User Manual

Allen-Bradley

Micro830 and Micro850 Programmable Controllers

Catalog Numbers Bulletin 2080-LC30 and 2080-LC50

Allen-Bradley • Rockwell Software

Rockwell Automation

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.

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

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™

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.

Additional Resources

These documents contain additional information concerning related Rockwell Automation products.

Resource	Description
Micro800 Programmable Controller External AC Power Supply Installation Instructions 2080-IN001	Information on mounting and wiring the optional external power supply.
Micro830 Programmable Controllers Installation Instructions 2080-IN002	Information on mounting and wiring the Micro830 10-point Controllers.
Micro830 Programmable Controllers Installation Instructions 2080-IN003	Information on mounting and wiring the Micro830 16-point Controllers.
Micro830 Programmable Controllers Installation Instructions 2080-IN004	Information on mounting and wiring the Micro830 24-point Controllers.
Micro830 Programmable Controllers Installation Instructions 2080-IN005	Information on mounting and wiring the Micro830 48-point Controllers.
Micro850 Programmable Controllers Installation Instructions 2080-IN007	Information on mounting and wiring the Micro850 24-point Controllers
Micro850 Programmable Controllers Installation Instructions 2080-IN008	Information on mounting and wiring the Micro850 48-point Controllers

Resource	Description
Micro800 16-point and 32-point 12/24V Sink/ Source Input Modules Installation Instructions 2085-IN001	Information on mounting and wiring the expansion I/O modules (2085-IQ16, 2085-IQ32T)
Micro800 Bus Terminator Module Installation Instruction 2085-IN002	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 2085-IN003	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 2085-IN004	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 2085-IN005	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 2085-IN006	Information on mounting and wiring the expansion I/O modules (2085-IF4, 2085-IF8, 2085-OF4)
Micro800 4-channel Thermocouple/RTD Input Module 2085-IN007	Information on mounting and wiring the expansion I/O module (2085-IRT4)
Micro800 RS232/485 Isolated Serial Port Plug-in Module Wiring Diagrams 2080-WD002	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 2080-WD003	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 2080-WD004	Information on mounting and wiring the Micro800 Non-isolated Unipolar Analog Output Plug-in Module.
Micro800 Non-isolated RTD Plug-in Module Wiring Diagrams 2080-WD005	Information on mounting and wiring the Micro800 Non-isolated RTD Plug-in Module.
Micro800 Non-isolated Thermocouple Plug-in Module Wiring Diagrams 2080-WD006	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 2080-WD007	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 2080-WD008	Information on mounting and wiring the Micro800 6-Channel Trimpot Analog Input Plug-In Module.
Micro800 Digital Relay Output Plug-in Module Wiring Diagrams 2080-WD010	Information on mounting and wiring the Micro800 Digital Relay Output Plug-in Module.
Micro800 Digital Input, Output, and Combination Plug-in Modules Wiring Diagrams 2080-WD011	Information on mounting and wiring the Micro800 Digital Input, Output, and Combination Plug-in Modules.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, http://ab.com	Provides declarations of conformity, certificates, and other certification details.

Resource	Description
Application Considerations for Solid-State Controls SGI-1.1	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 AG-7.1	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 for your Micro800 at the URL below.

http://ab.rockwellautomation.com/Programmable-Controllers/Connected-Components-Workbench-Software.

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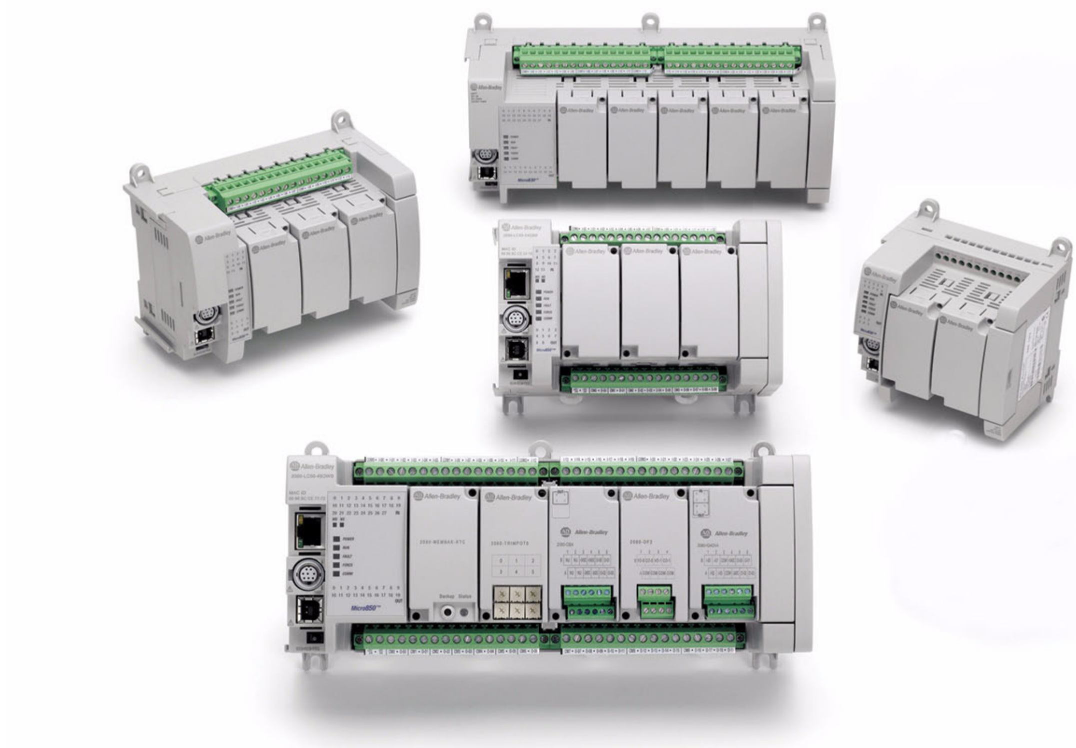
Hardware Overview



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

Topic	Page
Hardware Features	1
Micro830 Controllers	2
Micro850 Controllers	4
Programming Cables	6
Embedded Serial Port Cables	7
Embedded Ethernet Support	7

Hardware Features

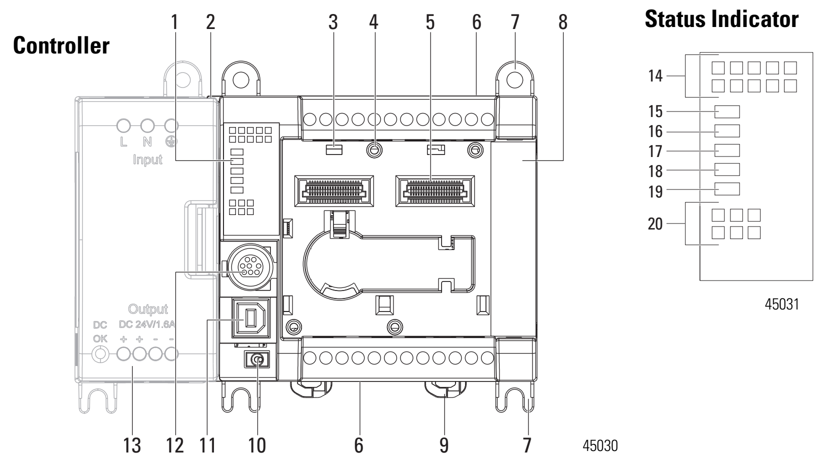
Micro830 and Micro850 controllers are an economical brick style controllers with embedded inputs and outputs. Depending on the controller type, it can accommodate from two to five plug-in modules. The Micro850 controller has expandable features and can additionally support up to four expansion I/O modules.

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

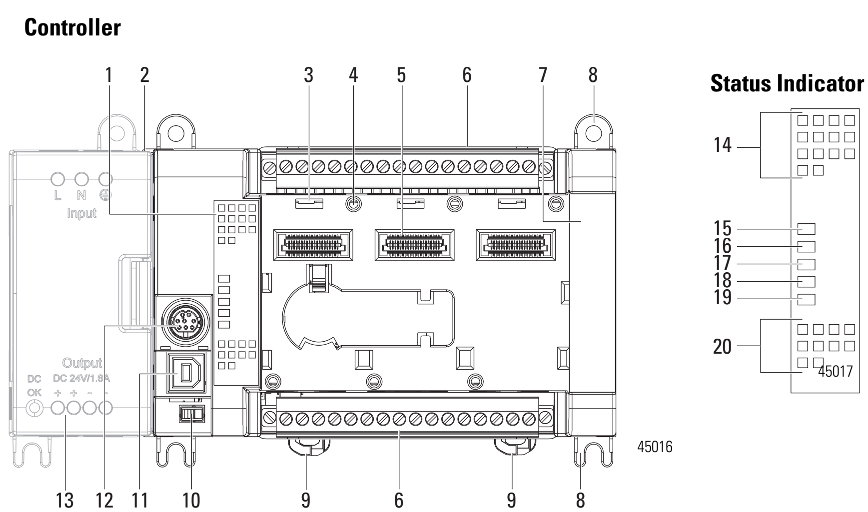
See Troubleshooting on page 305 for descriptions of status indicator operation for troubleshooting purposes.

Micro830 Controllers

Micro830 10/16-point Controllers and Status Indicators

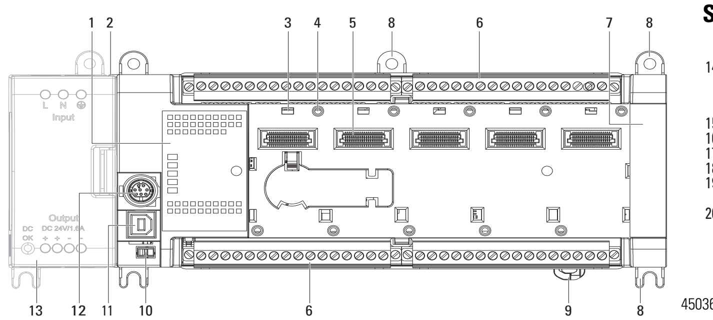


Micro830 24-point Controllers and Status Indicators

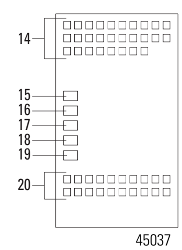


Micro830 48-point Controllers and Status Indicators

Controller



Status Indicator



Controller Description

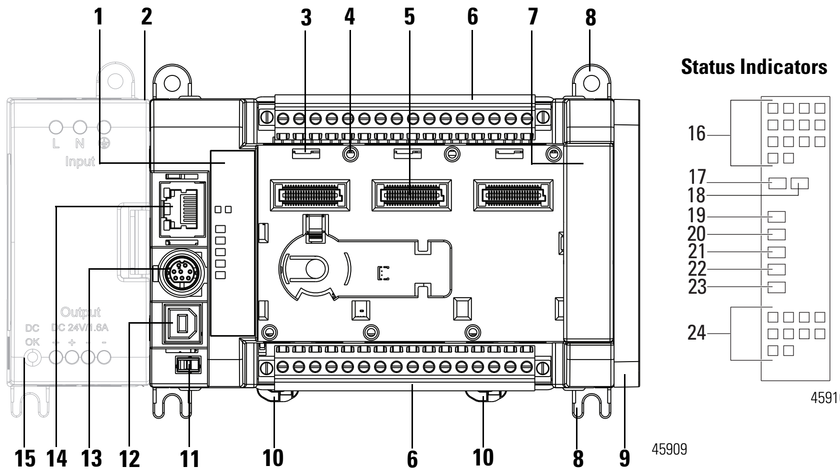
	Description		Description
1	Status indicators	8	Mounting screw hole / mounting foot
2	Optional power supply slot	9	DIN rail mounting latch
3	Plug-in latch	10	Mode switch
4	Plug-in screw hole	11	Type B connector USB port
5	40 pin high speed plug-in connector	12	RS232/RS485 non-isolated combo serial port
6	Removable I/O terminal block	13	Optional AC power supply
7	Right-side cover		

Status Indicator Description

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

Micro850 Controllers

Micro850 24-point Controllers and Status Indicators



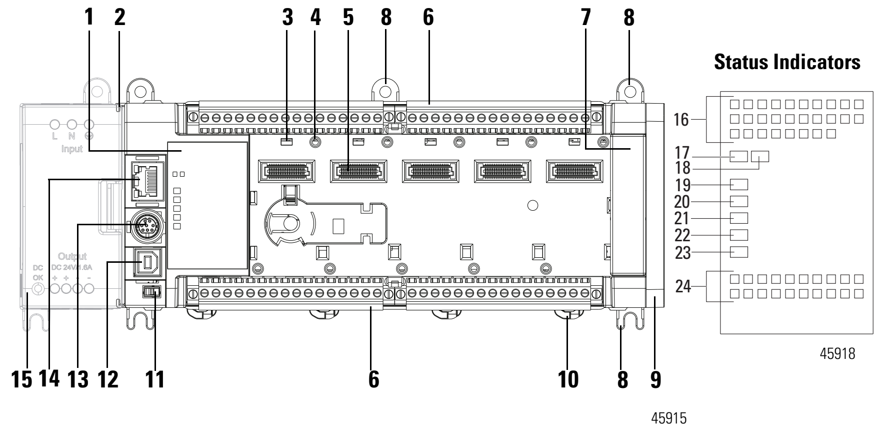
Controller Description

	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

	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		

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
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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 LEDs)
7	Right-side cover	15	Optional AC power supply
8	Mounting screw hole / mounting foot		

Status Indicator Description

	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		

Micro830 Controllers – Number and Type 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-LC30-24QBB		14			10	2	4
2080-LC30-24QVB		14		10		2	4
2080-LC30-24QWB		14	10				4
2080-LC30-48AWB	28		20				
2080-LC30-48QBB		28			20	3	6
2080-LC30-48QVB		28		20		3	6
2080-LC30-48QWB		28	20				6

Micro850 Controllers – Number and Types of Inputs and 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-LC50-24QBB		14			10	2	4
2080-LC50-24QVB		14		10		2	4
2080-LC50-24QWB		14	10				4
2080-LC50-48AWB	28		20				
2080-LC50-48QBB		28			20	3	6
2080-LC50-48QVB		28		20		3	6
2080-LC50-48QWB		28	20				6

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.

45221

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[1]		8-pin Mini DIN to 9-pin D Shell	0.5 m (1.5 ft)	1761-CBL-AP00[1]
8-pin Mini DIN to 8-pin Mini DIN	2 m (6.5 ft)	1761-CBL-HM02[1]		8-pin Mini DIN to 9-pin D Shell	2 m (6.5 ft)	1761-CBL-PM02[1]
				8-pin Mini DIN to 6-pin RS-485 terminal block	30 cm (11.8in.)	1763-NC01 series A

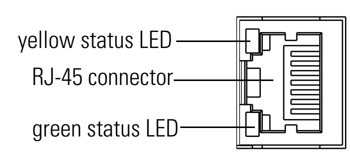
(1) Series C or later for Class 1 Div 2 applications.

Embedded Ethernet Support

For Micro850 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 Numbe r	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



45920

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

Ethernet Status Indication

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

- Module status
- Network status

See Troubleshooting on page 305 for descriptions of Module and Network status indicators.

About Your Controller

Programming Software for Micro800 Controllers

Connected Components Workbench 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 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

A free download is available at:

http://ab.rockwellautomation.com/Programmable-Controllers/Connected-Components-Workbench-Software

Use Connected Components Workbench

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).

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
- C-Tick 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 2004/108/EC Electromagnetic Compatibility (EMC) 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 2006/95/ECLow Voltage, 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[1]) to reduce the effects of electrical interference (Over Voltage Category II[2]) 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, Division2 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

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, V2, V1, V0 (or equivalent) if non-metallic. 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 additional 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

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:
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.	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.
EXPLOSION HAZARD • Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous. • 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. • Substitution of any component may impair suitability for Class I, Division 2. • If this product contains batteries, they must only be changed in an area known to be nonhazardous.	**RISQUE D'EXPLOSION** • Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement. • 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. • La substitution de tout composant peut rendre cet équipement inadapté à une utilisation en environnement de Classe I, Division 2. • S'assurer que l'environnement est classé non dangereux avant de changer les piles.

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. Refer to the figures on pages 19 and 20.

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:

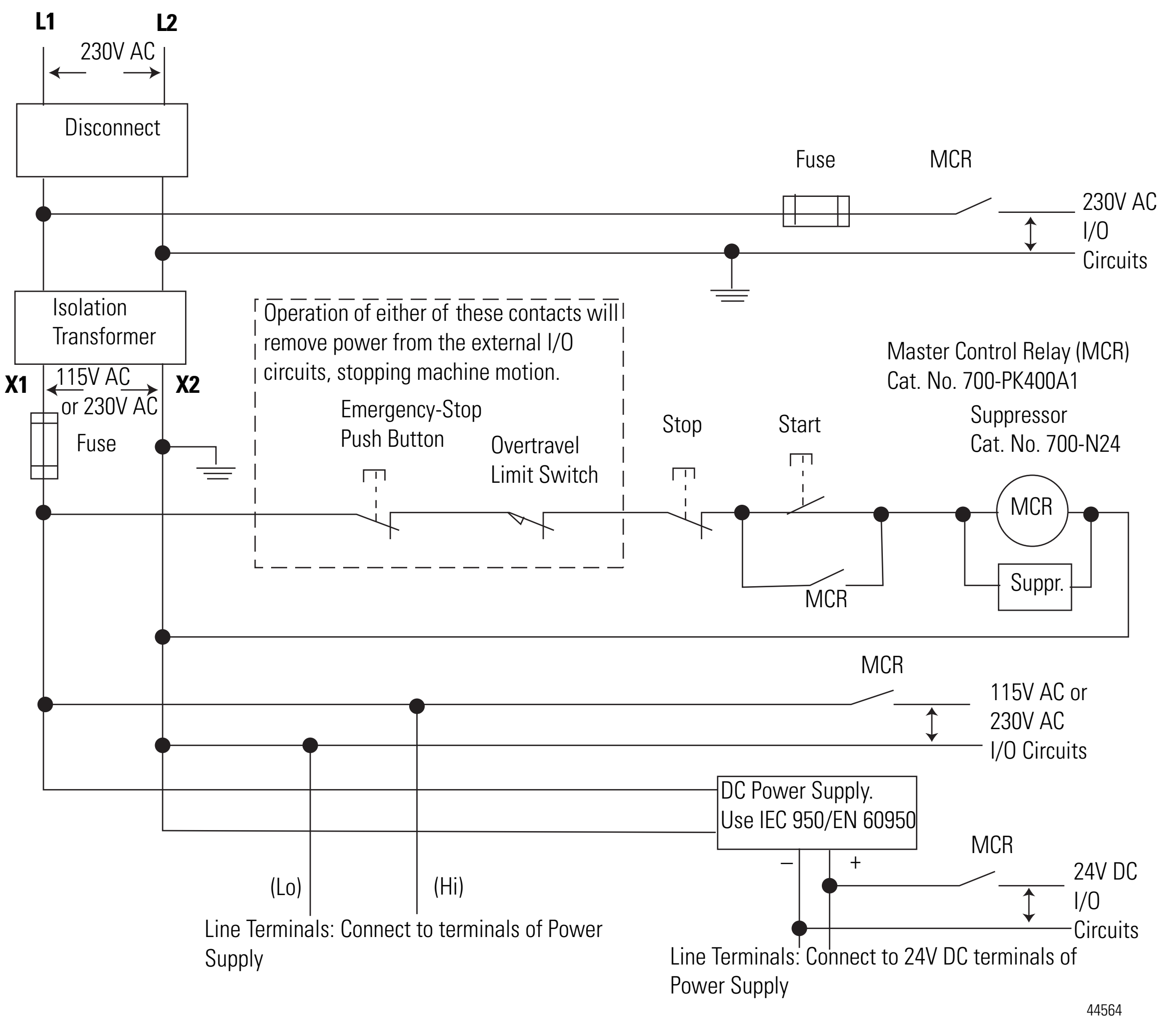
- Do not program emergency-stop switches in the controller program. Any emergency-stop switch should turn off all machine power by turning off the master control relay.
- Observe all applicable local codes concerning the placement and labeling of emergency-stop switches.

- 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.

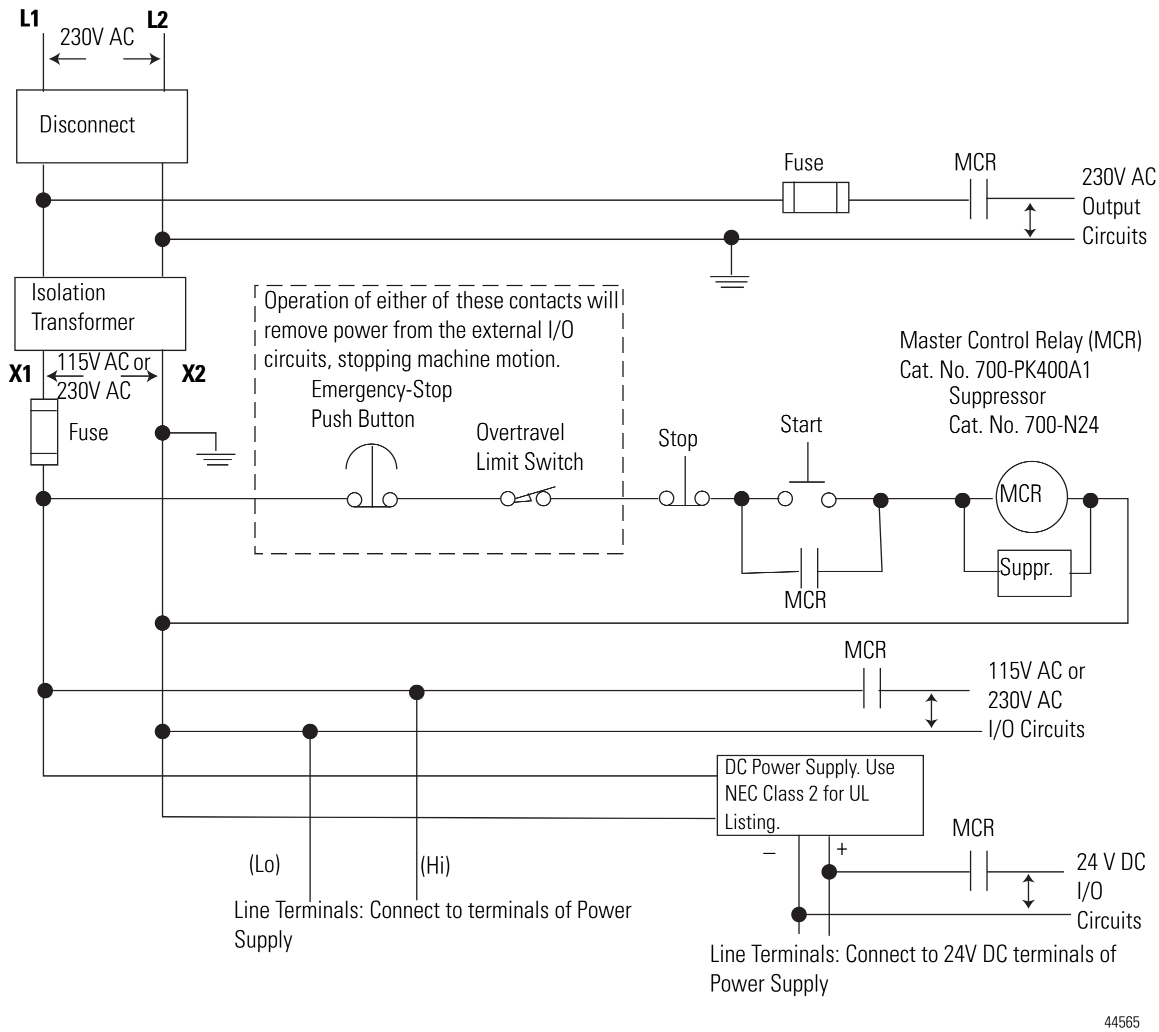
The following illustrations show the Master Control Relay wired in a grounded system.

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)



Schematic (Using ANSI/CSA Symbols)



Install Your Controller

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

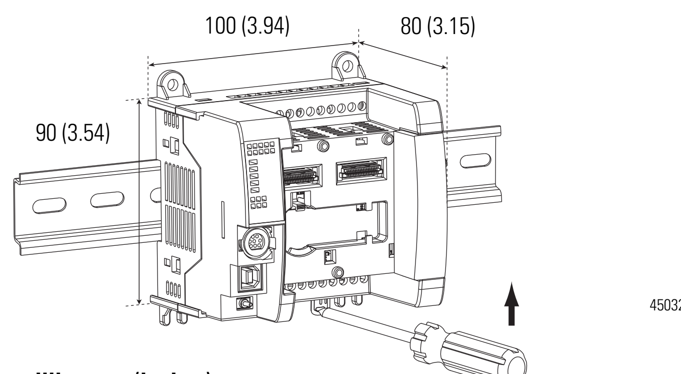
Topic	Page
Controller Mounting Dimensions	21
Mounting Dimensions	21
DIN Rail Mounting	23
Panel Mounting	24

Controller Mounting Dimensions

Mounting Dimensions

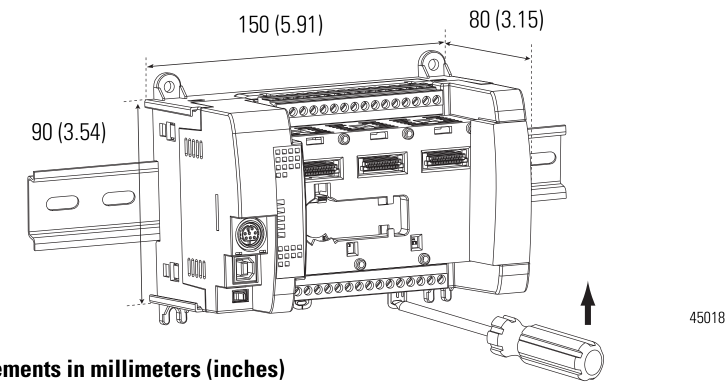
Mounting dimensions do not include mounting feet or DIN rail latches.

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



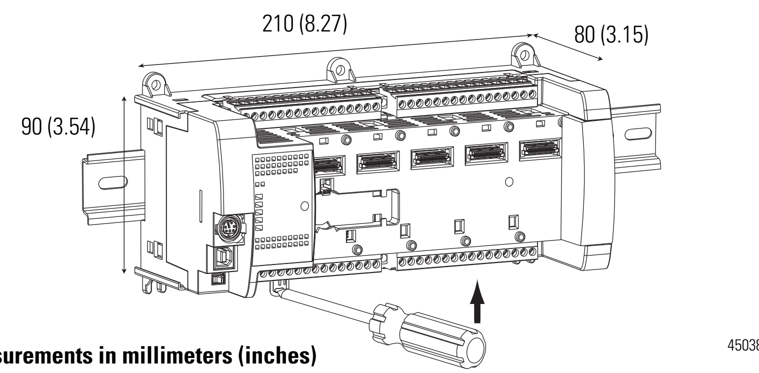
Measurements in millimeters (inches)

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



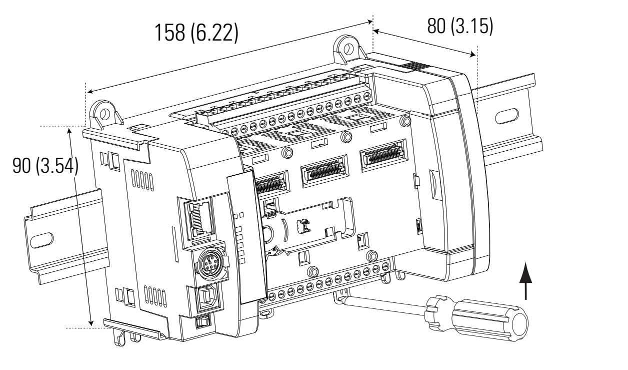
Measurements in millimeters (inches)

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



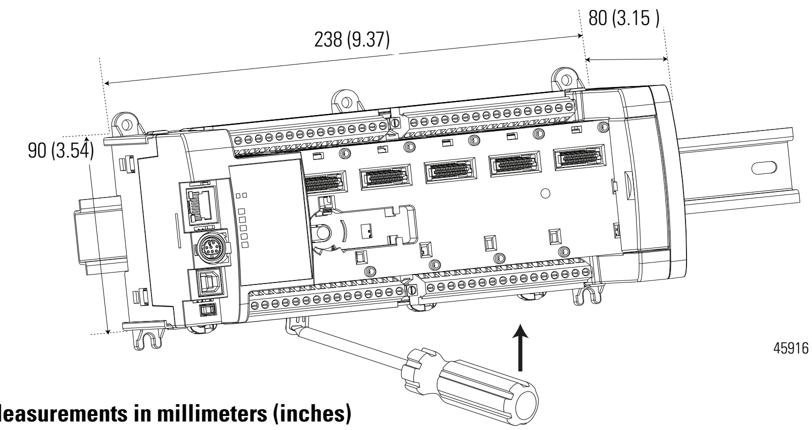
Measurements in millimeters (inches)

Micro850 24-Point Controllers
2080-LC50-24AWB, 2080-LC50-24QBB, 2080-LC50-24QVB, 2080-LC50-24QWB



Measurements in millimeters (inches)

Micro850 48-Point Controllers
2080-LC50-48AWB, 2080-LC50-48QWB, 2080-LC50-48QBB, 2080-LC50-48QVB



Measurements in millimeters (inches)

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: ±0.4 mm (0.016 in.).

