
Micro830, Micro850, and Micro870 (without plug-in/expansion I/O)	
10/16-point	5 W
24-point	8 W
48-point	11 W
Plug-in modules, each	1.44 W
Expansion I/O (system bus power consumption)	2085-IQ16 – 0.85 W 2085-IQ32T – 0.95 W 2085-IA8 – 0.75 W 2085-IM8 – 0.75 W 2085-OA8 – 0.90 W 2085-OB16 – 1.00 W 2085-OV16 – 1.00 W 2085-OW8 – 1.80 W 2085-OW16 – 3.20 W 2085-IF4 – 1.70 W 2085-IF8 – 1.75 W 2085-OF4 – 3.70 W 2085-IRT4 – 2.00 W

### Calculate Total Power for Your Micro830/Micro850/Micro870 Controller

To calculate Total Power for your Micro830, Micro850, and Micro870 controller, use the following formula:

$$\text{Total Power} = \text{Main Unit Power} + \text{No. of Plug-ins} * \text{Plug-in Power} + \text{Sum of Expansion I/O Power}$$

*Example 1:*

Derive Total Power for a 24-point Micro830 controller with two plug-ins.

$$\text{Total Power} = 8 \text{ W} + 1.44 \text{ W} * 2 + 0 = \mathbf{10.88 \text{ W}}$$

*Example 2:*

Derive Total Power for a 48-point Micro850 controller, with 3 plug-ins, and 2085-IQ16 and 2085-IF4 expansion I/O modules attached.

$$\text{Total Power} = 11 \text{ W} + 3 * 1.44 \text{ W} + 0.85 \text{ W} + 1.7 \text{ W} = \mathbf{17.87 \text{ W}}$$

*Calculate External AC Power Supply Loading for your Micro830 Controller*

To calculate External AC Power Supply Loading:

- Get total sensor current loading. For this example, assume it is 250 mA.
- Calculate Total Power Loading by Sensor using this formula:  
(24V \* 250 mA) 6 W.
- Derive External AC Power Supply Loading using this formula:  
**AC Power Supply Loading** = Total Power calculated for a Micro800 system with Plug in + Total power loading by Sensor

As an example, a 48-point Micro850 controller with 2 plug-ins, and 2085-IQ16 and 2085-IF4 expansion I/O, and 250mA sensor current (6W sensor power) will have the following Total Loading for AC Power Supply:

$$\text{Total loading for AC power supply} = 17.87\text{W} + 6\text{W} = 23.87 \text{ W}$$



**ATTENTION:** Maximum loading to AC Power Supply is limited to 38.4 W with maximum surrounding ambient temperature limited to 65 °C.

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