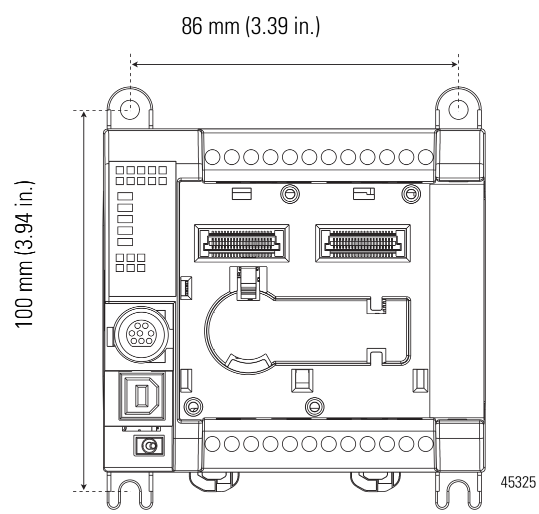
Follow these steps to install your controller using mounting screws.

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.

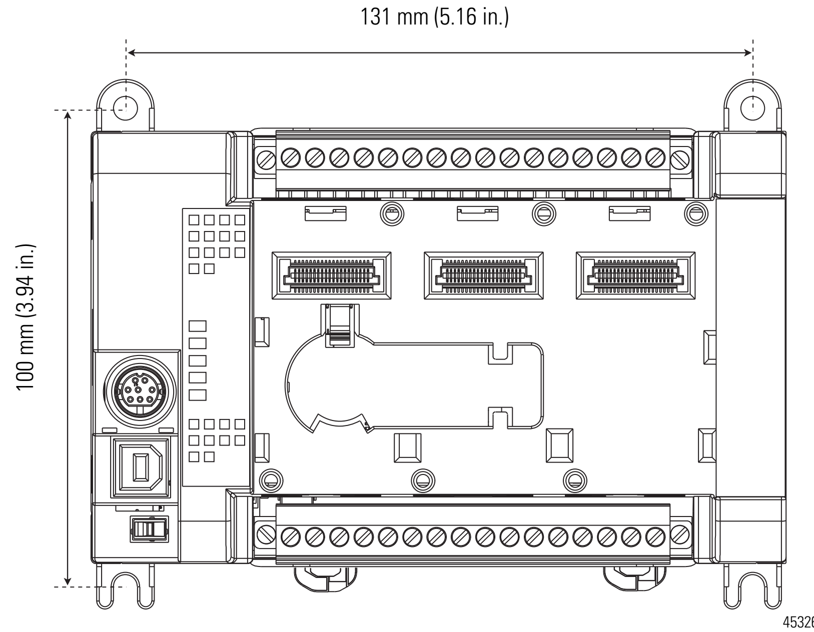
IMPORTANT	For instructions on how to install your Micro800 expansion I/O, see Expansion I/O Support on page 55.

Panel Mounting Dimensions

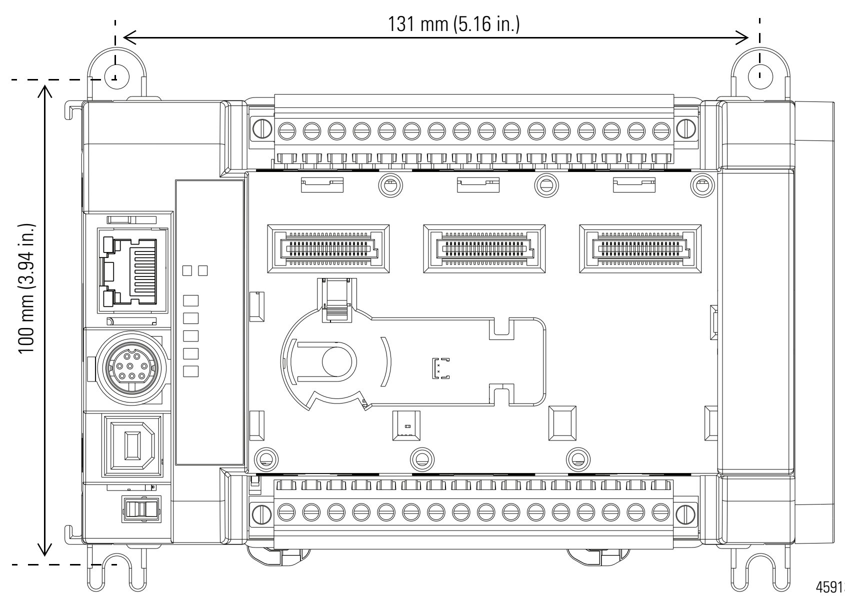
Micro830 10- and 16-Point Controllers
2080-LC30-10QWB, 2080-LC30-10QVB, 2080-LC30-16AWB, 2080-LC30-16QWB, 2080-LC30-16QVB



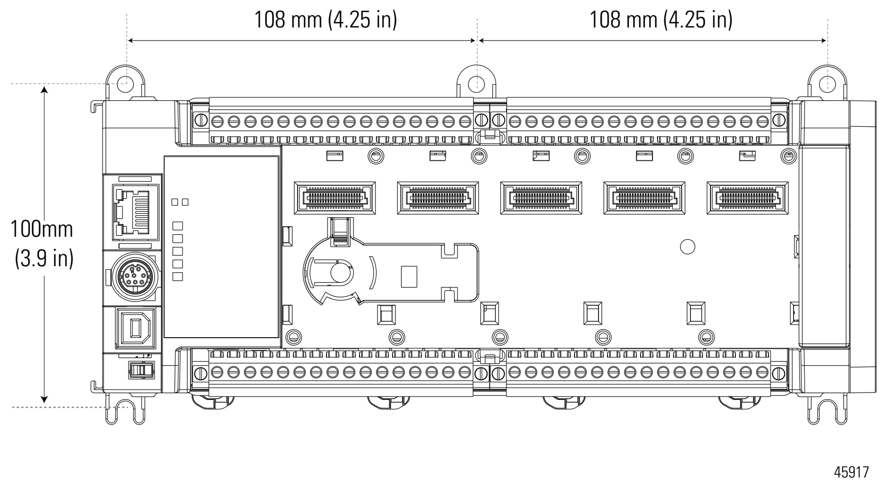
Micro830 24-Point Controllers
2080-LC30-24QWB, 2080-LC30-24QVB, 2080-LC30-24QBB



Micro850 24-Point Controllers
2080-LC50-24AWB, 2080-LC50-24QBB, 2080-LC50-24QVB, 2080-LC50-24QWB

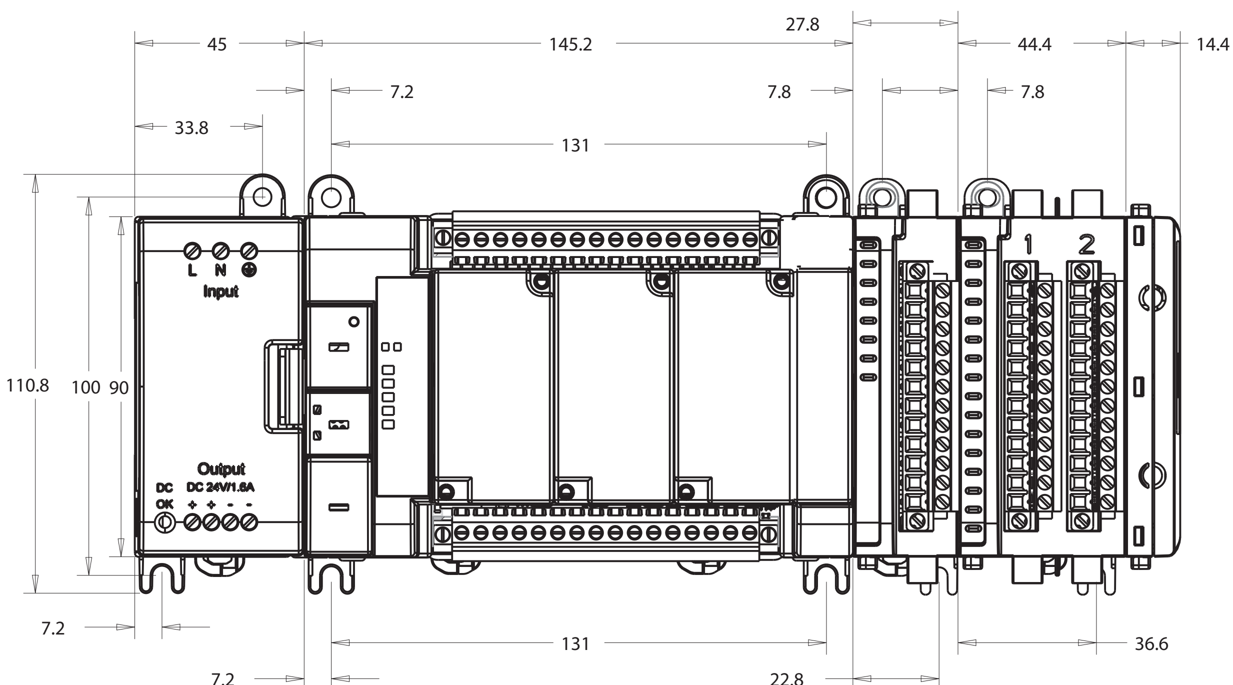


Micro830 48-Point Controllers
2080-LC30-48AWB, 2080-LC30-48QWB, 2080-LC30-48QVB, 2080-LC30-48QBB



System Assembly

Micro830 and Micro850 24-point Controllers (Front)

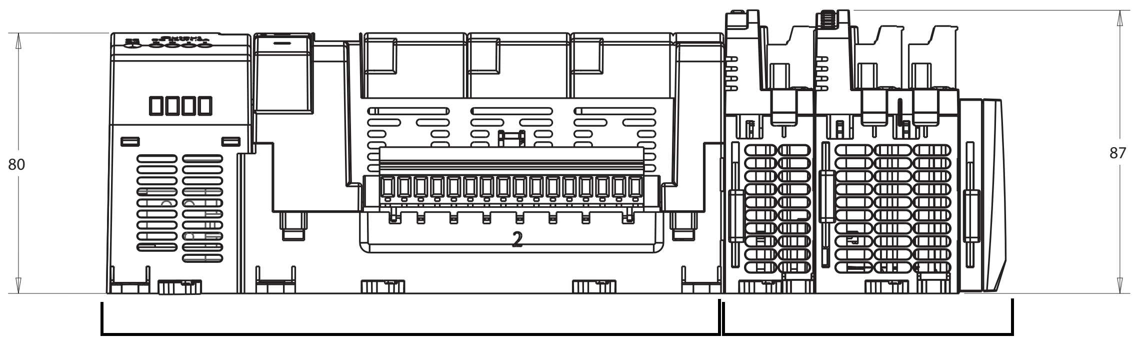


Micro830/Micro850 24pt Controller with Micro800 Power Supply

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

Measurements in millimeters

Micro830 and Micro850 24-point Controllers (Side)

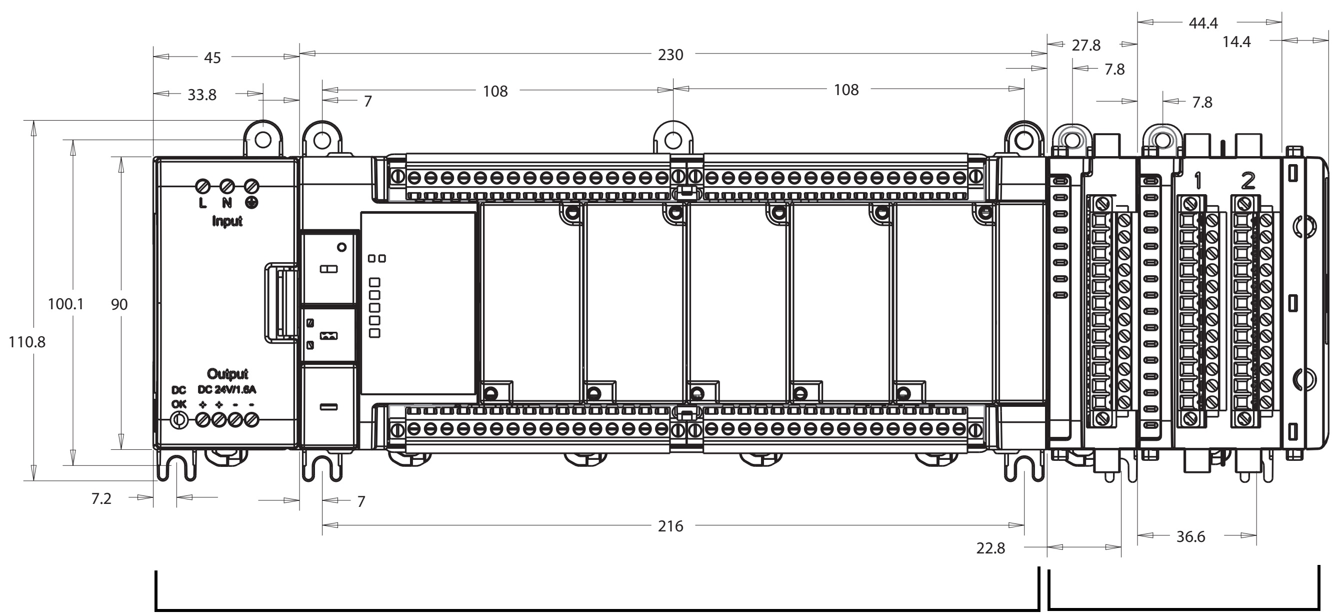


Micro830/Micro850 24pt Controller with Micro800 Power Supply

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

Measurements in millimeters

Micro830 and Micro850 48-point Controllers (Front)

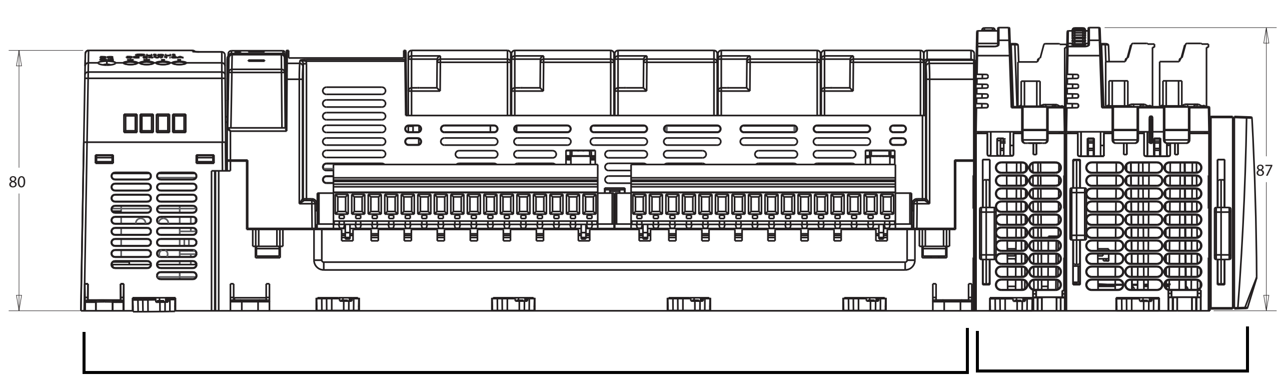


Micro830/Micro850 48pt Controller with Micro800 Power Supply

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

Measurements in millimeters

Micro830 and Micro850 48-point Controllers (Side)



Micro830/Micro850 48pt Controller with Micro800 Power Supply

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

Measurements in millimeters

Wire Your Controller

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

Topic	Page
Wiring Requirements and Recommendation	29
Use Surge Suppressors	30
Recommended Surge Suppressors	32
Grounding the Controller	33
Wiring Diagrams	33
Controller I/O Wiring	36
Minimize Electrical Noise	37
Analog Channel Wiring Guidelines	37
Minimize Electrical Noise on Analog Channels	37
Grounding Your Analog Cable	38
Wiring Examples	38
Plug-In Module Wiring	39
2080-OF2	40
2080-IF4 Terminal Block Wiring	41
Embedded Serial Port Wiring	41

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.

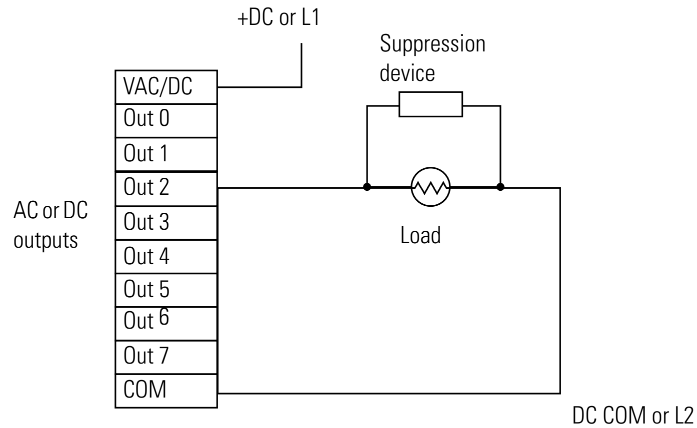
Wire Requirements

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

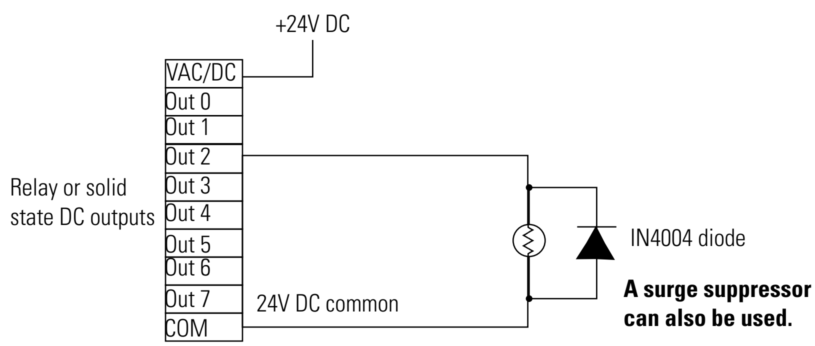
Use Surge Suppressors

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.

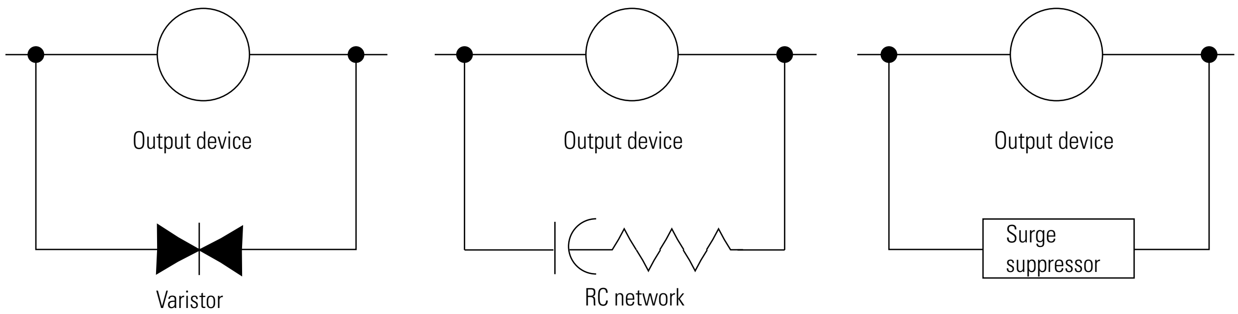


If the outputs are DC, we recommend that you use an 1N4004 diode for surge suppression, as shown below. For inductive DC load devices, a diode is suitable. A 1N4004 diode is acceptable for most applications. A surge suppressor can also be used. See Recommended Surge Suppressors on page 32. As shown below, 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 32 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[4]
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	Diode
Bulletin 100C, (C09 - C97)	24…48V AC	100-FSC48[1]	RC
	110…280V AC	100-FSC280[1]	
	380…480V AC	100-FSC480[1]	
	12…55V AC, 12…77V DC	100-FSV55[1]	MOV
	56…136V AC, 78…180V DC	100-FSV136[1]	
	137…277V AC, 181…250V DC	100-FSV277[1]	
	278…575V AC	100-FSV575[1]	
	12…250V DC	100-FSD250[1]	Diode
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[4]
Bulletin 509 Motor Starter Size 6	12…120V AC	199-FSMA1[2]	RC
	12…120V AC	199-GSMA1[3]	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 limted 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.

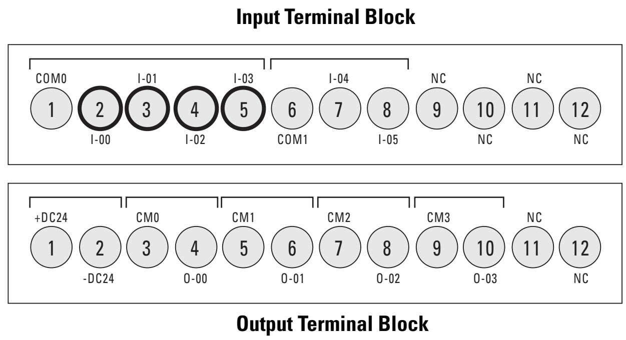
This product is intended to be mounted to a well grounded mounting surface such as a metal panel. Refer to the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1, for additional information.

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.

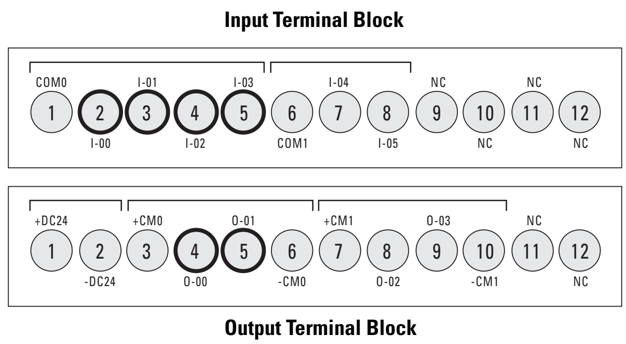
High-speed inputs and outputs are indicated by ◯.

2080-LC30-10QWB



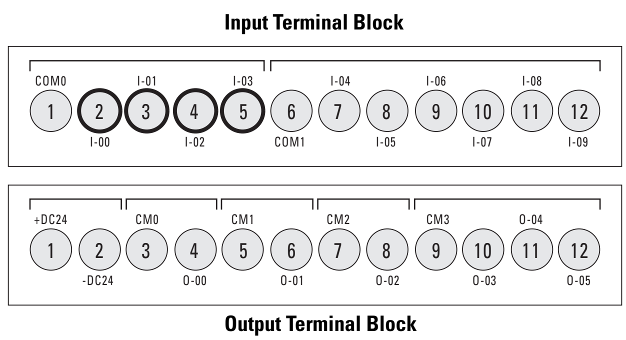
45033

2080-LC30-10QVB



45034

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

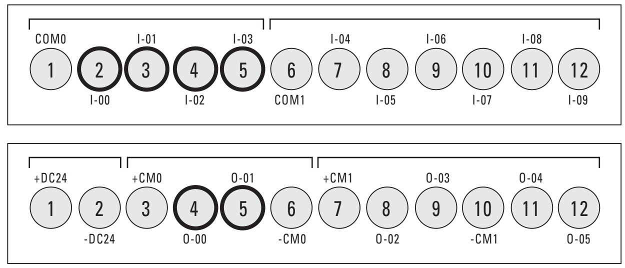


45028

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

2080-LC30-16QVB

Input Terminal Block

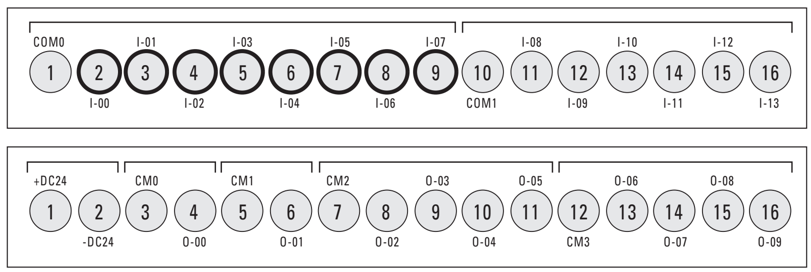


Output Terminal Block

45029

2080-LC30-24QWB / 2080-LC50-24AWB / 2080-LC50-24QWB

Input Terminal Block

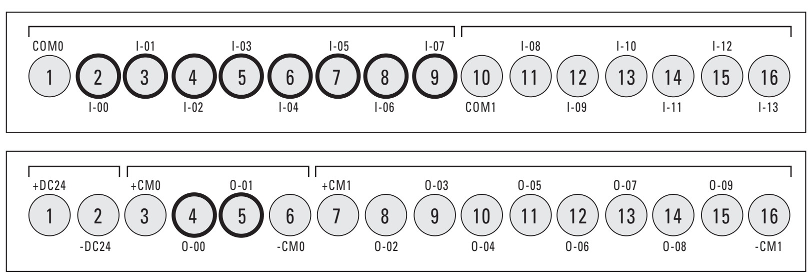


45019

Output Terminal Block

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

Input Terminal Block

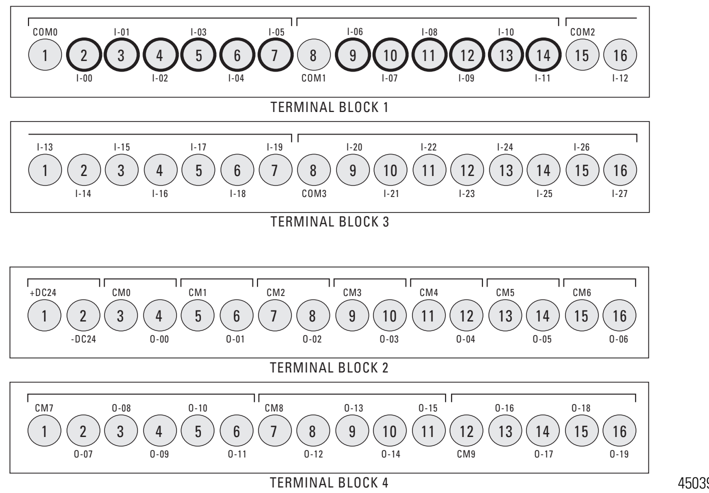


45020

Output Terminal Block

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

Input Terminal Block

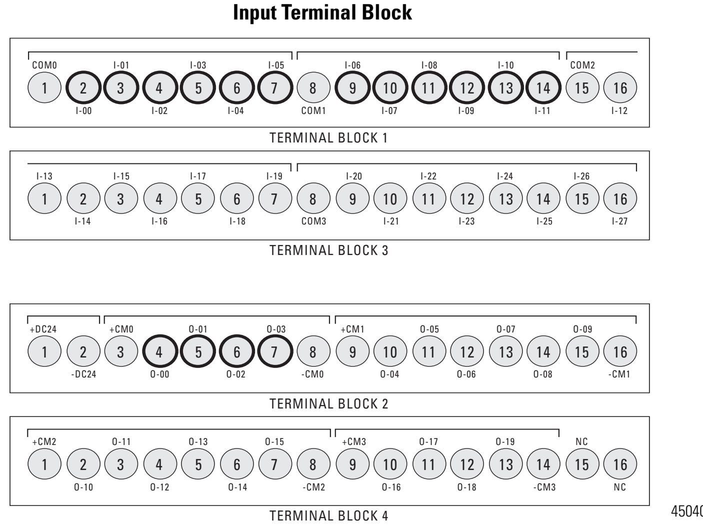


Output Terminal Block

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

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

Input Terminal Block



Output Terminal Block

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

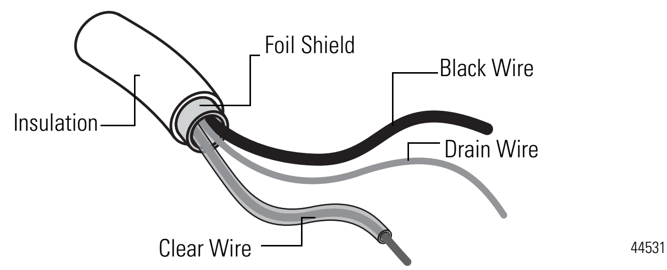
Inputs on analog channels employ digital high-frequency filters that significantly reduce the effects of electrical noise on input signals. However, because of the variety of applications and environments where analog controllers are installed and operated, it is impossible to ensure that all environmental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

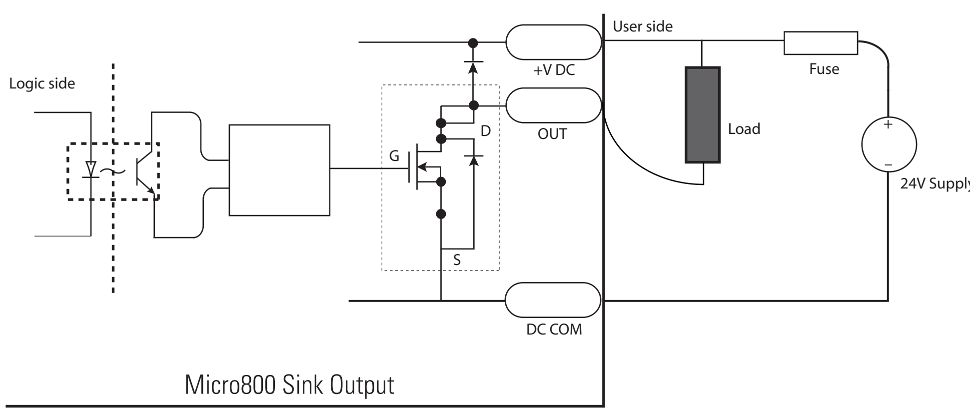


IMPORTANT	Do not ground the drain wire and foil shield at both ends of the cable.

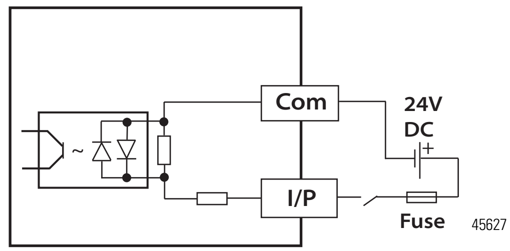
Wiring Examples

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

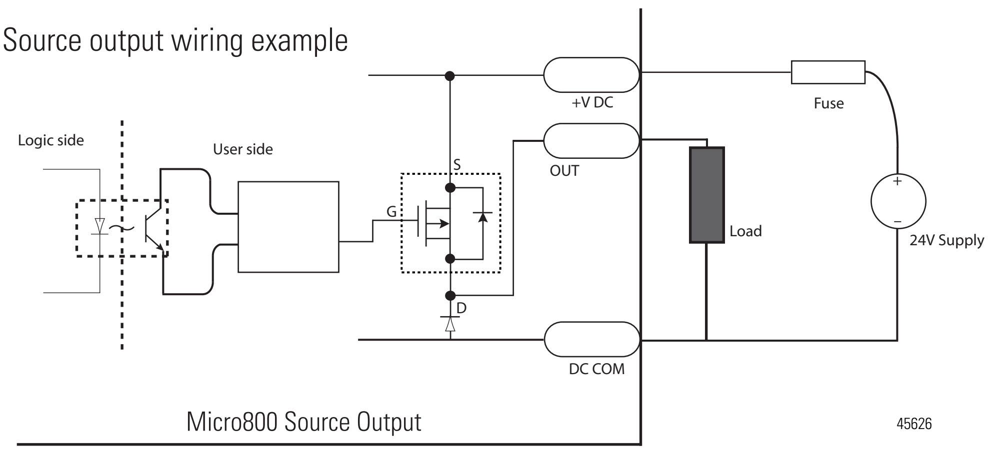
Sink output wiring example



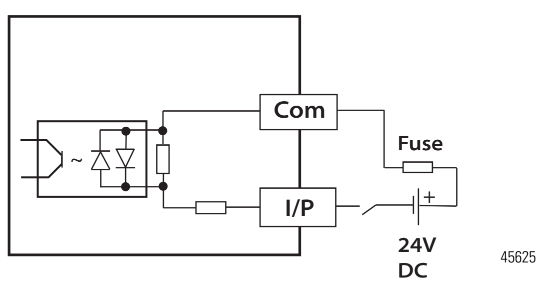
Sink input wiring example



Source output wiring example



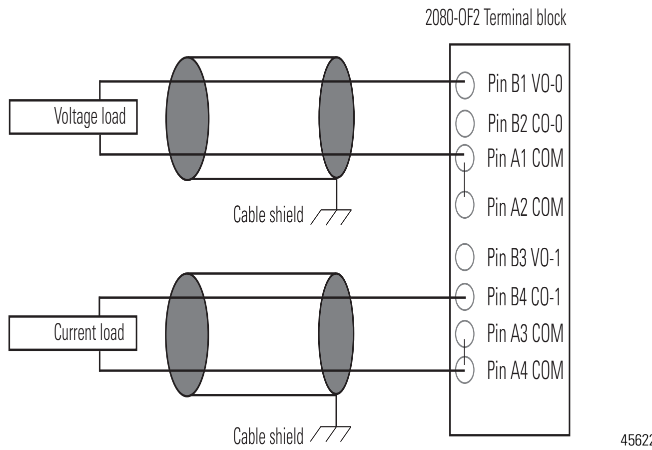
Source input wiring example



Plug-In Module Wiring

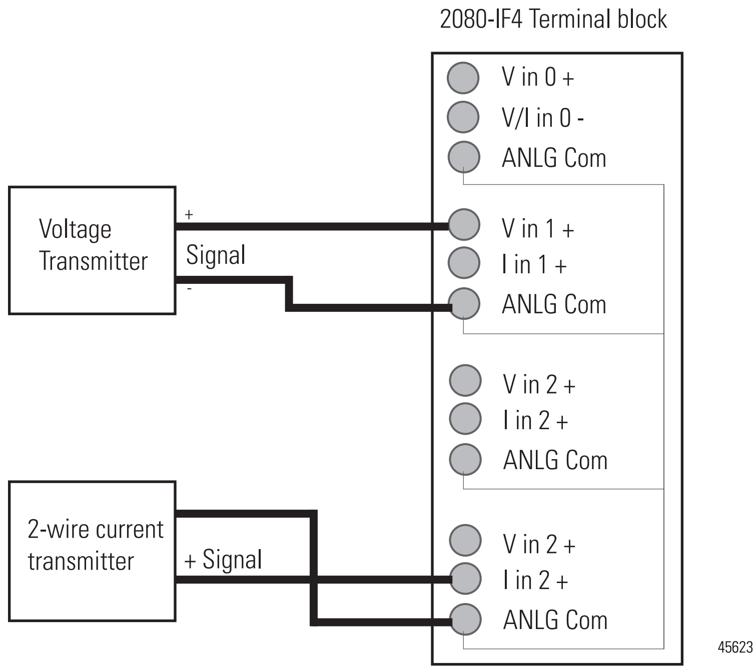
The following diagrams show additional wiring information that supplements the Wiring Diagrams included with your plug-in module.

2080-OF2



ATTENTION: A1…A4 are shorted to the main ground. There is no isolation between field and main unit power supply.

2080-IF4 Terminal Block Wiring



ATTENTION: Analog inputs are not isolated.

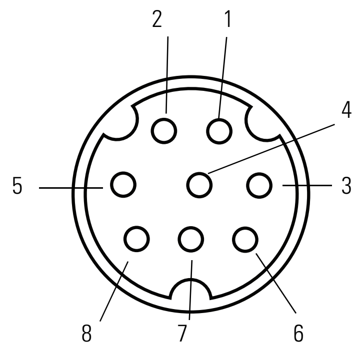
Embedded Serial Port Wiring

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 7 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)

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	43
Use Modems with Micro800 Controllers	46
Configure Serial Port	47
Configure Ethernet Settings	53

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

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

In addition, the Micro850 controller has an RJ-45 Ethernet port.

Supported Communication Protocols

Micro830/Micro850 controllers support the following communication protocols through the embedded RS-232/485 serial port as well as any installed serial port plug-in modules:

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

In addition, the embedded Ethernet communication channel allows your Micro850 controller to be connected to a local area network for various devices providing 10 Mbps/100 Mbps transfer rate. Micro850 controllers support the following Ethernet protocols:

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

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 249 for information on Modbus mapping. To configure the Serial port as Modbus RTU, see Configure Modbus RTU on page 50.

Modbus/TCP Server

The Modbus/TCP 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.

The Micro850 controller supports up to 16 simultaneous Modbus TCP Server connections.

No protocol configuration is required other than configuring the Modbus mapping table. For information on Modbus mapping, see Modbus Mapping for Micro800 on page 249.

CIP Symbolic 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 controller.

Micro850 controllers support up to 16 simultaneous EtherNet/IP server connections.

CIP Serial, supported on both Micro830 and Micro850 controllers, makes use of DF1 Full Duplex protocol, which provides point-to-point connection between two devices. It combines data transparency (American National Standards Institute ANSI - X3.28-1976 specification subcategory D1) and 2-way simultaneous transmission with embedded responses (subcategory F1).

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), or other controllers that support CIP Serial over DF1 Full-Duplex, such as ControlLogix and CompactLogix controllers that have embedded serial ports.

To configure CIP Serial, see Configure CIP Serial Driver on page 48.

To configure for EtherNet/IP, see Configure Ethernet Settings on page 53.

CIP Symbolic Addressing

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

Supported Data Types in CIP Symbolic

Data Type[1]	Description
BOOL	Logical Boolean with values TRUE and FALSE
SINT	Signed 8-bit integer value
INT	Signed 16-bit integer value
DINT	Signed 32-bit integer value
LINT[2]	Signed 64-bit integer value
USINT	Unsigned 8-bit integer value
UINT	Unsigned 16-bit integer value
UDINT	Unsigned 32-bit integer value
ULINT[2]	Unsigned 64-bit integer value
REAL	32-bit floating point value
LREAL[2]	64-bit floating point value
STRING	character string (1 byte per character)
SHORT_STRING[2]	character string (1 byte per character, 1 byte length indicator)

(1) Logix MSG instruction can read/write SINT, INT, DINT, LINT and REAL datatypes using "CIP Data Table Read" and "CIP Data Table Write" message types.
BOOL, USINT, UINT, UDINT, ULINT, LREAL, STRING and SHORT_STRING datatypes are not accessible with the Logix MSG instruction.

(2) Not supported in PanelView Component.

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 RS-232 port for the ASCII driver. Refer to the Connected Components Workbench Online Help for more information.

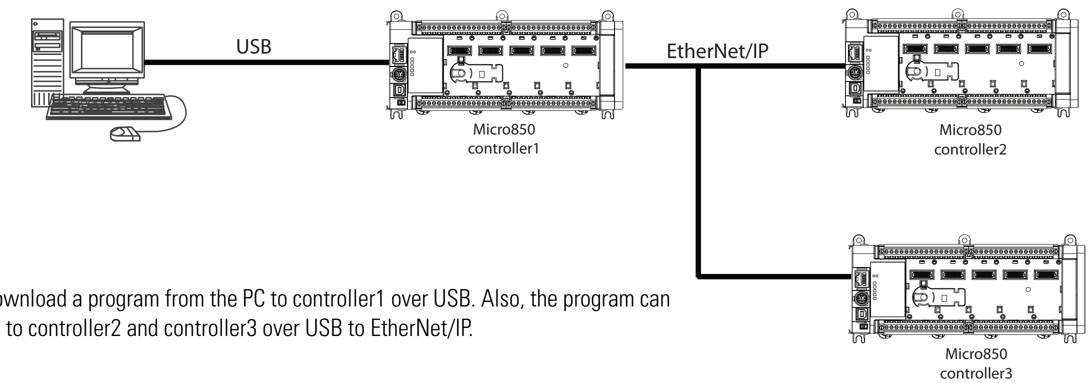
To configure the serial port for ASCII, see Configure ASCII on page 51.

CIP Communications Pass-thru

The Micro830 and Micro850 controllers support pass-thru on any communications port that supports Common Industrial Protocol (CIP). The maximum number of supported hops is **two**. 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.

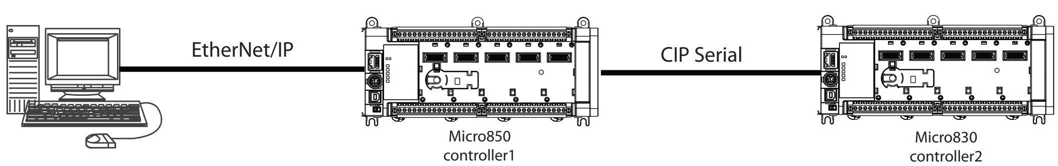
Examples of Supported Architectures

USB to EtherNet/IP



The user can download a program from the PC to controller1 over USB. Also, the program can be downloaded to controller2 and controller3 over USB to EtherNet/IP.

EtherNet/IP to CIP Serial



IMPORTANT	Micro800 controllers do not support three hops (for example, from EtherNet/IP → CIP Serial → EtherNet/IP).

Use Modems with Micro800 Controllers

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

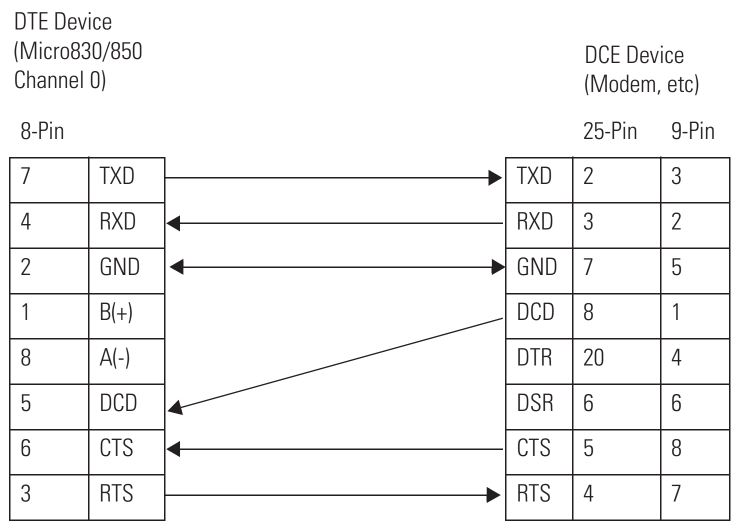
Making a DF1 Point-to-Point Connection

You can connect the Micro830 and Micro850 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:

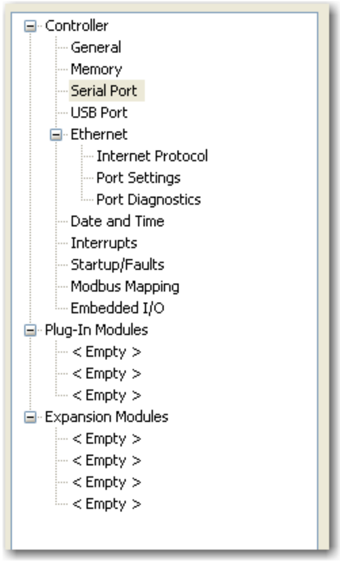


Configure Serial Port

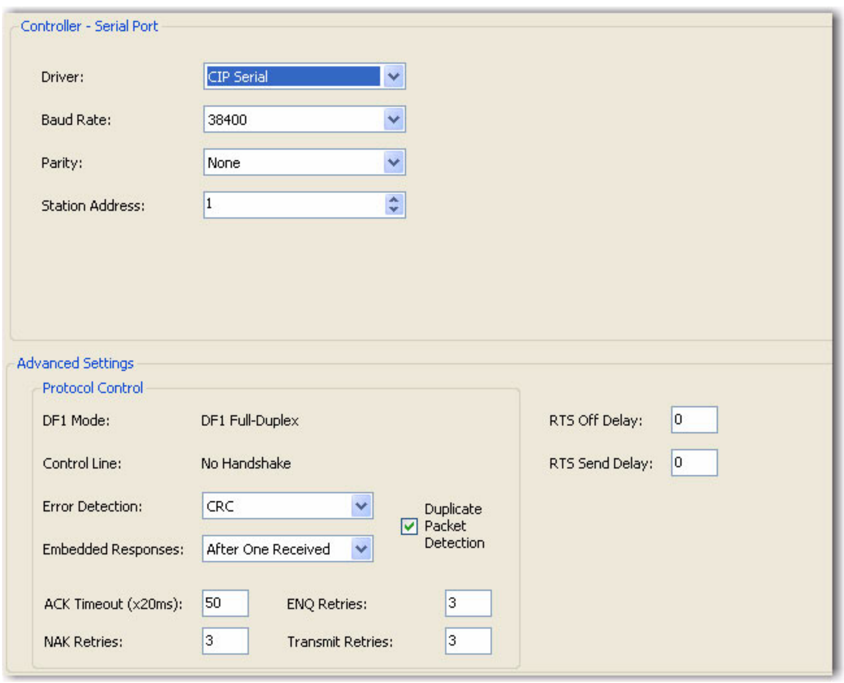
You can configure the Serial Port driver as CIP Serial, Modbus RTU, ASCII or Shutdown through the Device Configuration tree in Connected Components Workbench.

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.

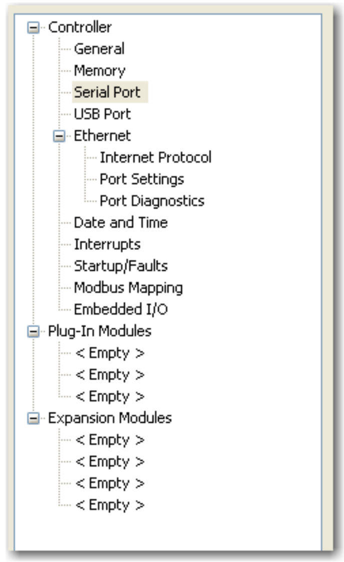
5. Click Advanced Settings and set Advanced parameters.
   Refer to the table CIP Serial Driver Parameters on page 49 for a description of the CIP Serial parameters.

CIP Serial Driver Parameters

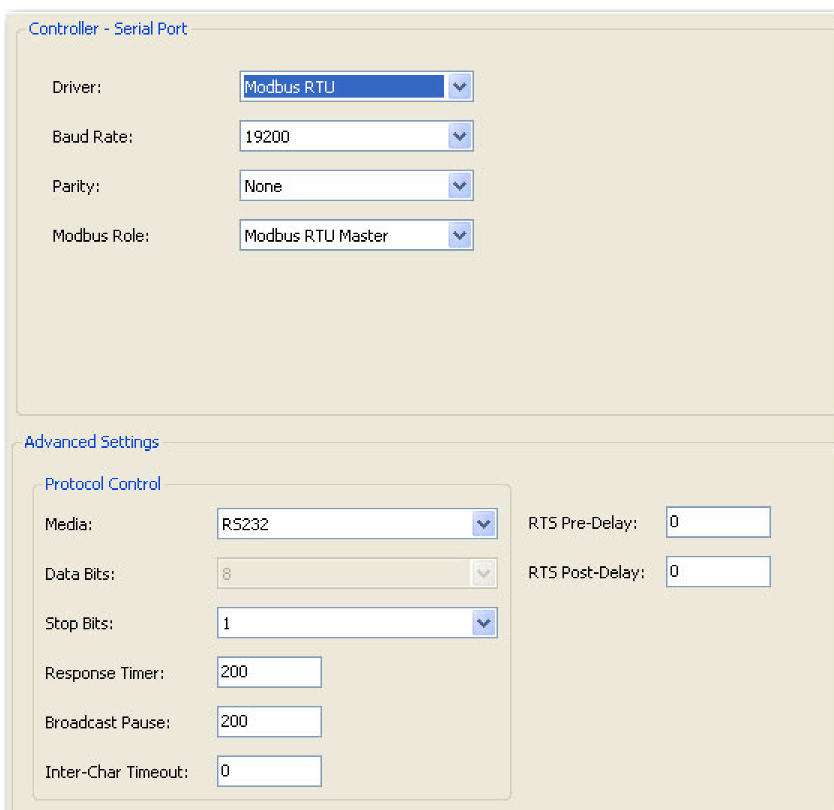
Parameter	Options	Default
Baud rate	Toggles between the communication rate of 1200, 2400, 4800, 9600, 19200, and 38400.	38400
Parity	Specifies the parity setting for the serial port. Parity provides additional message-packet error detection. Select Even, Odd, or None.	None
Station Address	The station 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
RTS Off Delay	Specifies the delay time between when the last serial character is sent to the modem and when RTS will be deactivated. Gives modem extra time to transmit the last character of a packet. The valid range is 0–255 and can be set in increments of 5 ms.	0
RTS Send Delay	Specifies the time delay between setting RTS until checking for the CTS response. For use with modems that are not ready to respond with CTS immediately upon receipt of RTS. The valid range is 0… 255 and can be set in increments of 5 ms.	0

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.



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.

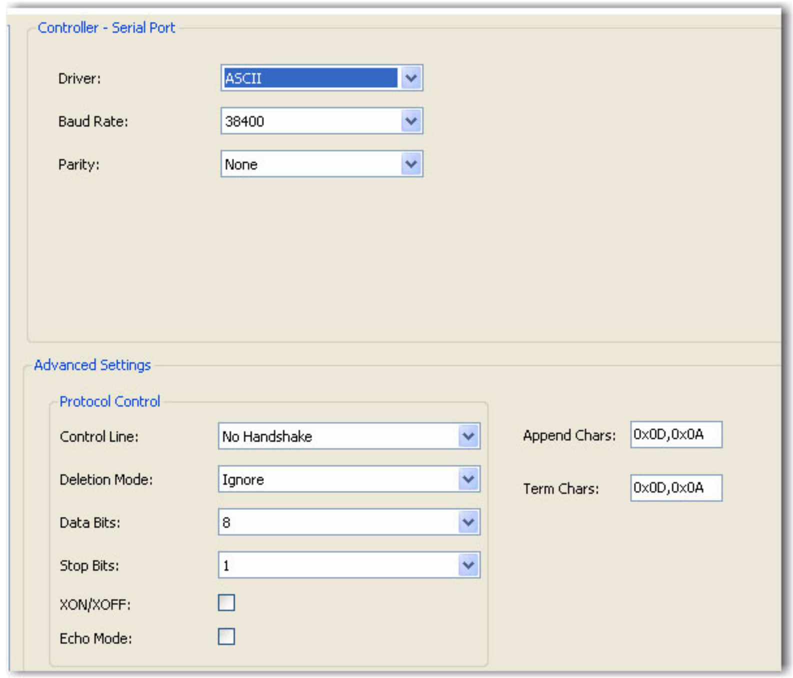
Modbus RTU Advanced Parameters

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 milliseconds	0
RTS Post-delay	0…999,999,999 milliseconds	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.

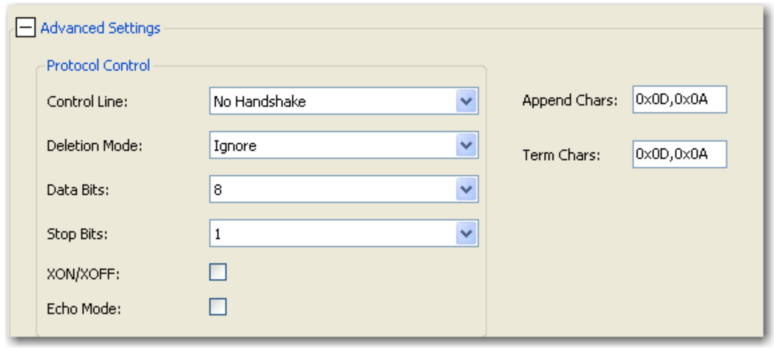


3. Specify baud rate and parity.

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.

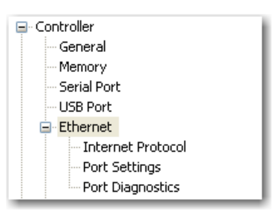


ASCII Advanced Parameters

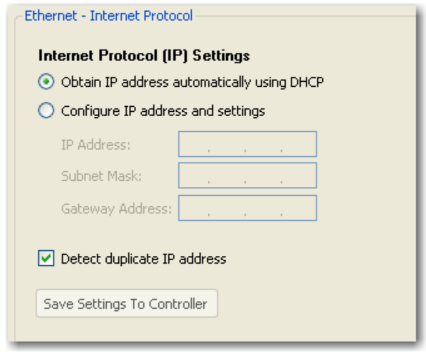
Parameter	Options	Default
Control Line	Full Duplex Half-duplex with continuous carrier Half-duplex without continuous carrier No Handshake	No Handshake
Deletion Mode	CRT Ignore Printer	Ignore
Data bits	7, 8	8
Stop bits	1, 2	1
XON/XOFF	Enabled or Disabled	Disabled
Echo Mode	Enabled or Disabled	Disabled
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.

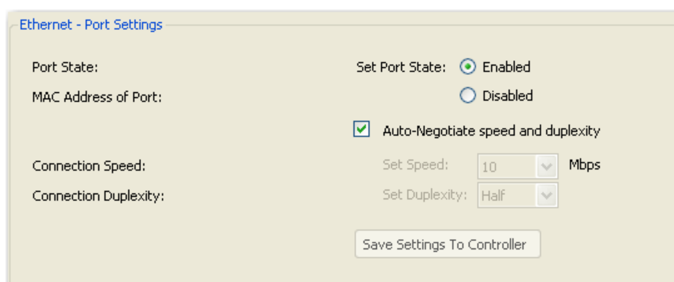


2. Under Ethernet, click Internet Protocol.
   Configure Internet Protocol (IP) settings. Specify whether to obtain the IP address automatically using DHCP or manually configure IP address, subnet mask, and gateway address.



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

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



5. Set Port State as Enabled or Disabled.
6. 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.
7. 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.

Expansion I/O Support

Micro850 controllers support a range of discrete and analog expansion I/O modules. You can attach up to four expansion I/O modules, in any combination, to a Micro850 controller, as long as the total number of embedded, plug-in, and expansion discrete I/O points is less than or equal to 132.

This chapter includes a description of features, installation and wiring requirements, configuration data structure and procedure, for Micro850 expansion I/O modules.

Topic	Page
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Hardware Features	56
Installation	58
Input/Output Wiring	61
Discrete Expansion I/O Features	70
Analog Expansion I/O Features	71
Configure Your Expansion I/O Module	79
I/O Data Mapping	94
Calibration of Analog Modules	100
Specifications	100

Micro850 Expansion I/O Modules

The following expansion I/O modules are compatible with Micro850 controllers:

Micro850 Expansion I/O Modules

Catalog Number	Type	Description
2085-IA8	Discrete	8-point, 120V AC input
2085-IM8	Discrete	8-point, 240V AC input
2085-OA8	Discrete	8-point, 120/240V AC Triac Output
2085-IQ16	Discrete	16-point, 12/24V Sink/Source Input
2085-IQ32T	Discrete	32-point, 12/24V Sink/Source Input
2085-OV16	Discrete	16-point, 12/24V DC Sink Transistor Output
2085-OB16	Discrete	16-point, 12/24V DC Source Transistor Output
2085-OW8	Discrete	8-point, AC/DC Relay Output
2085-OW16	Discrete	16-point, AC/DC Relay Output
2085-IF4	Analog	4-channel, 14-bit isolated[1] voltage/current input

Micro850 Expansion I/O Modules

Catalog Number	Type	Description
2085-IF8	Analog	8-channel, 14-bit isolated(1) voltage/current input
2085-OF4	Analog	4-channel, 12-bit isolated(1) voltage/current output
2085-IRT4	Analog	4-channel, 16-bit isolated(1) RTD and Thermocouple input module
2085-ECR	Terminator	2085 bus terminator

(1) Refers to isolation from field side wiring to controller, **not** channel-to-channel isolation.

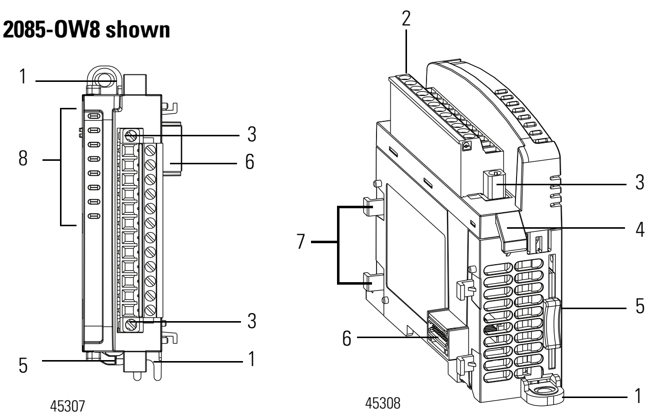
The bus terminator, 2085-ECR, serves as an end cap and terminates the end of the serial communication bus. It is **required** whenever an expansion I/O module is connected to the controller and should be connected to the last expansion I/O module in the system.

Hardware Features

Micro850 expansion I/O modules come as a single-width (87 x 28 x 90 mm, HxWxD) or double-width (87 x 46 x 90 mm, HxWxD) form factor. See specifications for Expansion I/O on page 240 to learn about your module's dimensions.

Single-width Expansion I/O

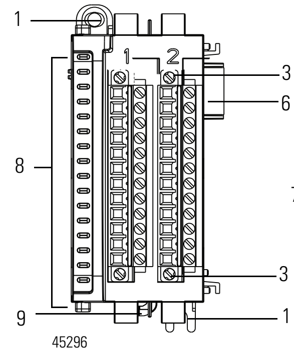
2085-OW8 shown



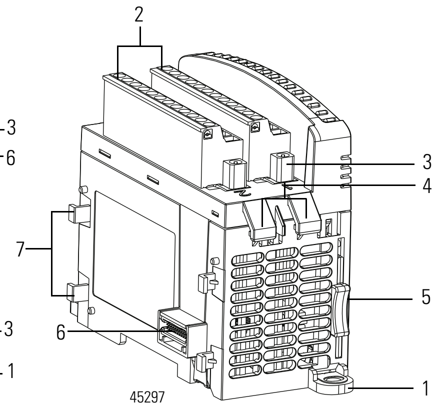
Front view **Right top view**

Double-width Expansion I/O

2085-OW16 shown



Front view



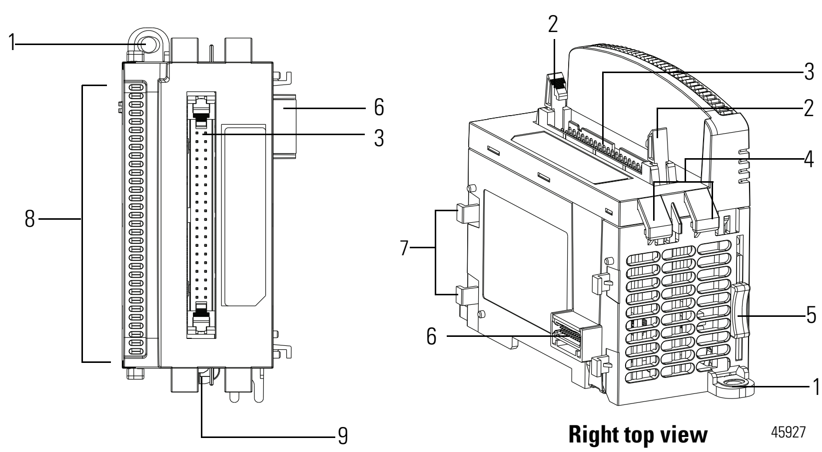
Right top view

Module Description

	Description		Description
1	Mounting screw hole / mounting foot	6	Bus connector (male/female)
2	Removable Terminal Block (RTB)(1)	7	Latch hooks
3	RTB hold down screws	8	I/O status LED
4	Cable grip	9	DIN rail mounting latch
5	Module interconnect latch		

(1) The removable terminal block has slots for mechanical keying, to prevent inadvertently making the wrong wire connections to your module. Expansion I/O modules are shipped with keys.

2085-IQ32T Hardware Features



Right top view

2085-IQ32T Hardware Components

	Description		Description
1	Mounting screw hole / mounting foot	6	bus connector (male and female)
2	Connector	7	latch hooks

2085-IQ32T Hardware Components

	Description		Description
3	Connector retaining arm	8	I/O status LEDs
4	Cable grip	9	DIN rail mounting latch
5	Module interconnecting latch		

Installation

To install the Micro850 expansion I/O, you need to perform the following steps.

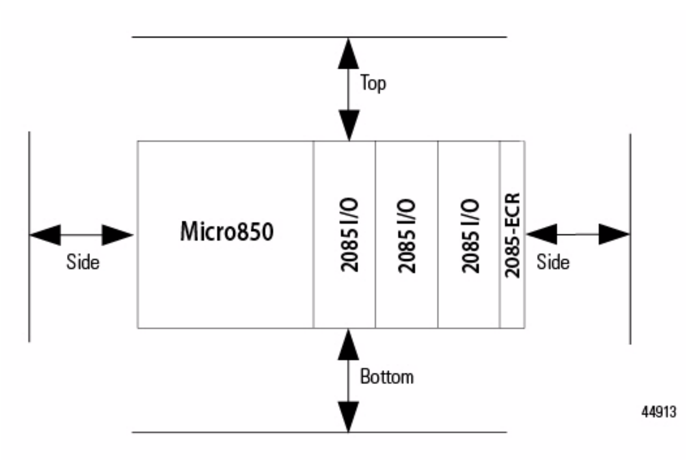
WARNING: If you insert or remove the module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed before proceeding.

Mount the Module

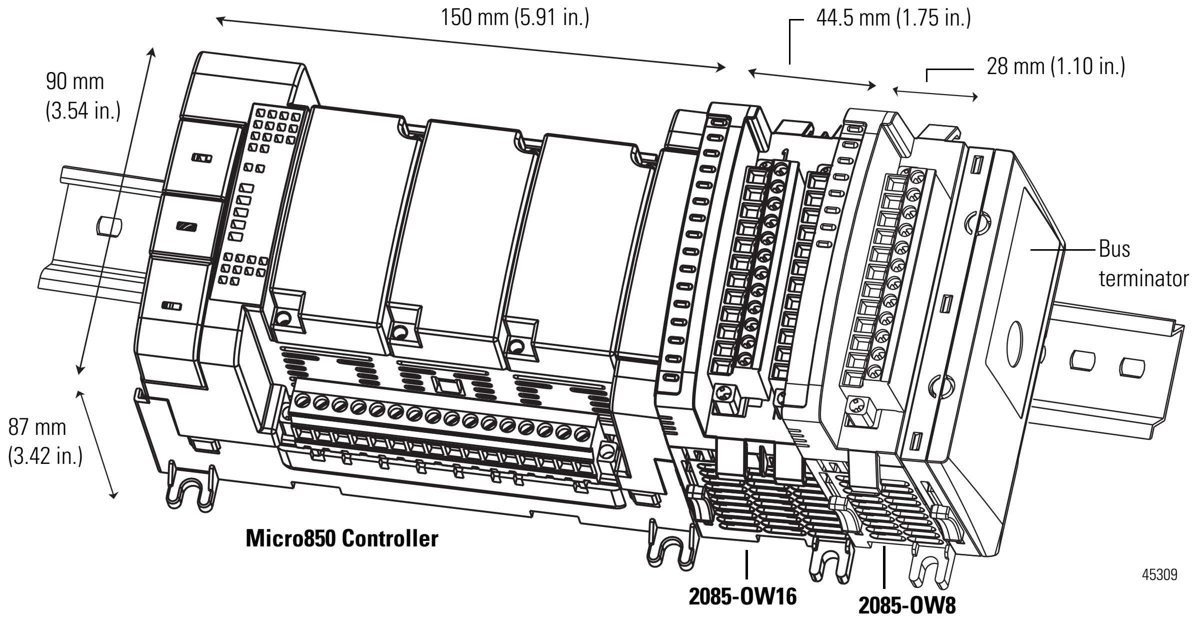
For more information on proper grounding guidelines, see the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Module Spacing

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, as shown:



Mounting Dimensions and DIN Rail Mounting



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

DIN Rail Mounting

The module can be mounted using the following DIN rails: 35 x 7.5 mm 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.

ATTENTION: This product is grounded through the DIN rail to chassis ground. Use zinc plated yellow-chromate steel DIN rail to assure proper grounding. The use of other DIN rail materials (for example, aluminum or plastic) that can corrode, oxidize, or are poor conductors, can result in improper or intermittent grounding. Secure DIN rail to mounting surface approximately every 200 mm (7.8 in.) and use end-anchors appropriately.

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 module onto the DIN rail, and then press the bottom until the module 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 module 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 two M4 (#8) per module. Hole spacing tolerance: ±0.4 mm (0.016 in.).

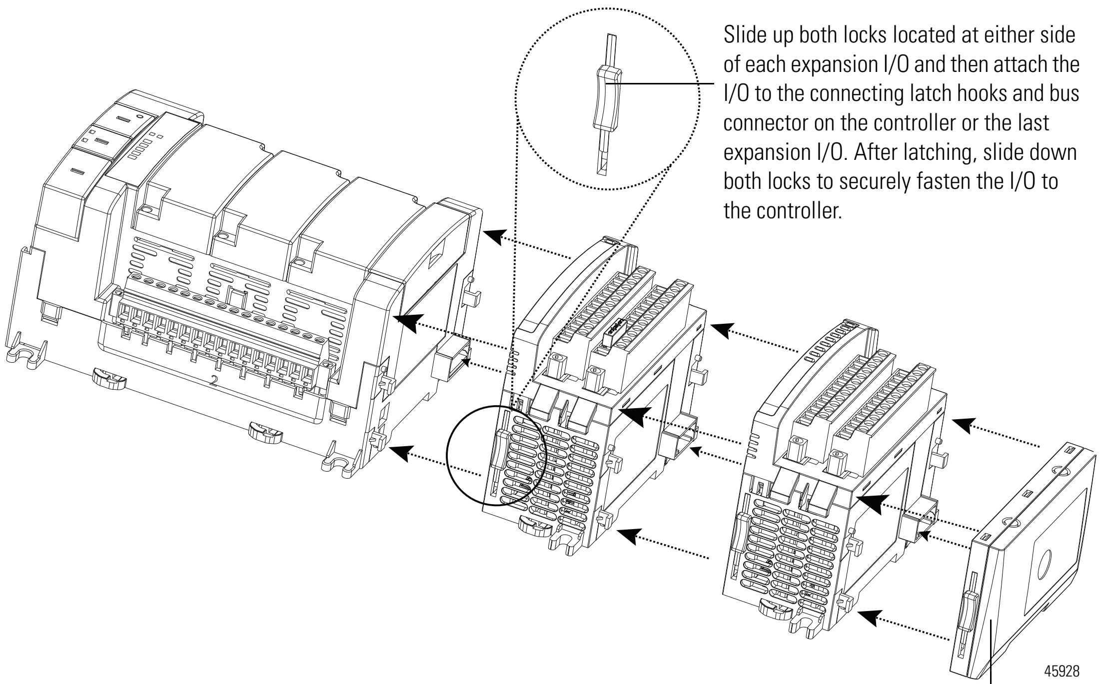
Follow these steps to install your module using mounting screws.

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

System Assembly

The Micro850 expansion I/O module is attached to the controller or another I/O module by means of interconnecting latches and hooks. The Micro850 controller and expansion I/O modules must terminate with a 2085-ECR Bus Terminator module.

ATTENTION: Failure to connect a bus terminator module to the last expansion I/O module will result in a controller fault.



Field Wiring Connections

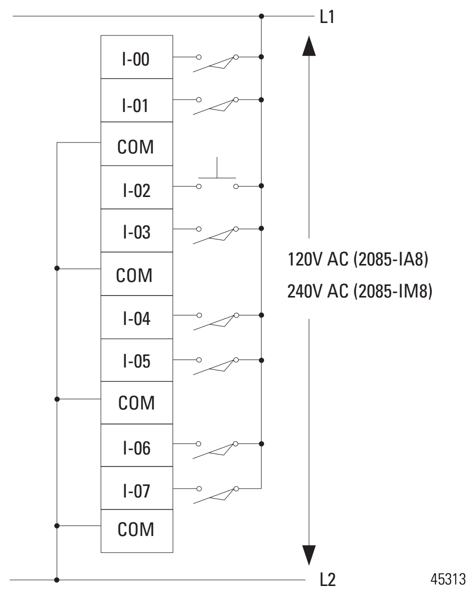
In solid-state control systems, grounding and wire routing helps limit the effects of noise due to electromagnetic interference (EMI).

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

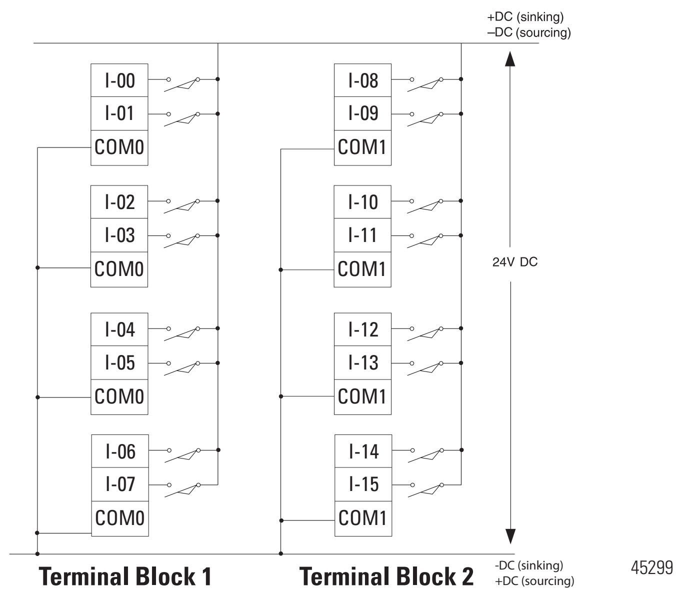
Input/Output Wiring

Basic wiring of devices to the expansion I/O modules are shown below.

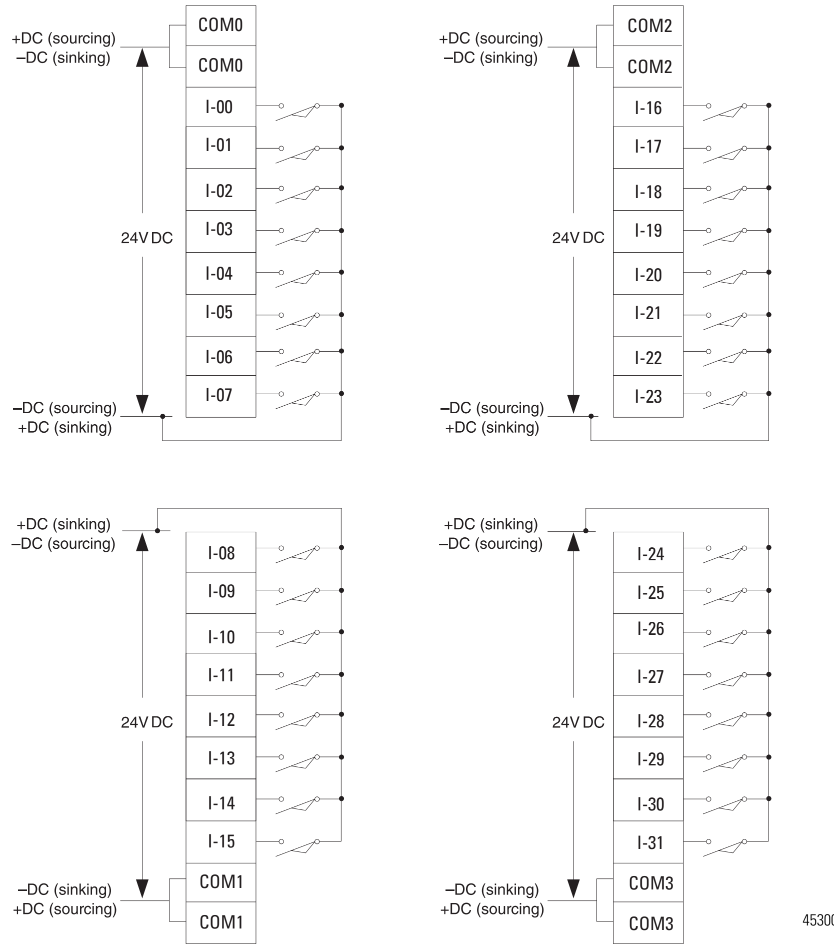
2085-IA8 or 2085-IM8



2085-IQ16

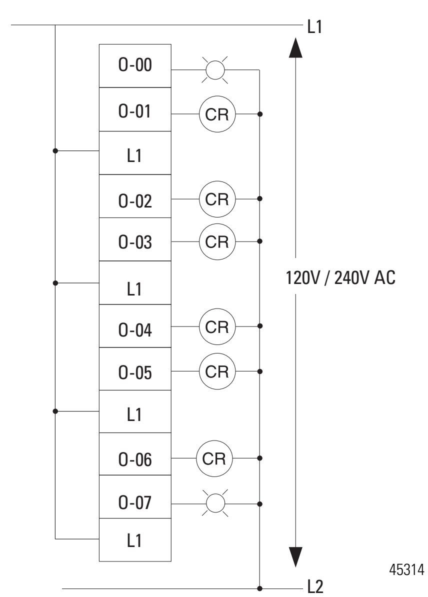


2085-IQ32T

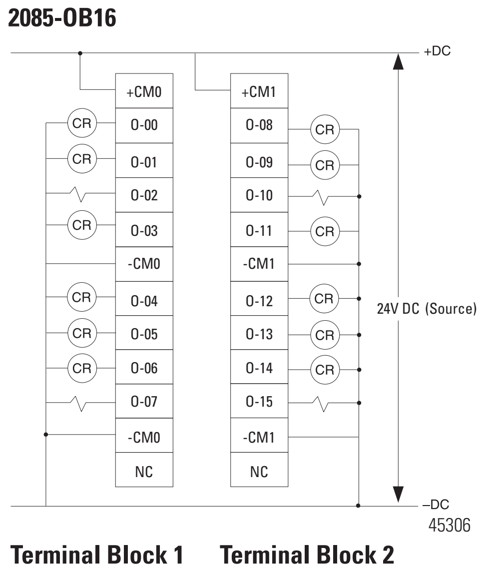


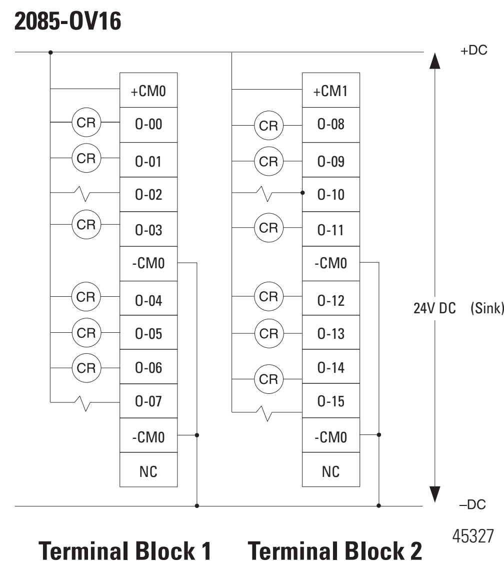
See Wiring Options for the 2085-IQ32T Module on page 67.

2085-OA8

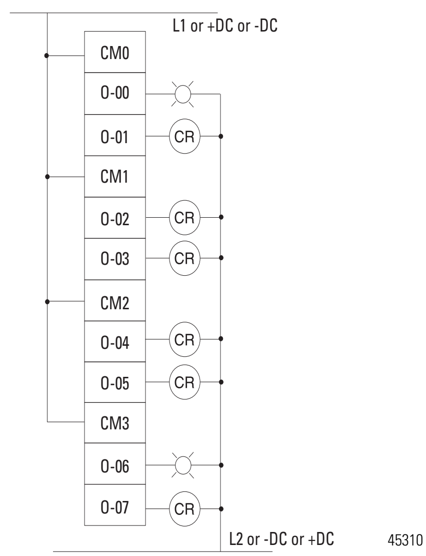


2085-OB16 and 2085-OV16

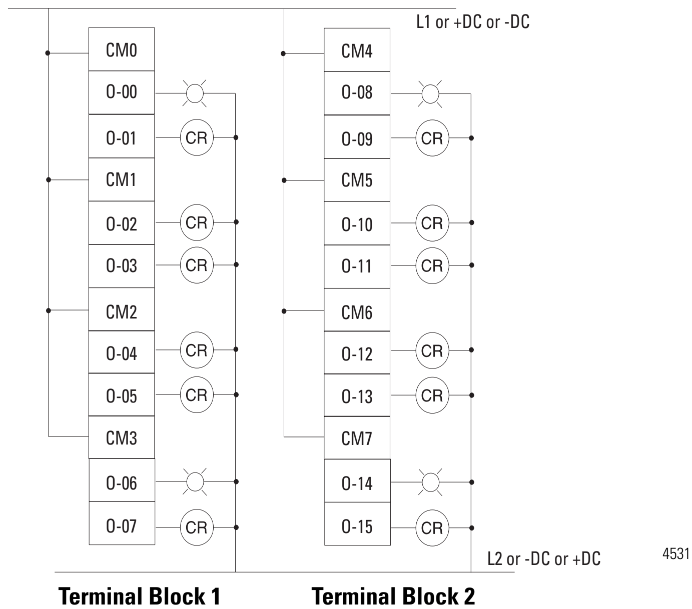




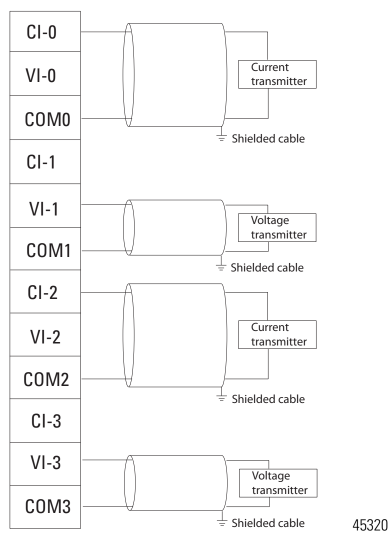
2085-OW8



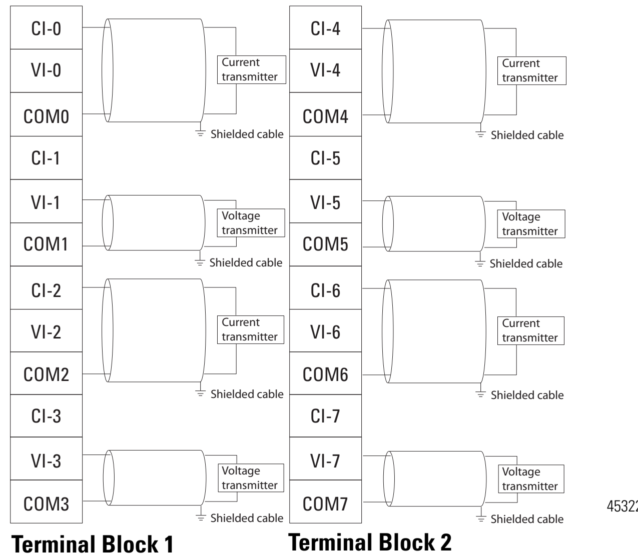
2085-OW16



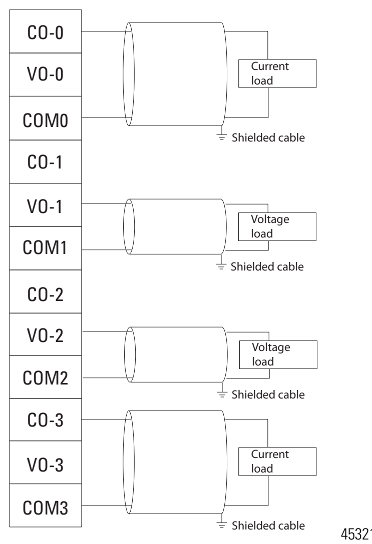
2085-IF4



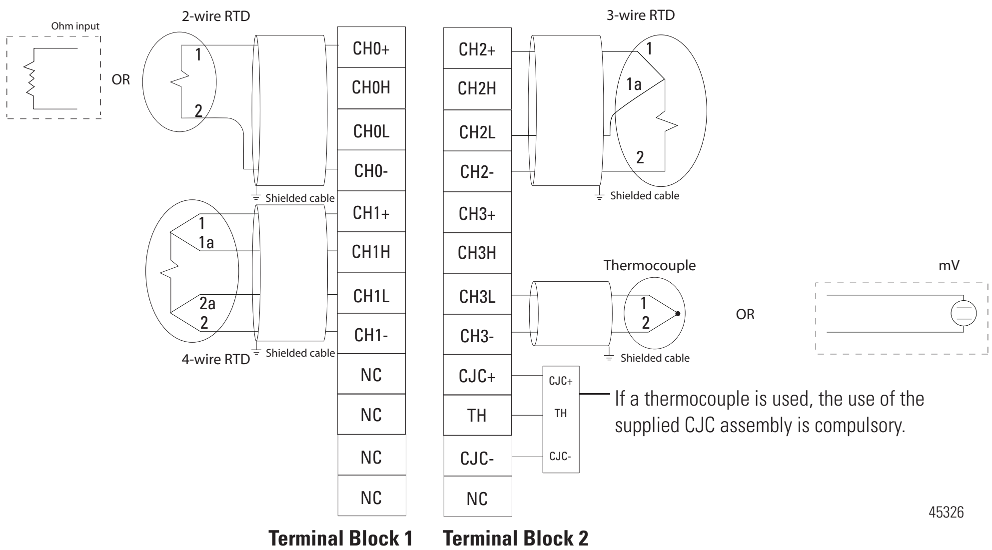
2085-IF8



2085-OF4



2085-IRT4



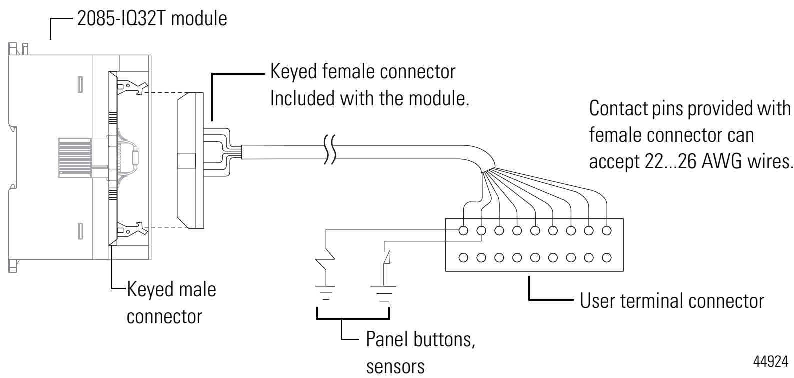
Wiring Options for the 2085-IQ32T Module

Included with your 2085-IQ32T module is a keyed 40-pin female connector and crimp type pins. These components allow you to wire I/O devices to the module using a 40-conductor cable or individual wires.

ATTENTION: To comply with UL restrictions, this equipment must be powered from a source compliant with the following:
Class 2 or Limited Voltage/Current.

When assembled, align the female connector over the module's male header using the keying slot as a guide. Firmly lock them together with the upper and lower retaining arms.

Option 1 – Wire the Connector with Available 40-pin Connector

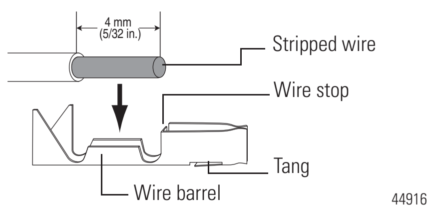


Assemble the Wire Contacts

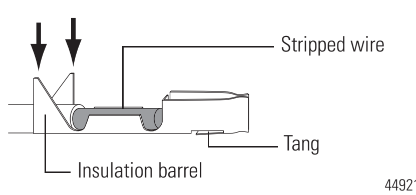
1. Strip the wire insulation to expose 4 mm (5/32 in.) of wire. Crimp pins can accept 22...26 AWG wire.

ATTENTION: Be careful when stripping wires. Wire fragments that fall into the module could cause damage. Once wiring is complete, be sure the module is free of all metal fragments before removing the protective debris strip. Failure to remove the strip before operating can cause overheating.

2. Insert the wire into the crimp pin as far as the wire stop.

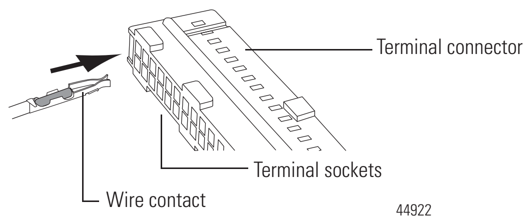


3. Crimp the wire barrel around the wire using small needle nose pliers.
4. Crimp the insulation barrel around the wire insulation using small needle nose pliers.



5. Solder wire and wire barrel together using lead-free solder and soldering pencil.

6. Insert the assembled wire contact into the terminal socket. Push the wire contact in until the tang latches. Make sure the tang is properly latched by lightly pulling on the wire.



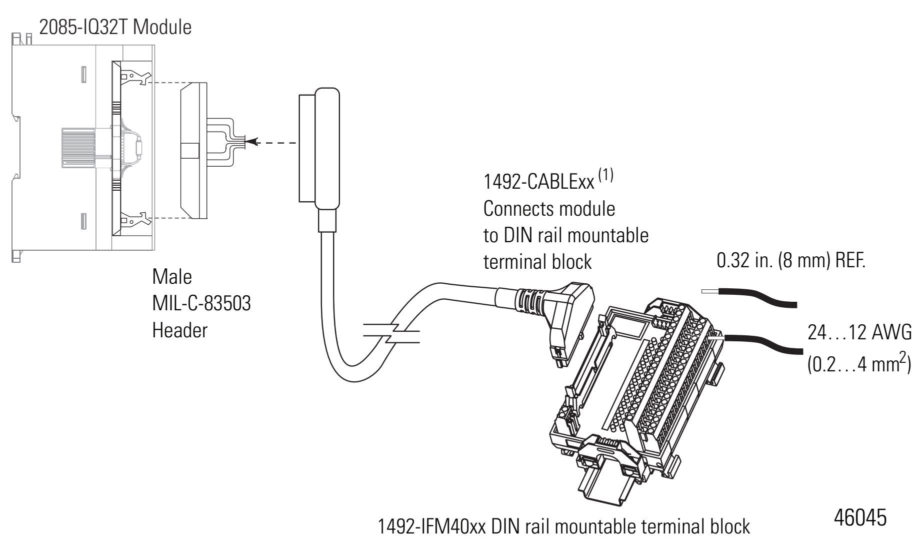
Option 2 – Use Allen-Bradley 1492 Connector Cables with Flying Leads

Preassembled 40-conductor cables with the 40-pin connector on one end and flying leads on the other end are also available from Allen-Bradley. They are available in 1 m, 2.5 m, and 5 m lengths. The catalog numbers from shortest to longest are:

- 1492-CAB010U62 (or 1492-CAB010P62)
- 1492-CAB025U62 (or 1492-CAB025P62)
- 1492-CAB050U62 (or 1492-CAB050P62)

The "U62" cables route the cable upward when plugged into the module, while "P62" cables route the cable downward when plugged into the module.

Option 3 – Use Allen-Bradley 1492 Cables with Keyed Connectors



(1) Maximum user cable length is dependent on how much voltage drop (current x (ohms/ft.) x (feet)) the user system can tolerate. The user system should take into account the minimum turn-on voltage required by external loads connected to the module, the minimum turn-on voltage required by the module, and all of the voltage drops associated with wiring to and from the load, sensors, terminal blocks, power sources and the module itself. See the table on page 70 for voltage drop values for the 1492 cables shown above.

Allen-Bradley 1492 wiring systems are available for connecting the I/O module to external I/O. These wiring systems include a pre-wired cable available in four lengths: 0.5m (1.6 feet), 1.0m (3.3 feet), 2.5m (8.2 feet), 5.0m (16.4 feet). An Interface Module for connecting external devices is also available. Cables are equipped with keyed connectors at both ends for proper connections. Interface modules are DIN rail mountable and are available with or without field side status indicating LEDs. Stick-on labels are provided with the Interface modules to identify I/O wiring termination points.

1492 Cables

Catalog No.	Voltage Drop at 30 °C		Voltage Drop at 60 °C	
Series C Cables	V DC and DC Com Wires(1)	Output Channel Wires(2)	V DC and DC Com Wires	Output Channel Wires
1492-CABLE005H	127 mv	34 mv	144 mv	38 mv
1492-CABLE010H	173 mv	45 mv	196 mv	51 mv
1492-CABLE025H	334 mv	83 mv	388 mv	95 mv
1492-CABLE050H	574 mv	147 mv	686 mv	169 mv

(1) Voltage drop at maximum rated current of 2 amps per conductor.

(2) Voltage drop at maximum rated current of 0.5 amps per output channel.

Discrete Expansion I/O Features

Micro850 discrete expansion I/O modules are input/output modules that provide On/Off detection and actuation.

Module Information

The Connected Components Workbench programming software makes it easy to configure the modules as most module features can be enabled or disabled through the device configuration portion of the software. You can also use the software to check any expansion I/O module in the system to retrieve:

- hardware revision information
- vendor ID
- module information

Channel Status Indicator Information

The discrete expansion I/O modules have yellow status indicators for each input/output point which indicates the On/Off state of the point.

Discrete Input

Discrete input modules interface to sensing devices and detect whether they are On or Off. These modules convert AC or DC On/Off signals from user devices to appropriate logic level for use within the processor.

The 2085-IA8, 2085-IM8, 2085-IQ16 and 2085-IQ32T modules update the controller with new data whenever an input point transitions from On to Off and Off to On.

On to Off and Off to On filter times can be adjusted through the Connected Components Workbench software. These filters improve noise immunity within a signal. A larger filter value affects the length of delay times for signals from these modules.

You can select from a series of operational ranges for each channel. The range designates the minimum and maximum signals that are detectable by the module.

Discrete Output

Output modules may be used to drive a variety of output devices. Typical output devices compatible with the outputs include:

- motor starters
- solenoids
- indicators

Follow these guidelines when designing a system.

- Make sure that the outputs can supply the necessary surge and continuous current for proper operation. (See specifications for Expansion I/O on page 240 for more information.)
- Make sure that the surge and continuous current are not exceeded. Damage to the module could result. When sizing output loads, check the documentation supplied with the output device for the surge and continuous current needed to operate the device. The Micro800 standard digital outputs are capable of directly driving the Micro800 standard digital inputs.

TIP	User-configurable options are not available in Connected Components Workbench for discrete output modules.

IMPORTANT	On controller minor and major fault, all output channels are de-energized.

Analog Expansion I/O Features

Analog expansion I/O modules are interface modules that convert analog signals to digital values for inputs and convert digital values to analog signals for outputs. Controllers can then use these signals for control purposes.

Analog Input and Output

Input/Output Types and Ranges

The 2085-IF4 and 2085-IF8 modules support four and eight input channels, respectively, while the 2085-OF4 supports four output channels. Each of the channels can be configured as current or voltage input/output, with current mode as default configuration.

Input/Output Type/Range for 2085-IF4, 2085-IF8, and 2085-OF4

Module	Input/Output Type/Range
2085-IF4	0…20 mA 4…20 mA (default) -10…10 V 0…10 V
2085-IF8	
2085-OF4	

To use an input or output as a current or voltage device, you must:

- wire the input/output connector for the correct input/output type (see Input/Output Wiring on page 61)
- configure the input/output as current or voltage through Connected Components Workbench (see Configure Your Expansion I/O Module on page 79)

Data formats

This parameter configures each channel to present analog data in any of the following formats:

- Raw/Proportional Data –The value presented to the controller is proportional to the selected input and scaled into the maximum data range allowed by the bit resolution of the A/D converter. For example, the data value range for a ±10V DC user input is -32,768…32,767, which covers the full-scale range of -10.5…10.5V. See Valid Range of the Data Formats for 2085-IF4, 2085-IF8, and 2085-OF4 on page 72.
- Engineering Units – The module scales the analog input data to the actual current or voltage values for the selected input range. The resolution of the engineering units is 0.001V or 0.001 mA per count.
- Percent Range – The input data is presented as a percentage of the normal operating range. For example, 0V…10V DC equals 0…100%. The amount over and under the normal operating range (the full-scale range) is also supported.

Valid Range of the Data Formats for 2085-IF4, 2085-IF8, and 2085-OF4

The valid range of each Data Format corresponds to the **full range** of each Type/Range (or normal range). For example, the full range of 0…20 mA is 0…21 mA.

Valid Range of the 2085-IF4 and 2085-IF8 Data Formats

Data Format	**Type/Range**			
	0…20 mA(4)	**4…20 mA(4)**	**-10…10V(4)**	**0…10 V(4)**
Raw/Proportional Data(1)	-32768…32767			
Engineering Units(2)	0…21000	3200…21000	-10500…10500	-500…10500
Percent Range(3)	0…10500	-500…10625	Not supported	-500…10500

(1) See Convert Analog Value to Data Format Value on page 73.

(2) The resolution is 0.001V or 0.001 mA per count. For example, 9999 here means 9.999V or 9.999 mA (or 9999 x 0.001).

(3) The resolution is 0.01% per count. For example, 9999 here means 99.99% (or 9999 x 0.01%). See Convert Analog Value to Data Format Value on page 73

(4) The full range value of:
a. 0…20 mA is 0…21 mA
b. 4 to 20 mA is 3.2…21 mA
c. -10…10V is -10.5…10.5V
d. 0…10V is -0.5…10.5V

Valid Range of the 2085-OF4 Data Formats

Data Format	**Type/Range**			
	0…20 mA(4)	**4…20 mA(4)**	**-10…10V(4)**	**0…10V(4)**
Raw/Proportional Data(1)	-32768…32767			
Engineering Units(2)	0…21000	3200…21000	-10500…10500	0…10500
Percent Range(3)	0…10500	-500…10625	Not supported	0…10500

(1) See Convert Analog Value to Data Format Value on page 73.

(2) The resolution is 0.001V or 0.001 mA per count. For example, 9999 here means 9.999V or 9.999 mA (or 9999 x 0.001.

(3) The resolution is 0.01% per count. For example, 9999 here means 99.99% (or 9999 x 0.01%). See Convert Analog Value to Data Format Value on page 73.

(4) The full range value of:
a. 0…20 mA is 0…21 mA
b. 4…20 mA is 3.2…21 mA
c. -10…10V is -10.5…10.5V
d. 0…10V is 0…10.5V

Convert Analog Value to Data Format Value

The formula for converting an analog value x to a data format value y (or conversely, deriving data format value y to analog value x) is as follows:

Y = ((X - Minimum Value of X Range)*(Range of Y)/(Range of X)) + (Minimum Value of Y Range)

Example 1:
Find the analog value Y of Type/Range 4...20 mA when the Raw/Proportional Data X is -20000.

Given:
X = -20000
Minimum value of X Range = -32768
Range of X = 32767 - (-32768) = 65535
Range of Y = 21- 3.2 = 17.8
Minimum value of Y Range = 3.2

Using the conversion formula:
Y = (-20000 - (-32768))*17.8/65535 + (3.2) = **6.668 mA**

Example 2:
Find the Raw/Proportional value (Y) of 10 mA (X) for type/range 4…20 mA.

Given:
X = 10 mA
Minimum Value of X Range = 3.2 mA *(Minimum value of 4…20 mA)*
Range of X = 21 - 3.2 = 17.8 mA *(Range of 4…20 mA)*
Range of Y = 32767 - (-32768) = 65535 *(Range of Raw/Proportional Data)*
Minimum Value of Y Range = -32768. *(Min value of Raw/Proportional Data)*

Using the conversion formula:
Y = **-7732.15** (decimals are not displayed)

Input Filter

For the input modules, 2085-IF4 and 2085-IF8, the input filter parameter lets you specify the frequency filter type for each channel. Frequency filter type affects noise rejection, as explained below. Select a frequency filter type considering acceptable noise and response time.

Through the Connected Components Workbench software, you can configure input filter as:

- 50/60Hz Rejection (default)
- No Filter
- 2-Point Moving Average
- 4-Point Moving Average
- 8-Point Moving Average

Noise Rejection

The input modules use a digital filter that provides noise rejection for the input signals.

The moving average filter reduces the high frequencies and random white noise while keeping an optimal step response. (See specifications for Analog Expansion I/O on page 244 for minimum and maximum response times.)

Normal Mode Rejection is better than 40 dB, while Common Mode Rejection is better than 60 dB @ 50/60 Hz, with the 50/60 Hz rejection filters selected. The modules perform well in the presence of common mode noise as long as the signals applied to the user plus and minus input terminals do not exceed the common mode voltage rating (±10 V) of the modules. Improper earth ground may be a source of common mode noise.

Process Level Alarms

Process level alarms alert you when the module has exceeded configured high and low limits for each channel (for input modules, it provides additional high-high and low-low alarms). When the channel input or output goes below a low alarm or above a high alarm, a bit is set in the status words. All Alarm Status bits can be read individually or read through the Channel Status Byte.

For the output module, 2085-OF4, it is possible to latch the alarm status bit when the latch configuration is enabled.

You can configure each channel alarm individually.

Clamping Limits and Alarm

For the output module, 2085-OF4, clamping limits the output from the analog module to remain within a range configured by the controller, even when the controller commands an output outside that range. This safety feature sets a high clamp and a low clamp. Once clamps are determined for a module, any data received from the controller that exceeds those clamps transitions the output to that limit but not beyond the clamp value. It also sets the alarm status bit when the alarm is enabled. It is also possible to latch the alarm status bit when the latch configuration is enabled.

For example, an application may set the high clamp on a module for 8V and the low clamp for -8V. If a controller sends a value corresponding to 9V to the module, the module will only apply 8V to its screw terminals.

You can configure the clamp limit (high/low clamp), the associated alarm, and its latching configuration on a per channel basis.

The following table shows the default values of the High/Low Clamps (in the order of low clamp value followed by the high clamp value) for the respective type/range when they are first enabled. You can change these values (within their full range) according to your application.

Default Range of High Clamp/Low Clamp Values

Data Format	**0…20 mA**	**4…20 mA**	**-10…10V**	**0…10V**
Raw/Proportional Data	-32768, 29647	-29822, 29086	-31207, 31207	-32768, 29647
Engineering Units	0, 20000	4000, 20000	-10000, 10000	0, 10000
Percent Range	0, 10000	0, 10000	Not supported	0, 10000

Specialty Module 2085-IRT4 Temperature Input Module

The 2085-IRT4 module lets you configure a sensor type for each of four input channels that linearizes analog signal into a temperature value.

Sensor Type

The following Thermocouple and RTD sensor types are supported by the 2085-IRT4 expansion I/O module.

Supported Thermocouple Types and mV Range

Sensor Range	Range	
B	300…1800 °C	(572…3272 °F)
C	0…2315 °C	(32…4199 °F)
E	-270…1000 °C	(-454…1832 °F)
J	-210…1200 °C	(-346…2192 °F)
K	-270…1372 °C	(-454…2502 °F)
TXK/XK (L)	-200…800 °C	(-328…1472 °F)
N	-270…1300 °C	(-454…2372 °F)
R	-50…1768 °C	(-58…3214 °F)
S	-50…1768 °C	(-58…3214 °F)
T	-270…400 °C	(-454…752 °F)
mV	0…100 mV	

Supported RTD Types and Ohms Range

Sensor Range	Range	
100 Ω Pt α = 0.00385 Euro	-200…870 °C	(-328…1598 °F)
200 Ω Pt α = 0.00385 Euro	-200…400 °C	(-328…752 °F)
100 Ω Pt α = 0.003916 U.S	-200…630 °C	(-328…1166 °F)
200 Ω Pt α = 0.003916 U.S.	-200…400 °C	(-328…752 °F)
100 Ω Nickel 618	-60…250 °C	(-76…482 °F)
200 Ω Nickel 618	-60…200 °C	(-76…392 °F)
120 Ω Nickel 672	-80…260 °C	(-112…500 °F)
10 Ω Copper 427	-200…260 °C	(-328…500 °F)
Ohms	0…500 Ohms	

Data format

You can configure the following data formats for channels 0…3 through the Connected Components Workbench software.

- Engineering Units x 1 – If you select engineering units x 1 as the data format for a Thermocouple and RTD input, the module scales input data to the actual temperature values for the selected Thermocouple/RTD type per Thermocouple/RTD standard. It expresses temperatures in 0.1 °C/° F units. For resistance inputs, the module expresses resistance in 0.1 ohm per count. For mV inputs, the module expresses it in 0.01 mV per count.
- Engineering Units x 10 – For a Thermocouple or RTD input, the module scales input data to the actual temperature values for the selected Thermocouple/RTD type per Thermocouple/RTD standard. With this format, the module expresses temperatures in 1 °C/° F units. For resistance inputs, the module expresses resistance in 1 ohm per count. For mV inputs, the module expresses it in 0.1 mV per count.
- Raw/Proportional Data Format – The value presented to the controller is proportional to the selected input and scaled into the maximum data range allowed by the bit resolution of the A/D converter. For example, the full data value range for a thermocouple type B 300…1800 °C is mapped to -32768…32767. See Convert Analog Value to Data Format Value on page 78 for the conversion method.
- Percent Range – The input data is presented as a percentage of the normal operating range. For example, 0…100 mV equals 0…100% or 300..1800 °C equals 0…100% for thermocouple type B sensor. See Convert Analog Value to Data Format Value on page 78 for the conversion method.

Valid Range of the Data Formats for 2085-IRT4

The following table shows the valid range of the Data Format versus the Data Type/Range for channels 0…3.

Valid Range of the 2085-IRT4 Data Formats

Data Format	Sensor Type – Temperature (10 Thermocouples, 8 RTDs)	Sensor Type 0…100 mV	Sensor Type 0…500 ohms
Raw/Proportional Data(1)	-32768…32767		
Engineering Units x 1	Temperature Value(3) (°C/°F)	0…10000(5)	0…5000(7)
Engineering Units x 10	Temperature Value(4) (°C/°F)	0…1000(6)	0…500(8)
Percent Range(2)	0…10000		

(1) See Convert Analog Value to Data Format Value on page 78.

(2) The resolution is 0.01% per count. For example, 9999 here means 99.99% (or 9999 x 0.01%). See Convert Analog Value to Data Format Value on page 78 for the conversion method.

(3) The resolution is 0.1 °C/°F per count. For example, 999 here means 99.9 °C/°F (or 999 x 0.1 °C/°F). The range depends on the selected sensor type.

(4) The resolution is 1 °C/°F per count. For example, 999 here means 999 °C/°F (or 999 x 1 °C/°F). The range depends on the selected sensor type.

(5) The resolution is 0.01 mV per count. For example, 9999 here means 99.99 mV (or 9999 x 0.01 mV).

(6) The resolution is 0.1 mV per count. For example, 999 here means 99.9 mV (or 999 x 0.1 mV).

(7) The resolution is 0.1 ohm per count. For example, 4999 here means 499.9 ohm (or 4999 x 0.1 ohm).

(8) The resolution is 1 ohm per count. For example, 499 here means 499 ohm (or 499 x 1 ohm).

Convert Analog Value to Data Format Value

The formula for converting an analog value x to a data format value y, or converting data format value y to analog value x, is as follows:

Y = ((X - Minimum Value of X Range)*(Range of Y)/(Range of X)) + (Minimum Value of Y Range)

Example:
Find the temperature value Y of thermocouple type K when the Raw/Proportional Data X is -20000.

Given:
X = -20000 (Raw/Proportional Value)
Minimum value of X Range = -32768 (Minimum value of Raw/Proportional Data)
Range of X = 32767 - (-32768) = 65535 (Range of Raw/Proportional Data)
Range of Y = 1372 - (-270) = 1642 (Range of Thermocouple K in °C)
Minimum value of Y Range = -270 °C (Minimum value of Thermocouple K)

Then:
Y = (-20000 - (-32768))*1642/65535 + (-270 °C) = **49.9 °C**

Temperature Units

Temperature value can be set to °C (default) or °F.

Open circuit response

This parameter defines the response to be taken by the module during an open circuit.

- Upscale – Sets input to full upper scale value of channel data word. The full-scale value is determined by the selected input type, data format, and scaling.
- Downscale – Sets input to full lower scale value of channel data word. The low scale value is determined by the selected input type, data format, and scaling.
- Hold Last State – Sets input to last input value.
- Zero – Sets input to 0 to force the channel data word to 0.

Filter frequency

The 2085-IRT4 module uses a digital filter that provides noise rejection for the input signals. The filter is set by default at 4 Hz per. The digital filter provides -3 db (50% amplitude) attenuation at 4 Hz filter frequency.

The -3dB frequency is the filter cut-off frequency. The cut-off frequency is defined as the point on the frequency response curve where frequency components of the input signal are passed with 3dB of attenuation. All input frequency components at or below the cut-off frequency are passed by the digital filter with less than 3 dB of attenuation. All frequency components above the cutoff frequency are increasingly attenuated.

The cut-off frequency for each channel is defined by its filter frequency selection and is equal to the filter frequency setting. Choose a filter frequency so that your fastest changing signal is below that of the filter's cut-off frequency. The cut-off frequency should not be confused with the update time. The cut-off frequency relates to how the digital filter attenuates frequency components of the input signal. The update time defines the rate at which an input channel is scanned and its channel data word is updated.

A lower filter frequency provides a better noise rejection, but it also increases the update time. A higher filter frequency provides a faster update time, but it decreases the noise rejection and effective resolution.

TIP For quickstart instructions on how to add, configure, delete and replace your expansion I/O module, see Configure Your Expansion I/O Module.

Configure Your Expansion I/O Module

The following sample project guides you through the step-by-step process of adding, configuring, deleting, and replacing expansion I/O modules in Connected Components Workbench.

TIP For more information about using the Connected Components Workbench software, you can refer to the Connected Components Workbench Online Help (it comes with your software).

In this sample project, you need to create a Connected Components Workbench project with a 2080-LC50-24QWB controller. Then, configure four expansion I/O devices (2085-IF4, 2085-IQ32T, 2085-OB16, 2085-IRT4) following the instructions below.

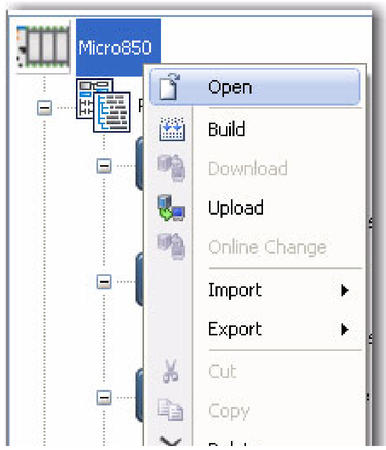
These instructions make use of the drag and drop mechanism available in Connected Components Workbench release 2 and higher, which allows the user to easily add, replace, delete devices through simple drag and drop motion.

Add an Expansion I/O

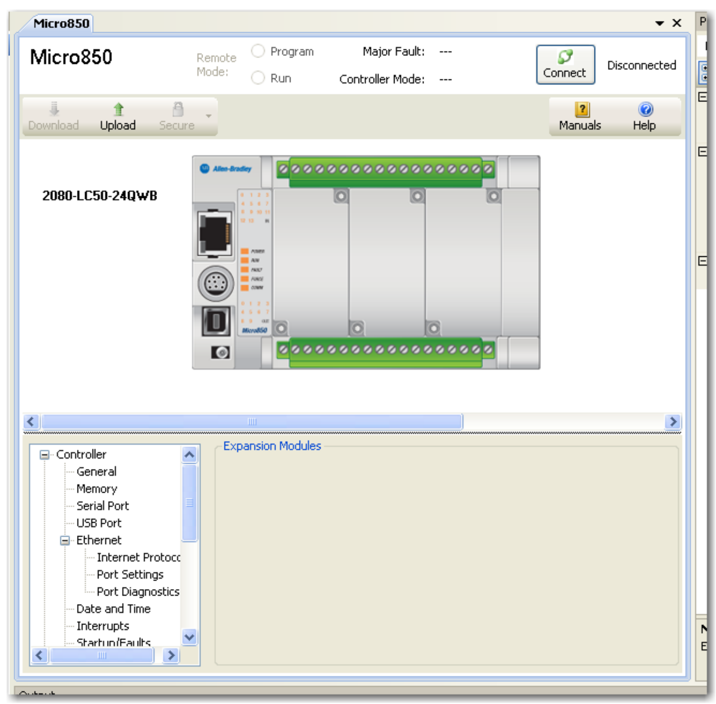
TIP Expansion I/O modules are automatically added to a project when using the "Discover" feature in Connected Components Workbench.

To add Expansion I/O modules to an existing Micro850 controller project, do the following:

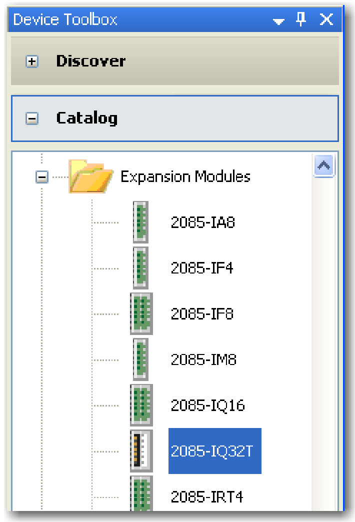
1. On the Project organizer pane, right-click Micro850 and choose Open.



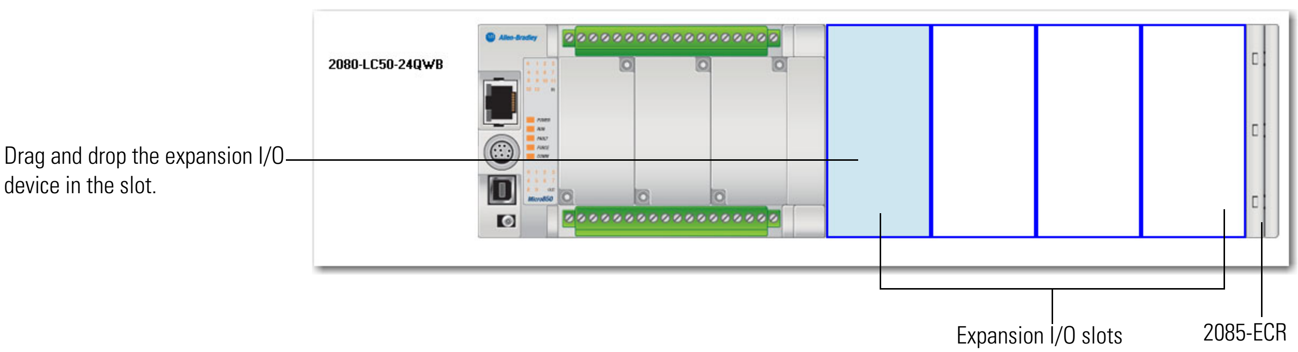
The Micro850 project page opens in the center pane with a graphical replica of the Micro850 controller on the first tier, Controller properties on the second tier, and an Output box on the last tier.

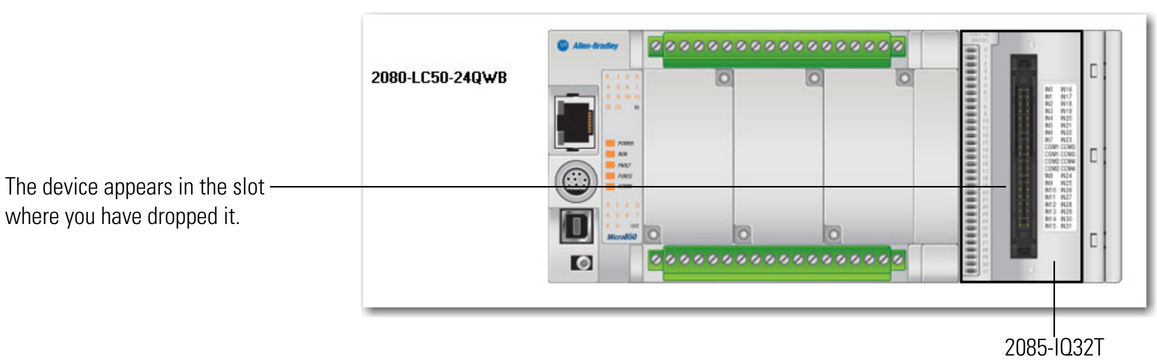


2. On the Device Toolbox pane, found at the rightmost corner of the Connected Components Workbench window, go to the Expansion Modules folder.

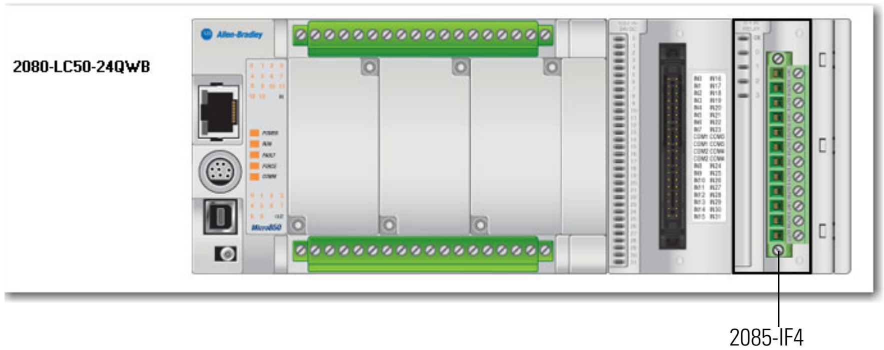


3. Click and drag 2085-IQ32T to the right of the controller graphic at the center pane. Four blue slots appear to indicate available slots for expansion I/O modules. Drop 2085-IQ32T on the first and rightmost slot against the controller.





4. From the Expansion Modules folder on the Device Toolbox pane, drag and drop 2085-IF4 on the second Expansion I/O slot, next to 2085-IQ32T.

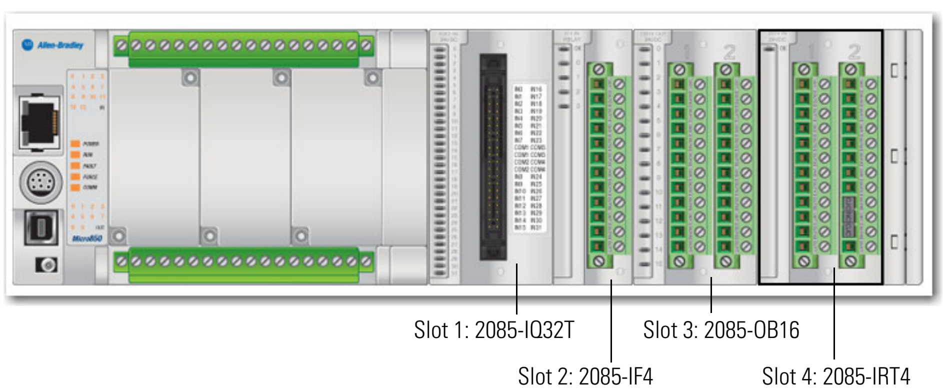


TIP To move an expansion I/O device to another slot, simply drag and drop the device to the preferred slot. For step-by-step instructions on how to delete and replace expansion I/O devices, see Delete and Replace an Expansion I/O Configuration on page 92.

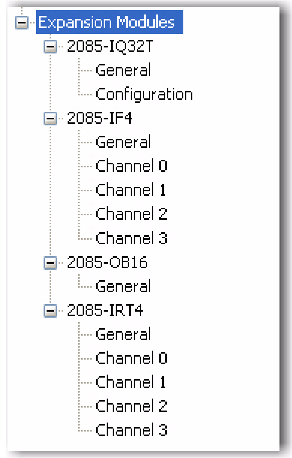
5. From the Expansion Modules folder on the Device Toolbox, drag and drop 2085-OB16 on the third Expansion I/O slot, next to 2085-IF4.
6. From the Expansion Modules folder on the Device Toolbox pane, drag and drop 2085-IRT4 on the fourth Expansion I/O slot, next to 2085-IRT4.

TIP You can edit default configuration by following the procedure provided in the next section, Edit Expansion I/O Configuration on page 83.

After you have added all four expansion I/O modules, your Connected Components Workbench project should look like this:



The Expansion Modules list should appear as shown below. To see device details for each of the expansion I/O you have just added, click General. To see default configuration properties, click Configuration (if available).

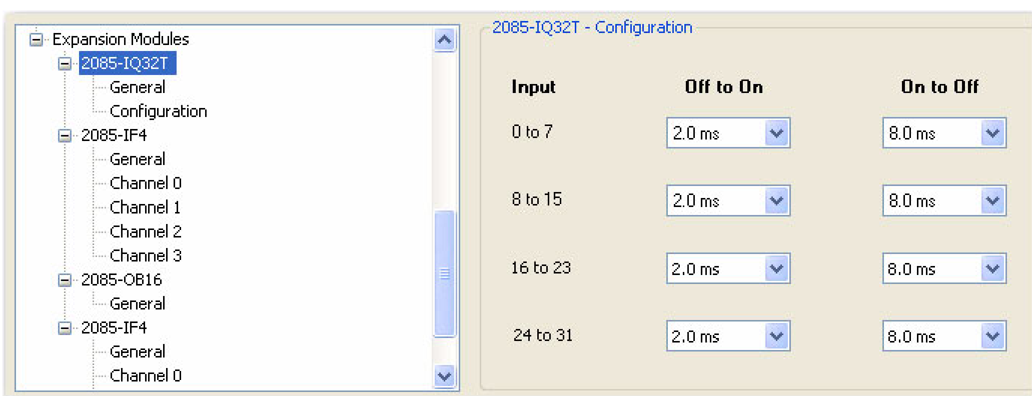


Edit Expansion I/O Configuration

You can edit default I/O configuration through the Expansion Modules Details box located right below the controller graphic.

IMPORTANT	To download configuration to your device, see Build, Save, Download a Project with Expansion I/O Configuration on page 94.

1. Select the Expansion I/O device you want to configure.

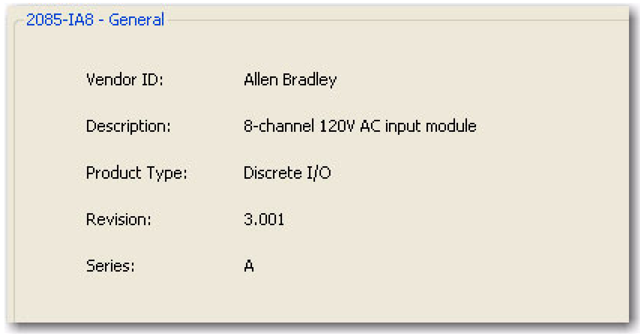


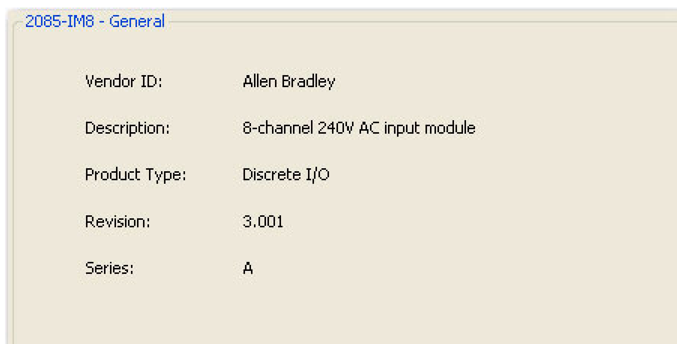
2. Click Configuration. Edit module and channel properties according to your requirements and application.

   The next sections show you configuration properties for each of the expansion I/O module.

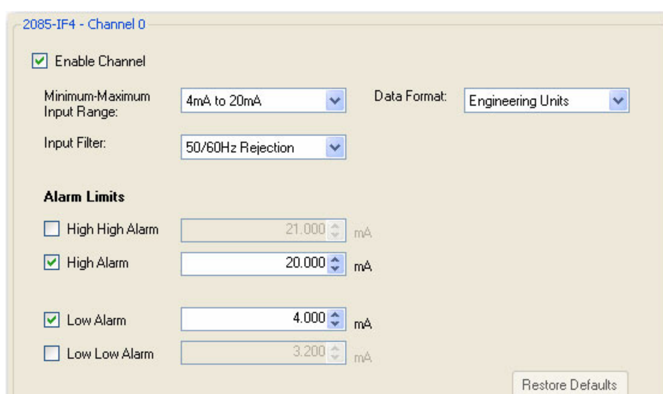
2085-IA8 and 2085-IM8

These two AC input modules only have general device details available for the user in Connected Components Workbench software. No configuration properties are available.



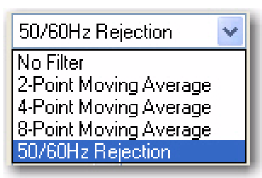


2085-IF4 and 2085-IF8

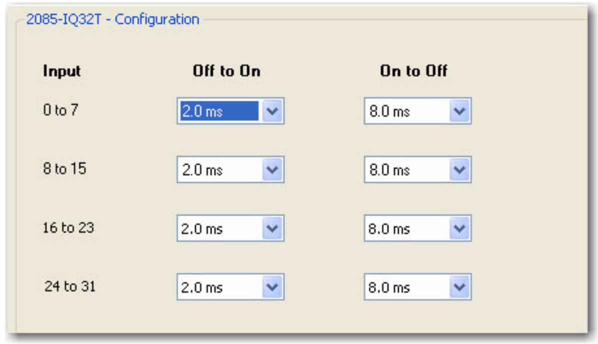


For the analog input modules, 2085-IF4 and 2085-IF8, you can configure properties such as input range, format, filter and alarm limits for each individual channel.

Configuration Parameters for 2085-IF4 and 2085-IF8

Configuration Property	What to do	Description
Enable Channel	Select or deselect the checkbox. The box is selected by default.	Enable or disable a channel through this checkbox. By default, each channel is enabled.
Minimum-Maximum Input Range	Choose from a range of values: • 0…20 mA • 4…20 mA (default) • -10…10 V • 0…10 V	Defines the input mode for the channel as either voltage or current, with current as default mode.
Data format	Select from the following options: • Raw/Proportional Data • Engineering Units (default) • Percent Range	See Data formats on page 72 for detailed information.
Input filter	Choose from the following values: 	See Input Filter on page 74 for detailed information.
High High Alarm	Check the checkbox to enable an alarm. By default, High High and Low Low Alarms are disabled and High and Low alarms are enabled.	Process level alarms alert you when the module has exceeded configured high, high high, low, and low low limits for each channel.
High Alarm		
Low Alarm		
Low Low Alarm		

2085-IQ16 and 2085-IQ32T

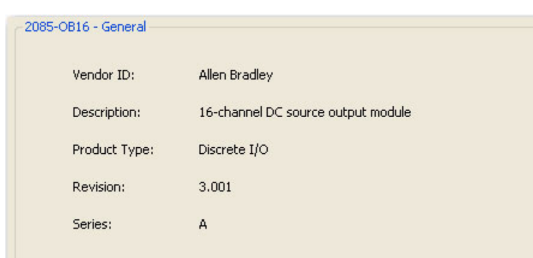


For the 16- and 32-channel DC input modules, 2085-IQ16 and 2085-IQ32T respectively, you can configure OFF to ON and ON to OFF ranges.

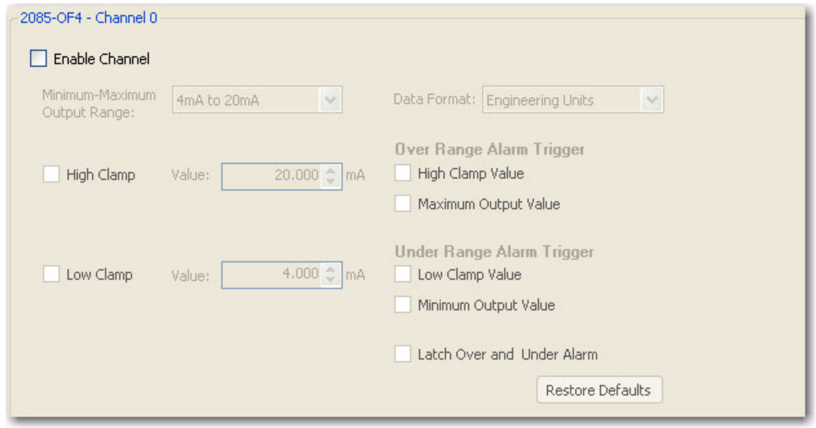
Configuration Property	What to do
Input	–
OFF to ON	Choose from the following values: 8.0 ms 4.0 ms 2.0 ms (default) 1.0 ms 0.5 ms 0.1 ms 0.0 ms
ON to OFF	Choose from the following values: 8.0 ms (default) 4.0 ms 2.0 ms 1.0 ms 0.5 ms 0.1 ms 0.0 ms

2085-OV16, 2085-OB16, 2085-OW16, 2085-OA8, 2085-OW8

The output modules, 2085-OV16, 2085-OB16, 2085-OW16, 2085-OA8, 2085-OW8, only have device details available to the user in Connected Components Workbench. There are no user configuration pages for these modules in the Connected Components Workbench software.



2085-OF4



For the analog output module, 2085-OF4, you can configure output unit, minimum to maximum output range, high clamp and low clamp values, and overrange and underrange values.

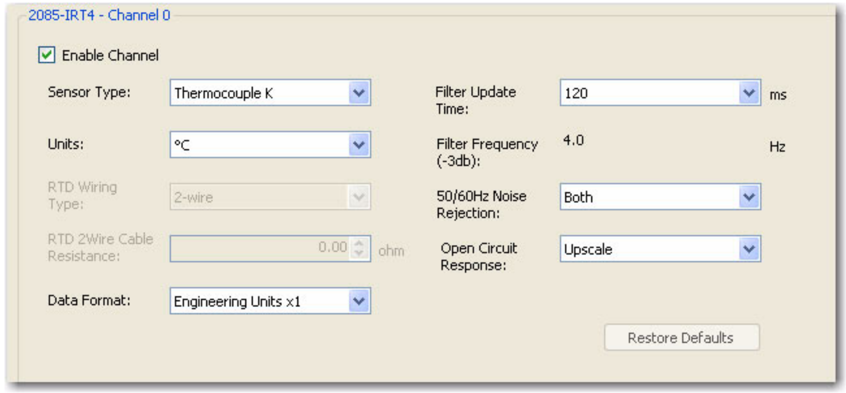
Configuration Parameters for 2085-OF4

Configuration Property	What to do	Description
Enable channel	Select or deselect the checkbox. Channel is not enabled by default.	Enable or disable a channel through this checkbox. By default, each channel is disabled.
Minimum-maximum output range	Choose from a range of values: • 0…20 mA • 4…20 mA (default) • -10…10 V • 0…10 V	For more information, see: • Input/Output Types and Ranges on page 72 • Valid Range of the Data Formats for 2085-IF4, 2085-IF8, and 2085-OF4 on page 72
Data format	Select from the following options: • Raw/Proportional Data • Engineering Units (default) • Percentage Data	See Data formats on page 72 for detailed information.
High clamp value	Click the checkbox to enable and enter a high clamp value.	Sets an appropriate alarm that limits the output from the analog module to remain within a range configured by the controller, even when the controller commands an output outside that range. This safety feature sets a high clamp and a low clamp. Once clamps are determined for a module, any data received from the controller that exceeds those clamps sets an appropriate limit alarm and transitions the output to that limit but not beyond the requested value.
Low clamp value	Click the checkbox to enable and enter a low clamp value.	

Configuration Parameters for 2085-OF4

Configuration Property	What to do	Description
Overrange alarm trigger	If you enabled and entered a High Clamp value, you can check High Clamp Value as overrange alarm trigger.  If you did not enable and entered a High Clamp value, you can check Maximum Output Value as your overrange alarm trigger. 	The overrange and underrange feature detects when the output module is operating beyond limits set by the output range. The trigger could be set based on clamp values or minimum/maximum output values.
Underrange alarm trigger	If you enabled and entered a Low Clamp value, you can check Low Clamp Value to set it as underrange alarm trigger.  If you did not enable and entered a Low Clamp value, you can check Minimum Output Value as underrange alarm trigger. 	
Latch over and under alarm	Click to latch.	Check the box to latch an alarm in the set position even if the condition that causes the alarm disappears.
Restore defaults	Click button to restore defaults.	Restores default device properties.

2085-IRT4



For the RTD and Thermocouple expansion I/O, 2085-IRT4, you can configure sensor type, data format, temperature units, and other properties, on each of the four individual channels.

Configuration Parameters for 2085-IRT4

Configuration Property	What to do	Description
Enable channel	Click the box to enable.	This parameter enables the particular channel for operation.

Configuration Parameters for 2085-IRT4

Configuration Property	What to do	Description
Sensor Type	Select from the following sensors: • 100Ω Platinum 385 • 200Ω Platinum 385 • 100Ω Platinum 3916 • 200Ω Platinum 3916 • 100Ω Nickel 618 • 200Ω Nickel 618 • 120Ω Nickel 672 • 100Ω Copper 427 • 0…500 Ohm • 0…100 mV • Thermocouple B • Thermocouple C • Thermocouple E • Thermocouple J • Thermocouple K • Thermocouple TXK/XK (L) • Thermocouple N • Thermocouple R • Thermocouple S • Thermocouple T	Defines the RTD or Thermocouple sensor type for the channel.
Units	Set as °C or °F	Sets the temperature unit to be used by the channel.
RTD Wiring Type	Set as any of the following: • 2-wire • 3-wire • 4-wire	The wiring type for channel x. This parameter is only available when the Sensor Type for the channel is RTD or (0 to 500 Ohm).
RTD 2Wire Cable Resistance	Replace value from 0.0 ohms…500.00 ohms to 0.0 ohms…655.35 ohms.	The specified cable resistance for the 2-wire cable. When the RTD 2Wire Cable Resistance value is smaller than the input value, it is subtracted from the input value during each read. When the value is greater than the input value, the under-range or open status bit is set (1). To configure the wire resistance, the Sensor Type must be RTD or (0…500 Ohm) and the RTD Wiring Type must be 2-wire. Otherwise, this parameter is not available.

Configuration Parameters for 2085-IRT4

Configuration Property	What to do	Description
Data Format	Choose from the following options: • Raw/Proportional Data • Engineering Units*1 • Engineering Units*10 • Percent range	For more information, see: • Data format on page 76 • Valid Range of the Data Formats for 2085-IRT4 on page 77
Filter Update Time	Set as the following (in msec): • 4 • 8 • 16 • 32 • 40 • 48 • 60 • 101 • 120 • 160 • 200 • 240 • 320 • 480	See Filter frequency on page 79. NOTE: Filter update time 4 ms is not available for Thermocouple sensor types B, R, S, E, J, C, K, L, N, or T or 0…10 mV. Filter update time 8 ms is not available for Thermocouple sensor types B, R, S.
Filter Frequency (-3dB)	Set as the following (in Hz): • 114 • 60 • 30 • 14 • 12 • 9.4 • 8.0 • 4.7 • 4.0 • 3.0 • 2.4 • 2.0 • 1.5 • 1.0	

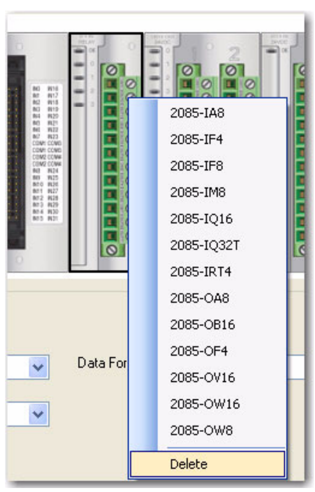
Configuration Parameters for 2085-IRT4

Configuration Property	What to do	Description
50/60 Hz Noise Rejection	Set as: • Both (default) • 50 Only • 60 Only • Neither	See Noise Rejection on page 74.
Open Circuit Response	Choose from the following options: • Upscale • Downscale • Hold Last State • Zero	Defines the response to be taken during an open circuit, whether to upscale, downscale, hold last state, or zero. **Upscale** – Sets input to full upper scale value of channel data word. The full-scale value is determined by the selected input type, data format, and scaling. **Downscale** – Sets input to full lower scale value of channel data word. The low scale value is determined by the selected input type, data format, and scaling. **Hold Last State** – Sets input to last input value. **Zero** – Sets input to 0 to force the channel data word to 0.

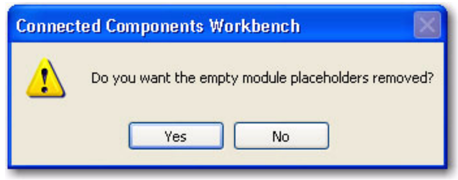
Delete and Replace an Expansion I/O Configuration

Using our example project, let us try to delete 2085-IF4 in slot 2 and 2085-OB16 in slot 3. Then, let us replace the modules with 2085-OW16 and another 2085-IQ32T module in slots 2 and 3, respectively. To do this:

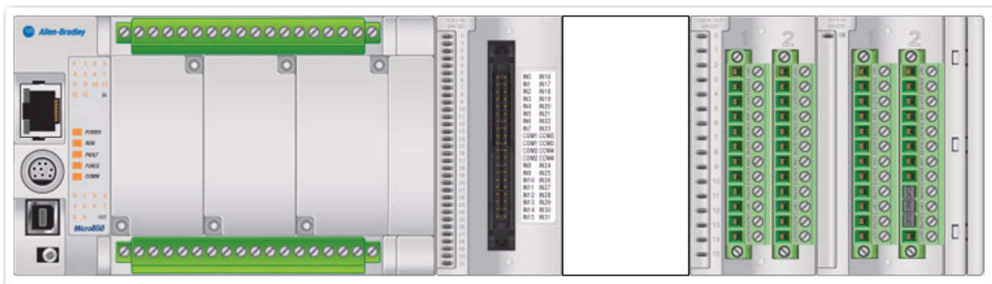
1. On the project graphic in the center pane, right-click 2085-IF4 and click Delete.



2. Another message box appears asking you if you want to empty the placeholders to the left to fill the empty slot. Click No.

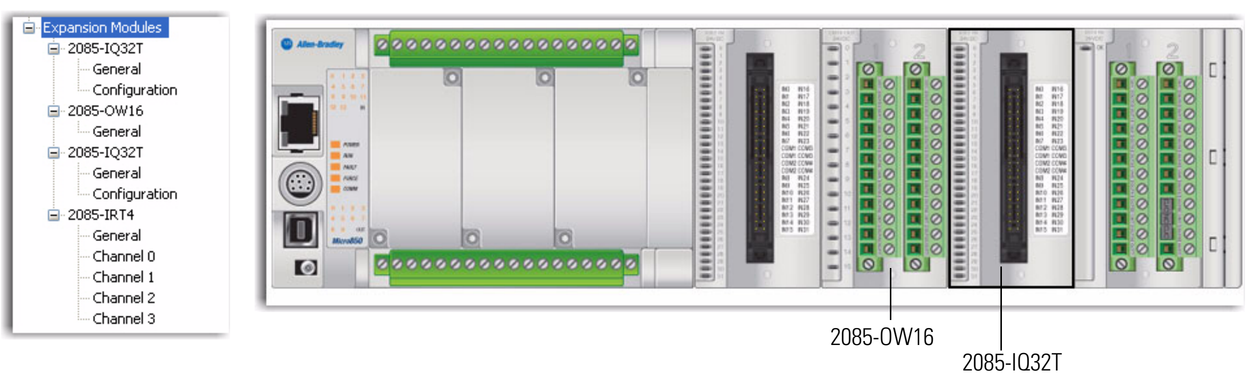


After deleting 2085-IF4 from slot 2, the project graphic should look like this:

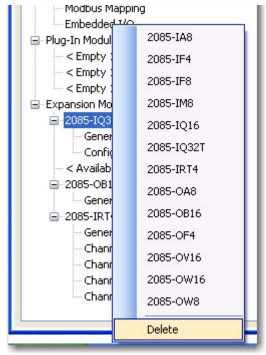


3. On the empty slot (slot 2), right-click and select 2085-OW16.
4. Next, replace 2085-OB16 in slot 3 with a 2085-IQ32T device. Right-click 2085-OB16 in slot 3, and choose 2085-IQ32T.

   The project graphic and Expansion Modules list should look like these after the modules are replaced:



TIP You can also delete and replace an expansion I/O through the Expansion Modules list. To replace, right-click the expansion I/O module you would like to replace, then select the Expansion I/O module you would like to replace it with, from the list that appears. To delete the Expansion I/O, choose Delete.



Build, Save, Download a Project with Expansion I/O Configuration

To learn how to build, save, and download the project to your controller, see the Connected Components Workbench Online Help.

I/O Data Mapping

This section includes I/O data mapping for the discrete, analog, and specialty expansion I/O modules.

Discrete I/O Data Mapping

TIP Use the Connected Components Workbench software to see Global Variables.

2085-IQ16 and 2085-IQ32T I/O Data Mapping

Discrete input states can be read from Global Variables _IO_Xx_DI_yy, where x represents the expansion slot number 1…4 and yy represents the point number 00…15 for 2085-IQ16 and 00…31 for 2085-IQ32T.

2085-OV16 and 2085-OB16 I/O Data Mapping

Discrete output states can be read from Global Variables _IO_Xx_ST_yy, where "x" represents the expansion slot number 1…4 and yy represents the point number 00…15.

Discrete output states can be written to Global Variables _IO_Xx_DO_yy, where "x" represents the expansion slot number 1…4 and yy represents the point number 00…15.

2085-IA8 and 2085-IM8 I/O Data Mapping

Discrete input states can be read from Global Variables _IO_Xx_DI_yy, where x represents the expansion slot number 1…4 and yy represents the point number 00…07.

2085-OA8 I/O Data Mapping

Discrete output states can be read from Global Variables _IO_Xx_ST_yy, where "x" represents the expansion slot number 1…4 and yy represents the point number 00…07.

Discrete output states can be written to Global Variables _IO_Xx_DO_yy, where "x" represents the expansion slot number 1…4 and yy represents the point number 00…07.

2085-OW8 and 2085-OW16 I/O Data Mapping

Discrete output states can be read from Global Variables _IO_Xx_ST_yy, where "x" represents the expansion slot number 1…4 and yy represents the point number 00…07 for 2085-OW8 and 00…15 for 2085-OW16.

Discrete output states can be written to Global Variables _IO_Xx_DO_yy, where "x" represents the expansion slot number 1…4 and yy represents the point number 00…07 for 2085-OW8 and 00…15 for 2085-OW16.

Analog I/O Data Mapping

The following sections provide I/O and status mapping for the following analog expansion I/O modules:

Catalog Number	Description
2085-IF4	4-channel, 14-bit analog voltage/current input module
2085-IF8	8-channel, 14-bit analog voltage/current input module
2085-OF4	4-channel, 12-bit analog voltage/current output module
2085-IRT4	4-channel, 16-bit RTD and Thermocouple input module

TIP Use the Connected Components Workbench software to see Global Variables.

2085-IF4 I/O Data Mapping

Analog input values are read from Global Variables _IO_Xx_AI_yy, where "x" represents the expansion slot number 1…4 and yy represents the channel number 00…03.

Analog input status values can be read from Global Variables IO_Xx_ST_yy, where "x" represents the expansion slot number 1…4 and yy represents the status word number 00…02.

2085-IF4(1) Status Data Mapping

Word	R/W	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status 0	R	PU	GF	CRC	Reserved												
Status 1	R	Reserved		HHA1	LLA1	HA1	LA1	DE1	S1	Reserved		HHA0	LLA0	HA0	LA0	DE0	S0
Status 2	R	Reserved		HHA3	LLA3	HA3	LA3	DE3	S3	Reserved		HHA2	LLA2	HA2	LA2	DE2	S2

(1) See Field Descriptions table for definition of each bit.

2085-IF8 I/O Data Mapping

Analog input values are read from Global Variables _IO_Xx_AI_yy, where "x" represents the expansion slot number 1…4 and yy represents the channel number 00…07.

Analog input status values can be read from Global Variables IO_Xx_ST_yy, where "x" represents the expansion slot number 1…4 and yy represents the status word number 00…04. Individual bits within a status word can be read by appending a .zz to the Global Variable name, where "zz" is the bit number 00…15.

2085-IF8(1) Status Data Mapping

Word	R/W	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status 0	R	PU	GF	CRC	Reserved												
Status 1	R	Reserved		HHA1	LLA1	HA1	LA1	DE1	S1	Reserved		HHA0	LLA0	HA0	LA0	DE0	S0
Status 2	R	Reserved		HHA3	LLA3	HA3	LA3	DE3	S3	Reserved		HHA2	LLA2	HA2	LA2	DE2	S2
Status 3	R	Reserved		HHA5	LLA5	HA5	LA5	DE5	S5	Reserved		HHA4	LLA4	HA4	LA4	DE4	S4
Status 4	R	Reserved		HHA7	LLA7	HA7	LA7	DE7	S7	Reserved		HHA6	LLA6	HA6	LA6	DE6	S6

(1) See Bit Field Descriptions table for a detailed definition of each bit.

Field Descriptions for 2085-IF4 and 2085-IF8 Input Modules

Field	Description	
CRC	CRC error	This bit is set (1) when there is a CRC error on the data received. It gets cleared when the next good data is received.
DE#	Data Error	These bits are set (1) when the enabled input channels are not getting any reading for the current sampling. The respective returned Input Data value remains the same as the previous sample.
GF	General Fault	This bit is set (1) when any of these faults occur: RAM test failure, ROM test failure, EEPROM failure, and reserved bits. All channel fault bits (S#) are set too.
HA#	High Alarm Overrange	These bits are set (1) when the input channel exceeds a preset high limit defined by the configuration selected (UL# is set).
HHA#	High High Alarm Overrange	These bits are set (1) when the input channel exceeds a preset high-high limit defined by the configuration selected (UL# is set).
LA#	Low Alarm (underrange)	These bits are set (1) when the input channel goes below the configured low alarm limit.
LLA#	Low Low Alarm (underrange)	These bits are set (1) when the input channel goes below the configured low-low alarm limit.
PU	Power Up	1. This bit is set after a power on. It is cleared when good configuration data is accepted by the module. 2. It is set when an unexpected MCU reset occurs in RUN mode. All channel fault bits (S#) are set too. The module stays connected with no configuration after the reset. PU and channel fault bits (S#) are cleared when a good configuration is accepted.
S#	Channel fault	These bits are set(1) if the corresponding channels are open, have data error or under/overrange.

2085-OF4 I/O Data Mapping

Analog output data can be written to Global Variables _IO_Xx_AO_yy, where "x" represents the expansion slot number 1…4 and yy represents the channel number 00…03.

Control bit states can be written to Global Variable _IO_Xx_CO_00.zz, where "x" represents the expansion slot number 1…4 and "zz" represents the bit number 00…12.

2085-OF4 Control Data Mapping

Word	Bit Position															
	15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Control 0	Reserved				CE3	CE2	CE1	CE0	UU3	UO3	UU2	UO2	UU1	UO1	UU0	UO0

Channel Alarm/Error Unlatch

UU*x* and **UO*x*** are written during run mode to clear any latched lunder- and over-range alarms. The alarm is unlatched when the unlatch bit is set (1) and the alarm condition no longer exists. If the alarm condition persists, then the unlatch bit has no effect.

CE*x* are written during run mode to clear any DAC hardware error bits and re-enable the error-disabled channel *x*.

You need to keep the unlatch bit set until verification from the appropriate input channel status word says that the alarm status bit has cleared(0), then you need to reset(0) the unlatch bit.

Status Data

Analog output status can be read from Global Variables IO_Xx_ST_yy, where “x” represents the expansion slot number 1…4 and “yy” represents the status word number 00…06. Individual bits within a status word can be read by appending a .zz to the Global Variable name, where "zz" is the bit number 00…15.

2085-OF4 Status Data Mapping

Word	Bit Position															
	15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Status 0	Channel 0 Data Value															
Status 1	Channel 1Data Value															
Status 2	Channel 2 Data Value															
Status 3	Channel 3 Data Value															
Status 4	PU	GF	CRC	Reserved	Reserved				E3	E2	E1	E0	S3	S2	S1	S0
Status 5	Reserved		U3	O3	Reserved		U2	O2	Reserved		U1	O1	Reserved		U0	O0
Status 6	Reserved															

Field Descriptions for 2085-OF4 Status Word

Field	Description	
CRC	CRC error	Indicates there is a CRC error on data receive. All channel fault bits (S*x*) are also set. The error is cleared when the next good data is received.
E*x*	Error	Indicates there is an DAC hardware error, broken wire or high load resistance associated with the channel *x*, an error code may be displayed on the respective input word (0…3) and the corresponding channel is locked (disabled) until user clears the error by writing the CE*x* bit in output data.
GF	General Fault	Indicates a fault has occurred, including: RAM test failure, ROM test failure, EEPROM failure, and reserved bits. All channel fault bits (S*x*) are also set.

Field Descriptions for 2085-OF4 Status Word

Field	Description	
O*x*	Over-Range Flag	Indicates the controller is attempting to drive the analog output above its normal operating range or above the channel's High Clamp level. However the module continues to convert analog output data to a maximum full range value if clamp levels are not set for the channel.
PU	Power Up	Indicates an unexpected MCU reset has occurred in RUN mode. All channel error bits (Ex) and fault bits (Sx) are also set. The module stays connected with no configuration after the reset. PU and channel fault bits are cleared when a good configuration is downloaded.
S*x*	Channel Fault	Indicates there is an error associated with the channel x.
U*x*	Under-Range Flag	Indicates the controller is attempting to drive the analog output below its normal operating range or below the channel's Low Clamp level (if clamp limits are set for the channel).

Specialty I/O Data Mapping

2085-IRT4 I/O Data Mapping

Analog input values can be read from Global Variables _IO_Xx_AI_yy, where “x” represents the expansion slot number 1…4 and yy represents the channel number 00…03.

Analog input status can be read from Global Variables IO_Xx_ST_yy, where “x” represents the expansion slot number 1…4 and yy represents the status word number 00…02. Individual bits within a status word can be read by appending a .zz to the Global Variable name, where "zz" is the bit number 00...15.

2085-IRT4 Status Data Mapping

Word	Bit Position															
	15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Status 0	DE3	DE2	DE1	DE0	OC3	OC2	OC1	OC0	R3	R2	R1	R0	S3	S2	S1	S0
Status 1	O3	O2	O1	O0	U3	U2	U1	U0	T3	T2	T1	T0	CJC over	CJC under	CJC OC	CJC DE
Status 2	PU	GF	CRC	Reserved												

Field Descriptions for 2085-IRT4

Field	Description	
CJC OC	Cold Junction Compensation Open Circuit	Indicates that the cold junction sensor is open-circuit. CJC DE bit, when set, indicates the cold junction sensor current readings is not reliable. The previous reading shall be used instead. It indicates internal compensation status if Tx is set.
CJC DE	Cold Junction Compensation Data Error	Indicates that the cold junction sensor current readings is not reliable. The previous reading will be used instead. It indicates internal compensation status if Tx is set.
CJC over	Cold Junction Compensation overrange	Indicates cold junction sensor overrange (above 75 °C).

Field Descriptions for 2085-IRT4

Field	Description	
CJC under	Cold Junction Compensation underrange	Indicates cold junction sensor is underrange (below -25 °C).
CRC	CRC error	Indicates there is a CRC error on data receive. All channelfault bits (Sx) are also set. The error is cleared when the next good data is received.
DEx	Data Error	Indicates that the current input data is not reliable. The previous input data is sent to the controller instead. Diagnostic status bits are for internal use only.
GF	General Fault	Indicates a fault has occurred, including: RAM test failure, ROM test failure, EEPROM failure, and reserved bits. All channel fault bits (Sx) are also set.
OCx	Open-Circuit Flag	Indicates that an open-circuit condition exists on the channel x.
Ox	Over-Range Flag	Indicates the controller is attempting to drive the analog output above its normal operating range or above the channel's High Clamp level. However the module continues to convert analog output data to a maximum full range value if clamp levels are not set for the channel.
PU	Power Up	Indicates an unexpected MCU reset has occurred in RUN mode. All channel error bits (Ex) and fault bits (Sx) are also set. The module stays connected with no configuration after the reset. PU and channel fault bits are cleared when a good configuration is downloaded.
Rx	RTD compensation	Indicates that the RTD compensation of channel x is not working. This is effective for RTD and ohm type only.
Sx	Channel Fault	Indicates there is an error associated with the channel x.
Tx	Thermocouple compensation	Indicates that the thermocouple compensation of channel x is not working. This is effective for thermocouple type only.
Ux	Underrange	Indicates that the input of channel x is at the minimum end of its normal operating range. The module automatically resets the bit when the under-range condition is cleared and the data value is within the normal operating range.

Calibration of Analog Modules

The analog modules are shipped to you calibrated.

Specifications

See Expansion I/O on page 240 for a list of specifications for each of the analog and digital expansion I/O modules.

Micro800 Plug-In Modules and Accessories

This chapter provides a brief description of plug-in modules and accessories that can be used with the Micro830 and Micro850 controllers. It includes the following sections:

Topic	Page
Accessory	108
External AC Power Supply	108
Plug-In Modules	101
Micro800 RS-232/RS-485 Isolated Serial Port Plug-in Module	106
Micro800 Non-isolated Unipolar Analog Input/Non-isolated Unipolar Analog Output	105
Micro800 Non-isolated Unipolar Analog Output Plug-in Module	105
Micro800 Non-isolated Thermocouple and RTD Plug-in Modules	106
Micro800 Memory Backup and High Accuracy RTC Plug-In Module	107
Micro800 6-Channel Trimpot Analog Input Plug-In Module	108

Plug-In Modules

With plug-in modules, you can enhance the functionality of your base unit controller. You can:

- Extend the functionality of embedded I/O without increasing the footprint of your controller.
- Improve performance by adding additional processing power or capabilities.
- Add additional communication functionality.

Micro800 supports the following plug-in modules:

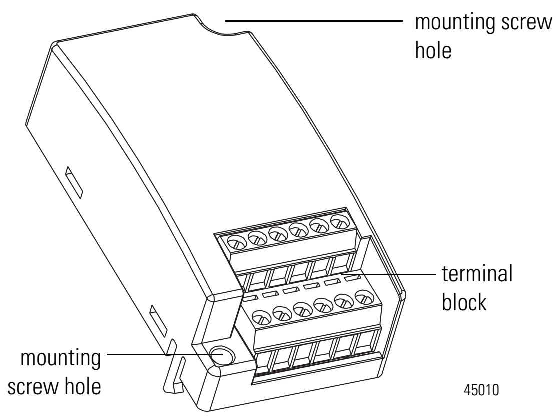
Module	Type	Description
2080-IQ4	Discrete	4-point, 12/24V DC Sink/Source Input
2080-IQ4OB4	Discrete	8-point, Combo, 12/24V DC Sink/Source Input 12/24V DC Source Output
2080-IQ4OV4	Discrete	8-point, Combo, 12/24V DC Sink/Source Input 12/24V DC Sink Output
2080-OB4	Discrete	4-point, 12/24V DC Source Output
2080-OV4	Discrete	4-point, 12/24V DC Sink Output
2080-OW4I	Discrete	4-point, AC/DC Relay Output
2080-IF2	Analog	2-channel, Non-isolated Unipolar Voltage/Current Analog Input

Module	Type	Description
2080-IF4	Analog	4-channel, Non-isolated Unipolar Voltage/Current Analog Input
2080-OF2	Analog	2-channel, Non-isolated Unipolar Voltage/Current Analog Output
2080-TC2	Specialty	2-channel, Non-isolated Thermocouple Module
2080-RTD2	Specialty	2-channel, Non-isolated RTD Module
2080-MEMBAK-RTC	Specialty	Memory Backup and High Accuracy RTC
2080-TRIMPOT6	Specialty	6-Channel Trim Pot Analog Input
2080-SERIALISOL	Communication	RS232/485 Isolated Serial Port

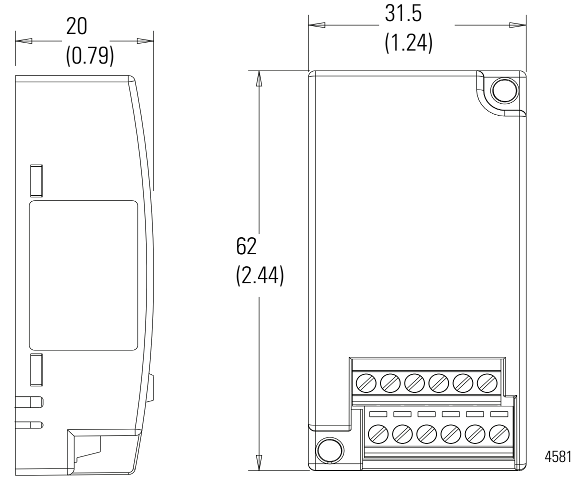
Hardware Features

The plug-in modules, except for the 2080-MEMBAK-RTC, can be inserted onto any plug-in slot on the Micro830/Micro850 controller.

2080-RTD2 shown



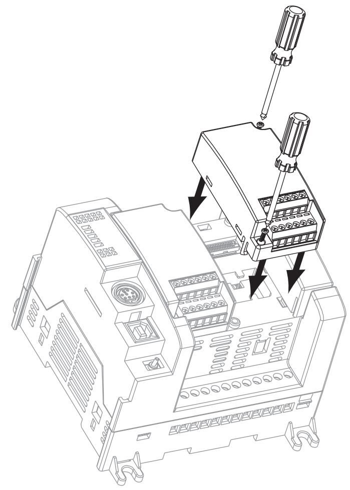
Measurements in millimeters (inches)



Side view **Front view**

Insert Module into Controller

Follow the instructions to insert and secure the plug-in module to the controller.



45012

1. Position the plug-in module with the terminal block facing the front of the controller as shown.
2. Snap the module into the module bay.
3. Using a screwdriver, tighten the 10…12 mm (0.39…0.47 in.) M3 self tapping screw to torque specifications.

Plug-In Features

Micro800 Discrete Input, Output, and Combination Plug-in Modules

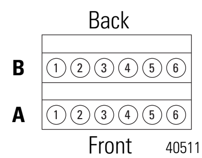
The following Micro800 discrete plug-in modules are supported by Micro830 and Micro850 controllers:

- 2080-IQ4
- 2080-IQ4OB4
- 2080-IQ4OV4
- 2080-OB4
- 2080-OV4

These modules convert AC or DC On/Off signals from user devices to appropriate logic level for use within the processor. They can update the controller with new data whenever a specified input point transitions from On to Off and Off to On.

Wire the Modules

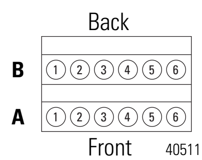
2080-IQ4



(View into terminal block)

Pin A1	I-02	Pin B1	I-00
Pin A2	I-03	Pin B2	I-01
Pin A3	COM	Pin B3	COM
Pin A4	COM	Pin B4	COM
Pin A5	Not used	Pin B5	Not used
Pin A6	Not used	Pin B6	Not used

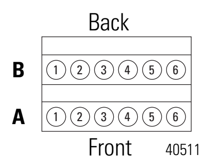
2080-IQ4OB4, 2080-IQ4OV4



(View into terminal block)

Pin A1	I-02	Pin B1	I-00
Pin A2	I-03	Pin B2	I-01
Pin A3	COM	Pin B3	COM
Pin A4	-24V DC	Pin B4	+24V DC
Pin A5	O-02	Pin B5	O-00
Pin A6	O-03	Pin B6	O-01

2080-OB4, 2080-OV4



(View into terminal block)

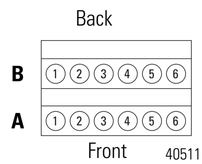
Pin A1	Not used	Pin B1	Not used
Pin A2	Not used	Pin B2	Not used
Pin A3	-24V DC	Pin B3	+24V DC
Pin A4	-24V DC	Pin B4	+24V DC
Pin A5	O-02	Pin B5	O-00
Pin A6	O-03	Pin B6	O-01

Micro800 AC/DC Relay Output Module

The 2080-OW4I is a 4-channel relay output and provides dry contact relay closure outputs for switching a variety of AC and DC voltages to field loads.

Relay output modules provide a suitable interface to noncritical output devices. These non-critical devices typically include status alarms or other field devices that are not used for primary safety shutdown purposes.

Wire the Module



(View into terminal block)

Pin A1 COM3	Pin B1 COM0
Pin A2 O-3	Pin B2 O-0
Pin A3 Not used	Pin B3 COM1
Pin A4 Not used	Pin B4 O-1
Pin A5 Not used	Pin B5 COM2
Pin A6 Not used	Pin B6 O-2

Micro800 Non-isolated Unipolar Analog Input/Non-isolated Unipolar Analog Output

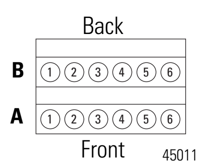
The 2080-IF2 or 2080-IF4 plug-in adds extra embedded Analog I/O – up to 10 analog inputs for 2080-IF2 and 20 analog inputs for 2080-IF4 – and offers 12-bit resolution.

This plug-in can be used in any slot of your Micro830/850 controller. Removal and Insertion Under Power (RIUP) is not supported.

Wire the Module

Follow the pinout diagram to wire your plug-in module.

12-Pin Female Terminal Block



2080-IF2

(View into terminal block)

Pin A1 COM	Pin A5 Not used	Pin B3 COM
Pin A2 Not used	Pin A6 Not used	Pin B4 VI-1
Pin A3 Not used	Pin B1 VI-0	Pin B5 CI-1
Pin A4 COM	Pin B2 CI-0	Pin B6 COM

2080-IF4

(View into terminal block)

Pin A1 COM	Pin A5 VI-3	Pin B3 COM
Pin A2 VI-2	Pin A6 CI-3	Pin B4 VI-1
Pin A3 CI-2	Pin B1 VI-0	Pin B5 CI-1
Pin A4 COM	Pin B2 CI-0	Pin B6 COM

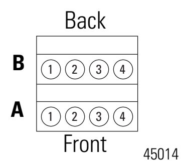
Micro800 Non-isolated Unipolar Analog Output Plug-in Module

The 2080-OF2 plug-in adds extra embedded Analog I/O, up to 10 analog outputs, and offers 12-bit resolution. This plug-in can be used in any slot of your Micro830/Micro850 controller. Removal and Insertion Under Power (RIUP) is not supported.

Wire the Module

Follow the pinout diagram to wire your plug-in module. Do not connect both the voltage and current terminals at the same time.

8-Pin Female Terminal Block



(View into terminal block)

Pin A1 COM	Pin B1 VO-0
Pin A2 COM	Pin B2 CO-0
Pin A3 COM	Pin B3 VO-1
Pin A4 COM	Pin B4 CO-1

Micro800 Non-isolated Thermocouple and RTD Plug-in Modules

These plug-in modules (2080-TC2 and 2080-RTD2) help to make temperature control possible when used with PID. These plug-ins can be used in any slot of your Micro830/Micro850 controller. Removal and Insertion Under Power is not supported.

The RTD and Thermocouple plug-in modules are discussed in detail in the next chapter. (See Non-isolated Thermocouple and RTD Plug-in Modules on page 317).

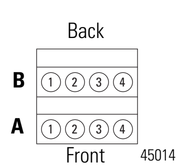
Micro800 RS-232/RS-485 Isolated Serial Port Plug-in Module

The 2080-SERIALISOL plug-in supports CIP Serial (RS-232 only), Modbus RTU (RS-232 only), and ASCII (RS-232 only) protocols. Unlike the embedded Micro830/Micro850 serial port, this port is electrically isolated, making it ideal for connecting to noisy devices, such as variable frequency and servo drives, as well as for communications over long cable lengths, up to 100 m (109.36 yd) using RS-485.

Wire the Module

Follow the pinout diagram to wire your plug-in module.

8-Pin Female Terminal Block

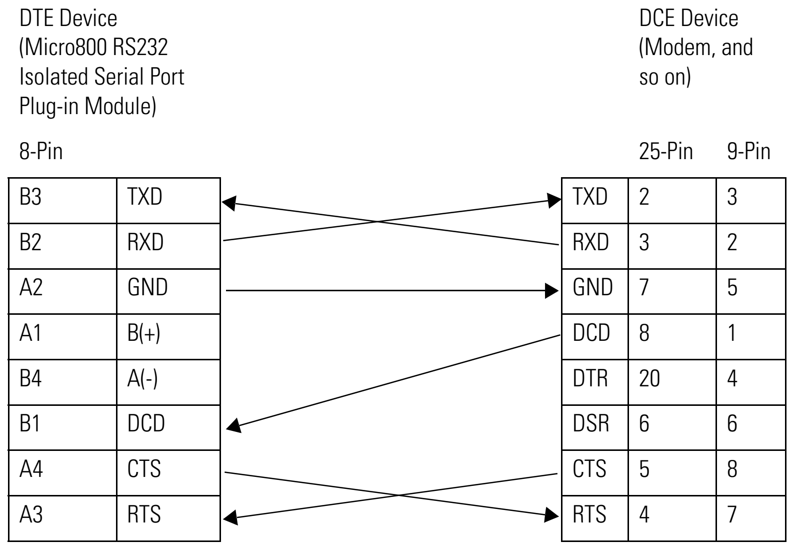


(View into terminal block)

Pin A1 RS485 B+	Pin B1 RS232 DCD
Pin A2 GND	Pin B2 RS232 RXD
Pin A3 RS232 RTS	Pin B3 RS232 TXD
Pin A4 RS232 CTS	Pin B4 RS485 A-

Serial Port to Modem Cable Pinout

When connecting Micro800 to a modem using an RS-232 cable, the maximum that the cable length may be extended is 15.24 m (50 ft).



ATTENTION: Do not connect to pins A1 and B4 for RS-232 connections. This connection will cause damage to the RS-232/485 communication port.

Micro800 Memory Backup and High Accuracy RTC Plug-In Module

This plug-in (2080-MEMBAK-RTC) allows you to make a backup copy of the project in your controller, and adds precision real-time clock function without needing to calibrate or update periodically.

It can also be used to clone/update Micro830/Micro850 application code. However, it cannot be used as additional Run-Time Program or Data Storage.

This plug-in is physically keyed so that it can only be installed in the leftmost slot (slot 1) of your Micro830/Micro850 controller. Removal and Insertion Under Power is supported.

Status Indicator

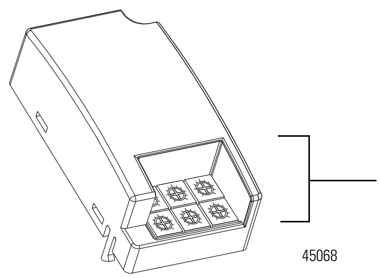
State	Description
Solid red (2 s)	Startup cycle test in progress
Flashing red	Back up in progress
Solid red (contunuous)	Battery low

Back Up/Restore the project

Backup data can be retrieved through the USB adapter, using the software provided.

Micro800 6-Channel Trimpot Analog Input Plug-In Module

The 2080-TRIMPOT6 plug-in offers an affordable method of adding six analog presets for speed, position and temperature control.



Channels

0	1	2
3	4	5

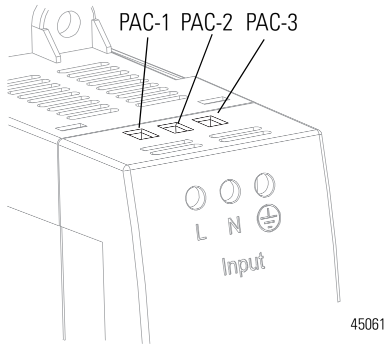
This plug-in can be used in any slot of your Micro830/Micro850 controller. Removal and Insertion Under Power (RIUP) is not supported.

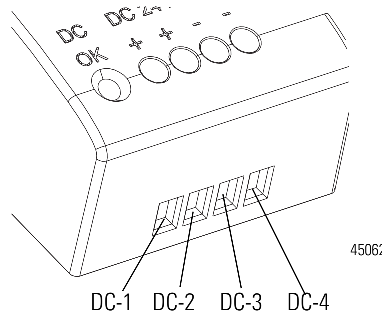
Accessory

External AC Power Supply

Use this optional power supply (2080-PS120-240VAC) in applications with smaller systems when a 24V DC power supply is not available.

Wire the Module





AC Input Connectors			**DC Output Connectors (DC 24V/ 1.6 A)**		
PAC-1	AC hot	100…240V AC	DC-1	+	
PAC-2	AC neutral	100…240V AC	DC-2	+	
PAC-3	Safety ground		DC-3	-	
			DC-4	-	

Specifications

For Micro800 plug-in specifications, see Micro800 Plug-In Modules on page 228.

Notes:

Program Execution in Micro800

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

Overview of Program Execution

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

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 supports jumps within a program. Call a subroutine of code within a program by encapsulating that code as a User Defined Function Block (UDFB). 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.

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, Micro830/850 controllers support

- four Selectable Timed Interrupts (STI). STIs execute assigned programs once every set point interval (0…65535 ms).
- eight Event Input Interrupts (EII). EIIs execute assigned programs once every time the selected input rises or falls (configurable).
- two to six High Speed Counter (HSC) interrupts. HSCs execute assigned programs based on the counter's accumulated count. The number of HSCs depend on the number of controller embedded inputs.

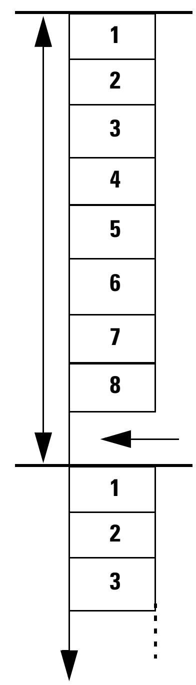
The Global System Variables associated with cycles/scans are:

- __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 eight main steps within a loop. The loop duration is a cycle time for a program.

1. Scan input variables
2. Consume bound variables
3. Execute POUs
4. Produce bound variables
5. Update output variables
6. Save retained values
7. Process IXL messages
8. Sleep until next cycle



In a case where bindings are defined, variables consumed by a resource are updated after the inputs are scanned and the variables produced for other resources are sent before updating inputs.

When a cycle time is specified, a resource waits until this time has elapsed before starting the execution of a new cycle. The POUs execution time varies depending on the number of active steps in SFC programs and instructions such as jumps, IFs, and returns. 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.

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;
2. Communication data packet receiving and transmitting;
3. Motion engine periodical execution.

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. Practically, if the load of one or several of the above activities is heavy, you should provide a reasonable buffer when you calculate the Watchdog timeout setting.

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
__SYSVA_TCYCYCTIME	TIME	Programmed cycle time. **Note**: 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

On firmware revision 2 and later, all digital output variables driven by the I/O scan gets cleared on powerup and during transition to RUN mode.

Two system variables are also available on revision 2.x:

System Variables for Scan and Powerup on Firmware Release 2.x

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. **Note**: 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, 2080-MEMBAK-RTC, 2080-LCD). **Note**: True only on the first scan after a powerup, or running a new ladder for the first time.

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	24- and 48-points
Program steps(1)	4 K	10 K
Data bytes	8 KB	20 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.

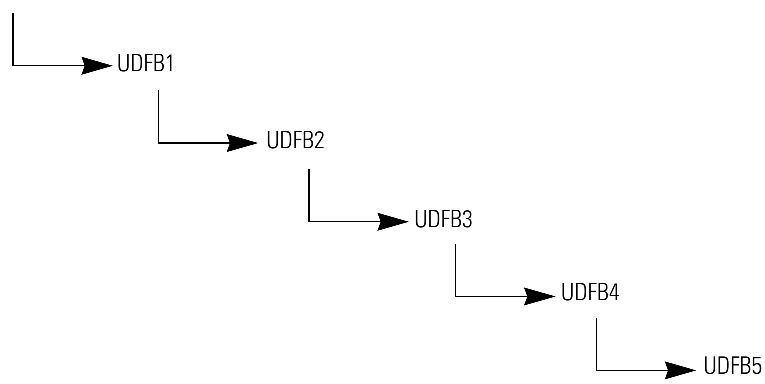
The Micro830 and Micro850 controller also has project memory, which stores a copy of the entire downloaded project (including comments), as well as configuration memory for storing plug-in setup information, and so on.

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/Program Organizational Unit (POU) can use up to 64 Kb of internal address space. With Micro830/Micro850 24/48-point controllers supporting up to 10,000 steps, you could potentially use all of the available internal programming space with just 4 Program Organizational Units (POU). It is recommended that you split large programs into smaller programs to improve code readability, simplify debugging and maintenance tasks.
- 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.

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 RSLogix500 CPT Compute instruction, ST combined with UDFB is a great alternative.
  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.

Notes:

Positioning with Embedded Pulse Train Outputs (PTO)

Certain Micro830 and Micro850 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.

PTO and motion axes support on the Micro830 and Micro850 controllers are summarized below.

PTO and Motion Axis Support on Micro830 and Micro850

Controller	PTO (built-in)	Number of Axes Supported
10/16 Points[1] 2080-LC30-10QVB 2080-LC30-16QVB	1	1
24 Points 2080-LC30-24QVB[1] 2080-LC30-24QBB[1] 2080-LC50-24QVB 2080-LC50-24QBB	2	2
48 Points 2080-LC30-48QVB[1] 2080-LC30-48QBB[1] 2080-LC50-48QVB 2080-LC50-48QBB	3	3

(1) For Micro830 catalogs, Pulse Train Output functionality is only supported on 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 118 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.	• Input and Output Signals on page 119
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.	• Motion Axis and Parameters on page 133 • Motion Axis Configuration in Connected Components Workbench on page 145
Motion Function Blocks	A set of instructions that configure or act upon an axis of motion.	• Connected Components Workbench Online Help • Motion Control Function Blocks on page 123 • Axis_Ref Data Type on page 140 • Function Block and Axis Status Error Codes on page 142 • Homing Function Block on page 157
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.	• See Acceleration, Deceleration, and Jerk Inputs on page 125.

To use the Micro800 motion feature, you need to:

1. Configure the Axis Properties
See Motion Axis Configuration in Connected Components Workbench on page 145 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 119 for fixed and configurable inputs/outputs
   b. See Sample Motion Wiring Configuration on 2080-LC30-xxQVB/2080-LC50-xxQVB on page 122 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.

Configurable input/output

Motion Signals	Input/Output	Notes
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 145.

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.

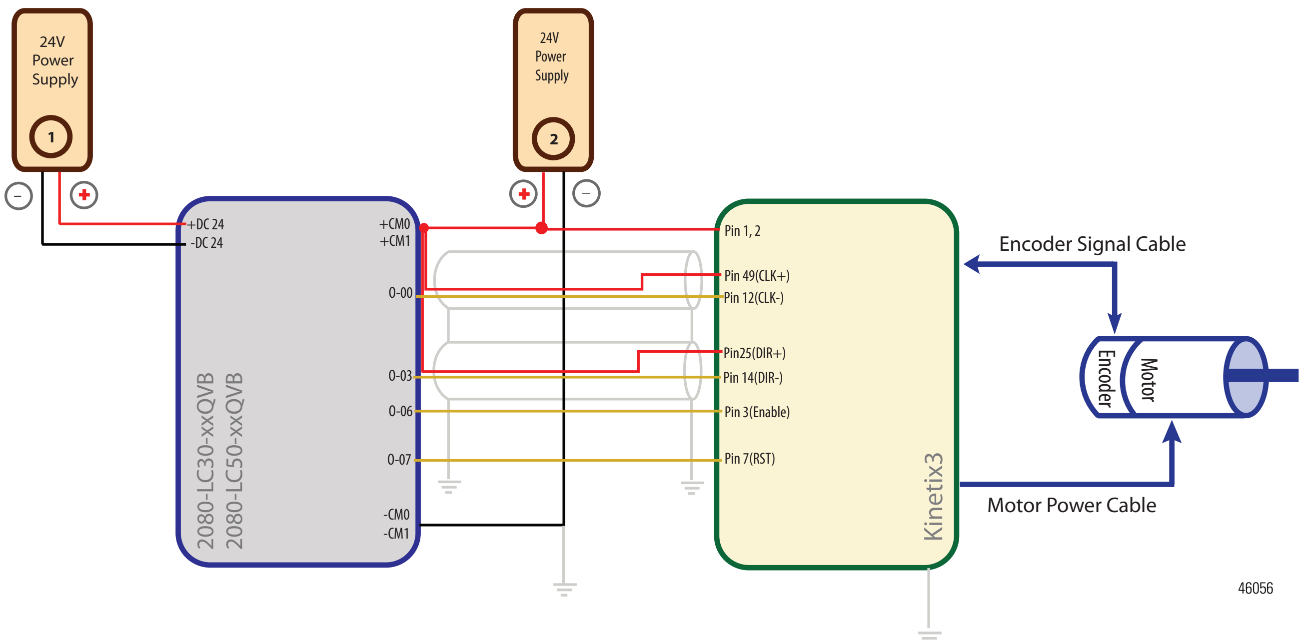
Motion Wiring Input/Output Description

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

Motion Wiring Input/Output Description

Motion Signals	Input/Output	Description	Uniqueness
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
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

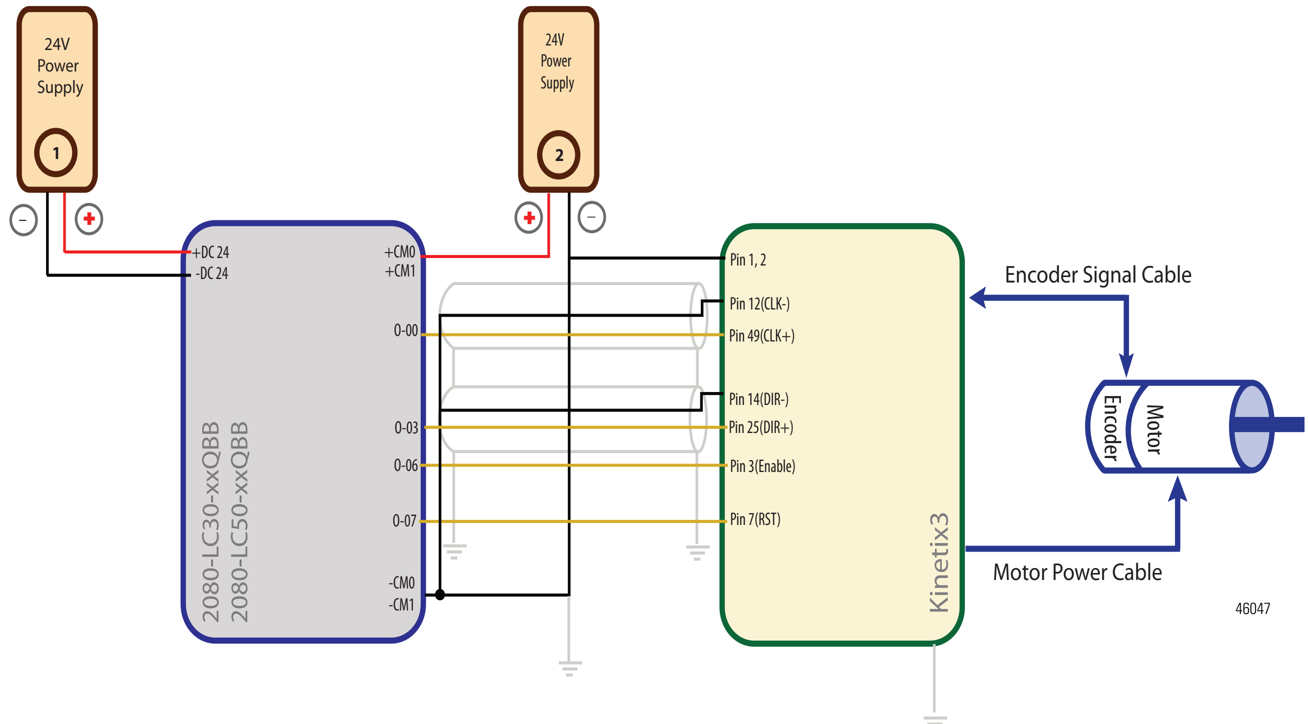


Notes:

(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.

To help you configure Kinetix3 drive parameters so the drive can communicate and be controlled by a Micro830/Micro850 controller, see publication CC-QS025.

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



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.

To help you configure Kinetix3 drive parameters so the drive can communicate and be controlled by a Micro830/Micro850 controller, see publication CC-QS025.

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	

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 the 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: 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.

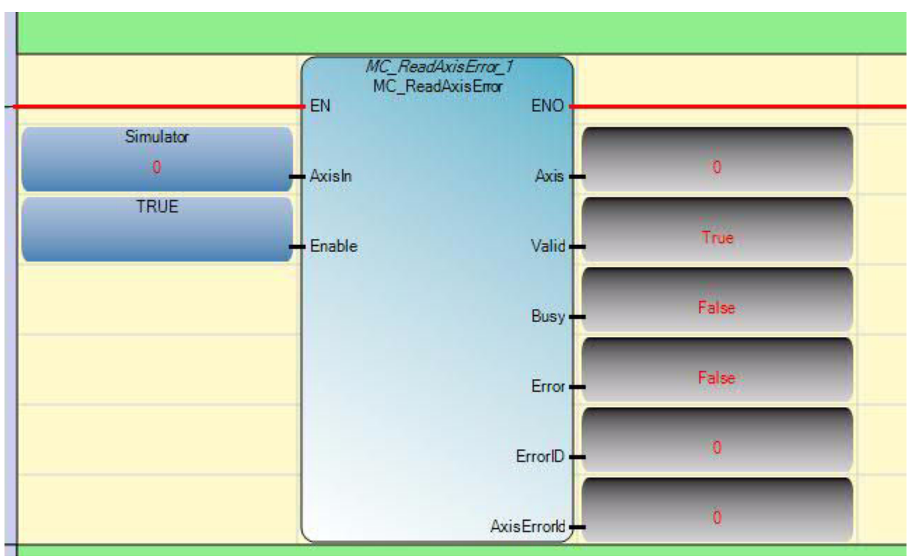
General Rules for the Motion Control Function Blocks

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

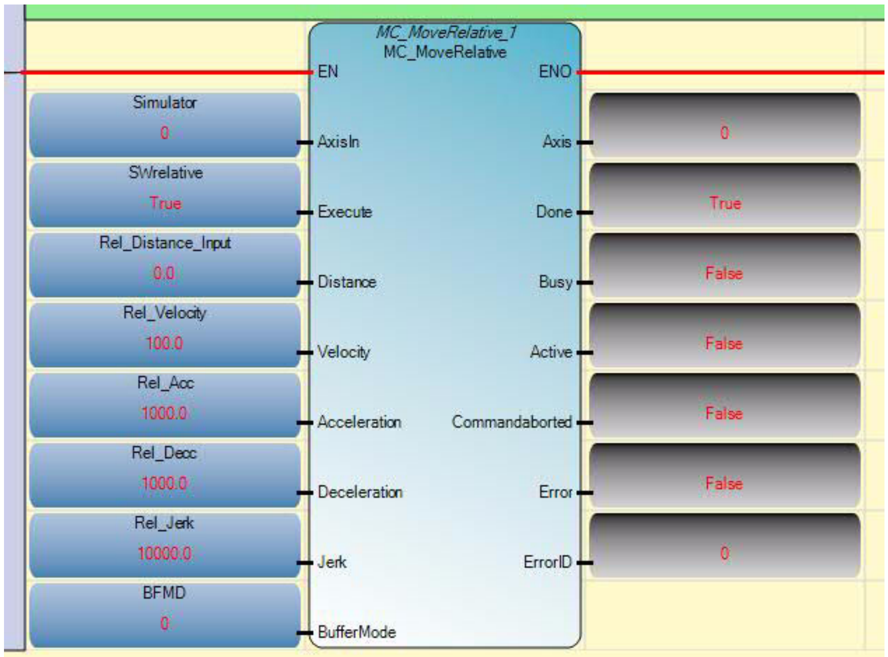
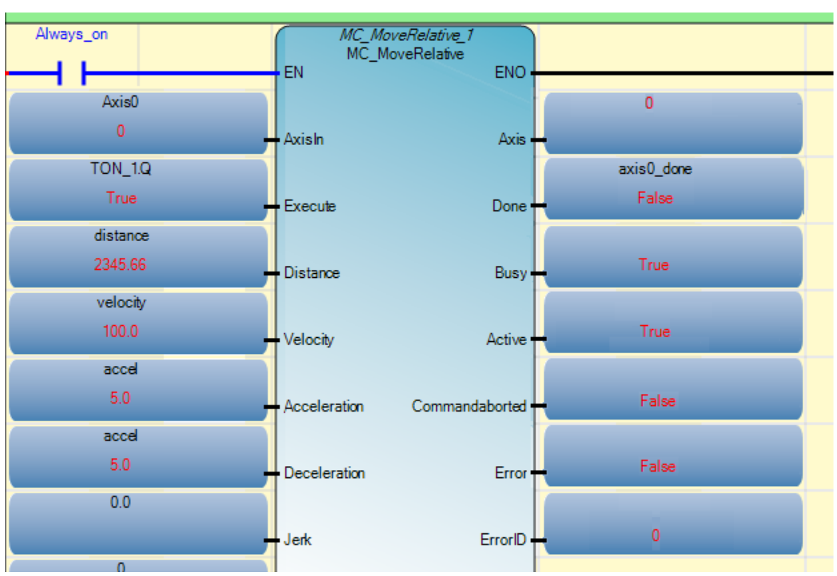
General Rules for the Motion Function Block

Parameter	General Rules
Input parameters	**When Execute is True**: 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. **When Enable is True**: The parameters are used with the rising edge of the Enable input and can be modified continuously.
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. In this case, the Error output is 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 x direction* decides the motion direction, if the value is not 0. For example, if velocity x direction = +300, then direction is positive.
Acceleration, Deceleration, and Jerk Inputs	• 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). • 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). • 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). • If Jerk is set as non-zero value, S-Curve profile is generated. If Jerk is set as zero, trapezoidal profile is generated. • 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). See Function Block and Axis Status Error Codes on page 142 for more information about error codes.

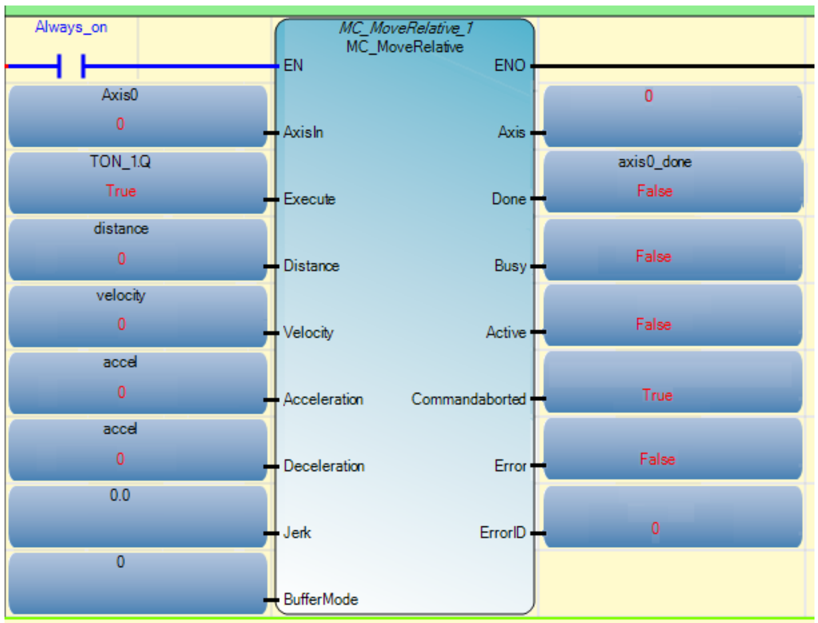
General Rules for the Motion Function Block

Parameter	General Rules
Output Exclusivity	**With Execute**: 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. 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. 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. .  **With Enable**: 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. The Valid, Enabled, Busy, Error, and ErrorID outputs are reset with the falling edge of Enable as soon as possible. 
Axis output	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). 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.

General Rules for the Motion Function Block

Parameter	General Rules
Behavior of Done Output	The output Done is set when the commanded action has completed successfully. With multiple function blocks working on the same axis in a sequence, the following rule applies: 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. 
Behavior of Busy Output	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). 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. 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 eventhough the function block has finished executing. 

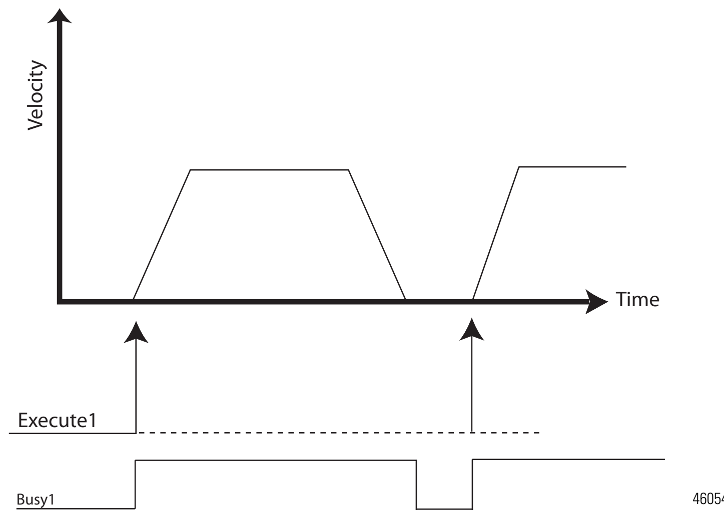
General Rules for the Motion Function Block

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	CommandAborted is set when a commanded motion is aborted by another motion command. When CommandAborted occurs, other output signals such as InVelocity are reset. 
Enable and Valid Status	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. 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. 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.
Relative Move versus Absolute Move	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.
Buffered Mode	For all motion control function blocks, BufferMode input parameter is ignored. Only aborted moves are supported for this release.
Error Handling	All blocks have two outputs which deal with errors that can occur during execution. These outputs are defined as follows: • **Error** – Rising edge of "Error" informs that an error occurred during the execution of the function block, where the function block cannot successfully complete. • **ErrorID** – Error number. **Types of errors**: • Function block logic (such as parameters out of range, state machine violation attempted) • hard limits or soft limits reached • Drive failure (Drive Ready is false) For more information about function block error, see Motion Function Block and Axis status Error ID on page 143.

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

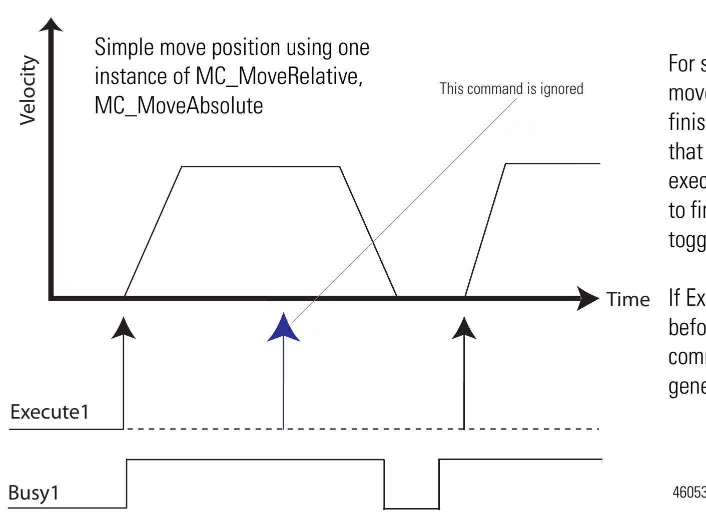
The general rule is that when a movement function block is busy, then a function block **with the same instance** (for example, MC_MoveRelative2) cannot be executed again until the function block status is not busy.

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.

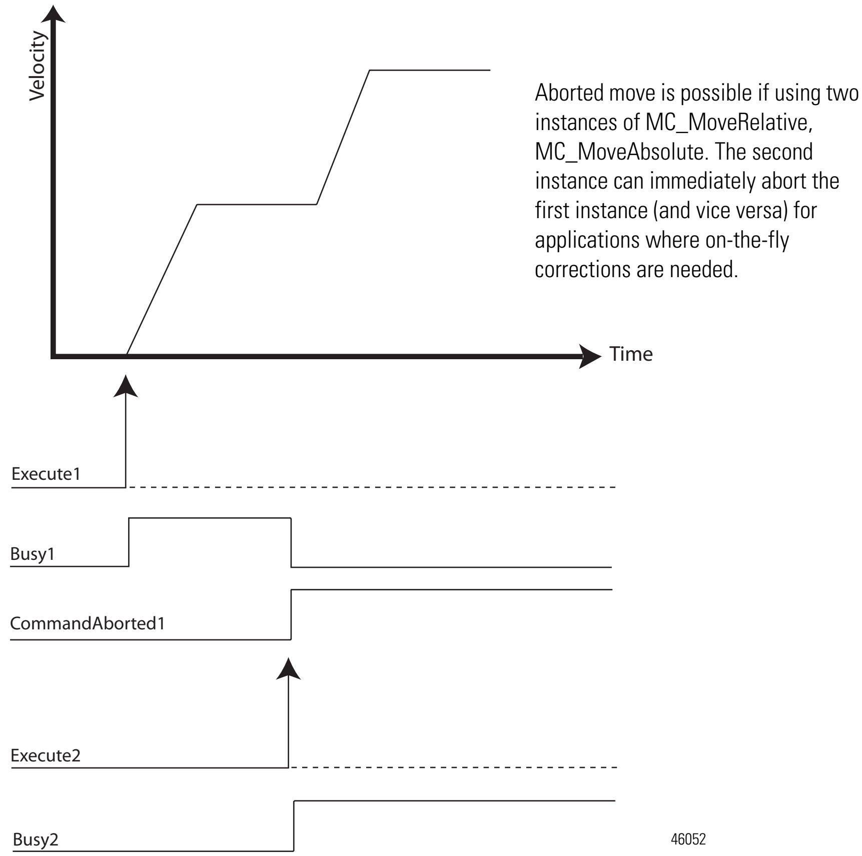
Example: Move to Position Ignored Due to Busy



For simple moves, the movement function block finishes. Busy output indicates that the function block is executing and must be allowed to finish before Execute input is toggled again.

If Execute is toggled again before Busy is false, the new command is ignored. No error is generated.

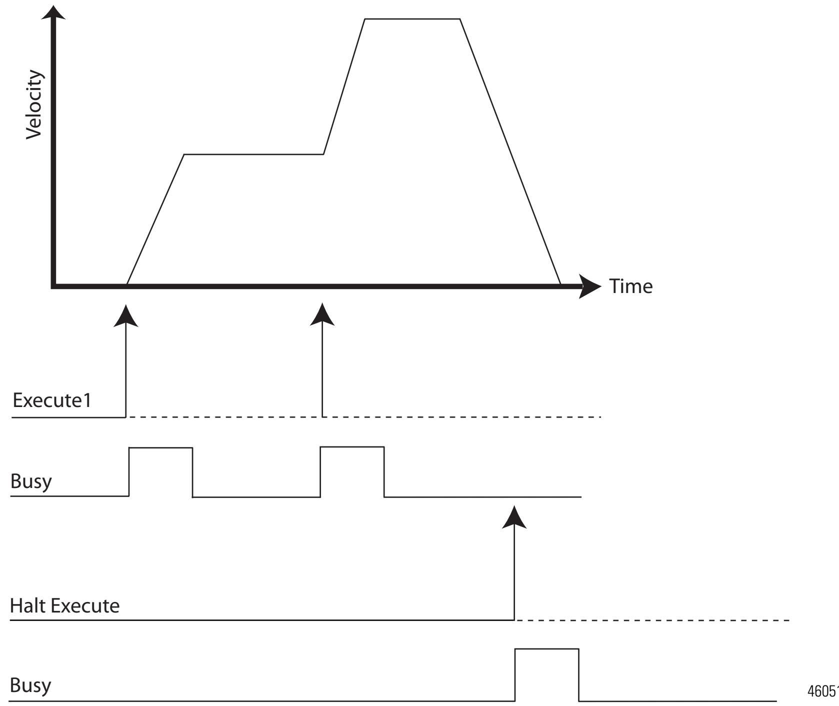
Example: Successful Aborted Move



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.

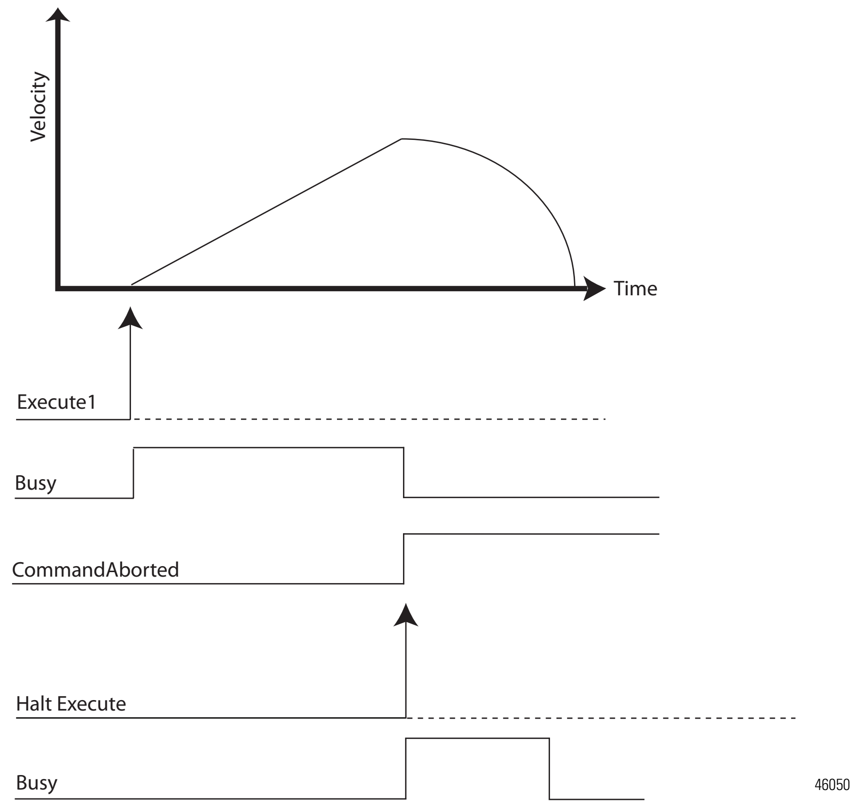
To bring the axis to a standstill, use MC_Halt.



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.

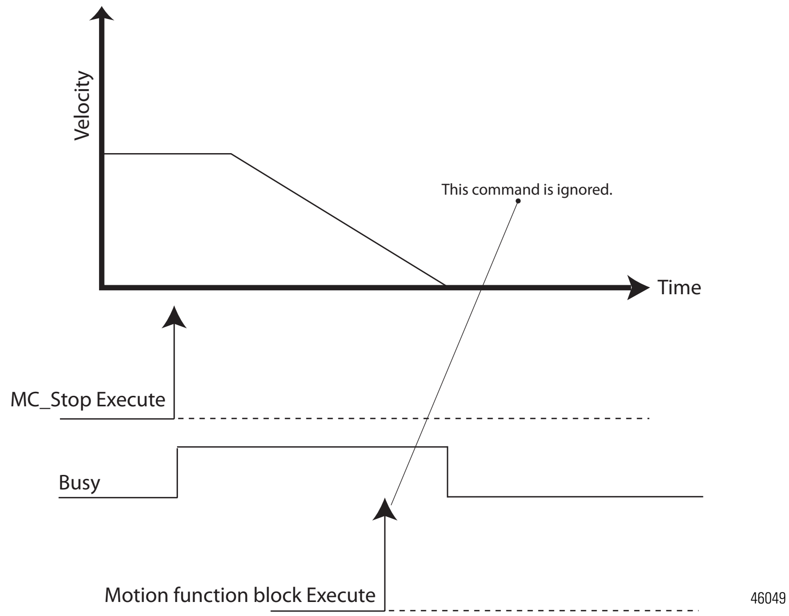
ATTENTION: If MC_Halt aborts another motion function block during acceleration and the MC_Halt Jerk input parameter is less than the Jerk of the currently executing function block, the Jerk of the currently executing function block is used to prevent an excessively long deceleration.

Example: Aborted Movement Function Block During Acceleration/Deceleration



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.

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.

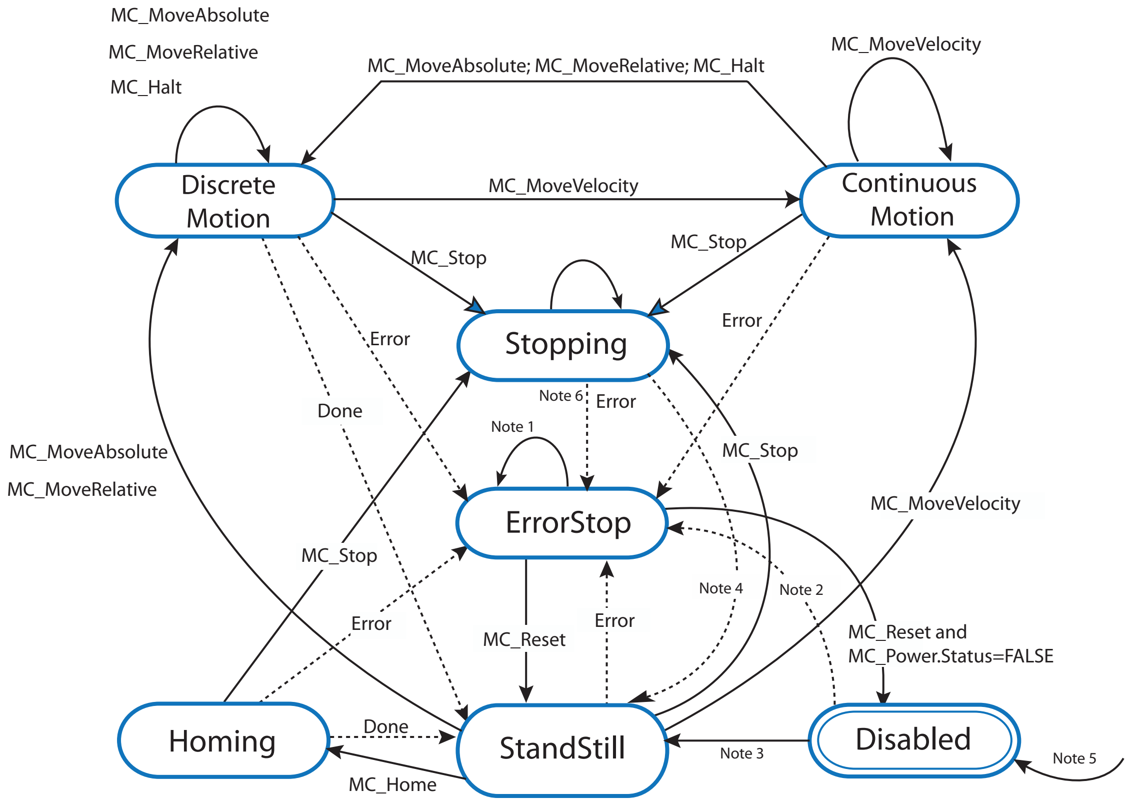
TIP	MC_Stop can abort other motion function blocks but can never be aborted itself.
TIP	MC_Stop goes to the Stopping state and normal operation cannot resume.

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.

(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.

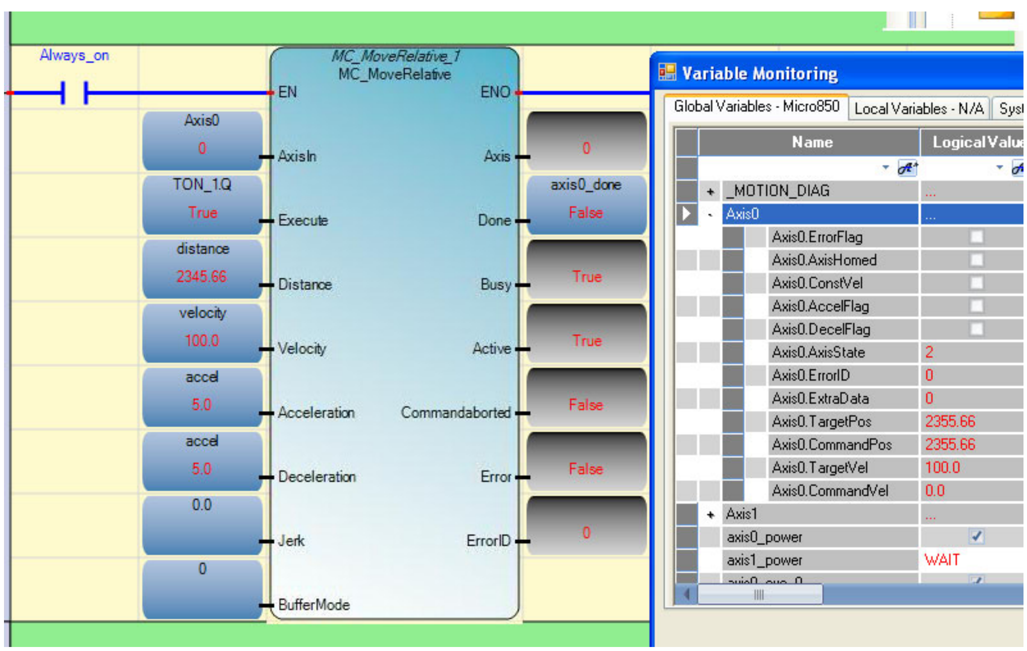
Motion States

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.



Limits

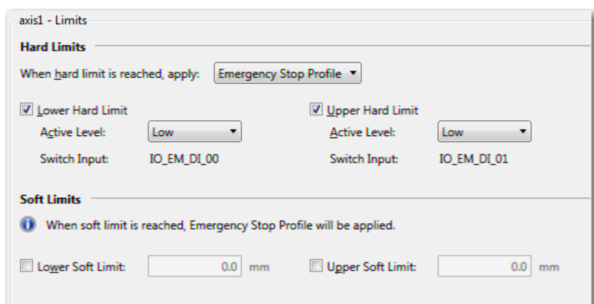
The Limits parameter sets a boundary point for the axis, and works in conjunction with the Stop parameter to define a boundary condition for the axis on the type of stop to apply when certain configured limits are reached.

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 145 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 157.

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

Function Block	Limits Checking
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.

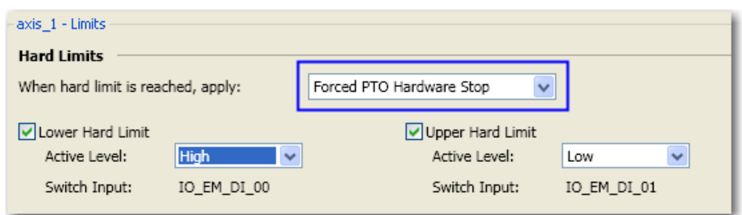
For a continuous motion, if the axis is homed, and the soft limit in the motion direction is enabled, soft limit will be detected before PTO pulse limit being detected.

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 µs).



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

Direction Type	Value used[1]	Direction description
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.

(1) 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 Axis States on page 135.
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 Motion Function Block and Axis status Error ID on page 143.
ExtraData	UINT16	Reserved.
TargetPos	REAL (float)[1]	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)[1]	On a moving axis, this is the current position the controller commands the axis to go to.
TargetVel	REAL (float)[1]	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 PTO Pulse Accuracy on page 156 for more information.
CommandVel	REAL (float)[1]	During motion, this element refers to the velocity the controller commands the axis to use. This element is a signed value indicating direction information.

(1) See Real Data Resolution on page 153 for more information on REAL data conversion and rounding.

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.

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.

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(1)	UINT16
MaxScantime(1)	UINT16
CurrEngineInterval(1)	UINT16
MaxEngineInterval(1)	UINT16
ExtraData	UINT16

(1) 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 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(1)
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: • MC_power function block attempts to control the same axis. • MC_Stop function block is executed against the same axis at the same time. • Two or more MC_TouchProbe function blocks are executed against the same axis at the same time.	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[1]
09	MC_FB_ERR_VELOCITY	The function block cannot execute because the motion profile requested in the function block cannot be achieved due to current axis velocity. Some examples: • The function block requests the axis to reverse the direction while the axis is moving. • The required motion profile cannot be achieved due to current velocity too low or too high. 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.	The axis is not operational. The motion profile requested in the function block cannot be achieved because of current axis velocity. Some examples: • The function block requests the axis to reverse the direction while the axis is moving. • The required motion profile cannot be achieved due to current velocity too low or too high. 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.
10	MC_FB_ERR_SOFT_LIMIT	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.	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.
11	MC_FB_ERR_HARD_LIMIT	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.	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.
12	MC_FB_ERR_LOG_LIMIT	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.	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.
13	MC_FB_ERR_ENGINE	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.	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: http://support.rockwellautomation.com/MySupport.asp.
16	MC_FB_ERR_NOT_HOMED	The Function Block cannot execute because the axis needs to be homed first. Execute homing against the axis using MC_Home Function Block.	The axis is not operational because the axis is not homed. Reset the state of the axis using the MC_Reset Function Block.
128	MC_FB_PARAM_MODIFIED	**Warning**: The requested motion parameter for the axis has been adjusted. The function block executes successfully.	Motion internal Fault, Error ID = 0x80. Contact your local Rockwell Automation technical support representative. For contact information, see: http://support.rockwellautomation.com/MySupport.asp.

(1) 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 and Micro850 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

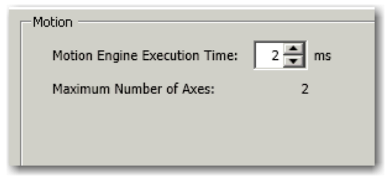
A maximum of three motion axes can be configured through the Connected Components Workbench software. To add, configure, update, delete, and monitor an axis in Connected Components Workbench, refer to the next sections.

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 156 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.

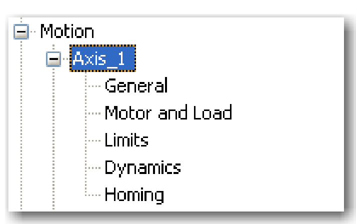
2. Provide an axis name. Click Enter.

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

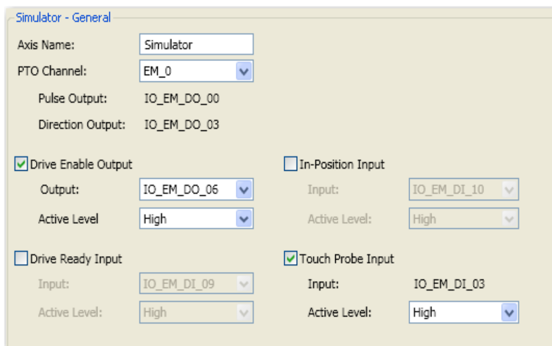


TIP To help you edit these motion properties, see Edit Axis Configuration on page 147. You can also learn more about axis configuration parameters.

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 119 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.

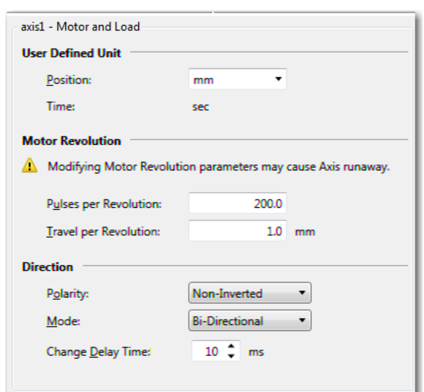
PTO Channel Naming

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 153

Motor and Load Parameters

Parameter	Description and Values
User-defined unit	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: – mm – cm – inches – revs – custom unit (ASCII format of up to 7 characters long)
Time	Read only. Predefined in seconds.
Motor revolution	Defines pulse per revolution and travel per revolution values.
Pulse per revolution[1]	Defines the number of pulses needed to obtain one revolution of the drive motor. *Range*: 0.0001…8388607 *Default*: 200.0
Travel per revolution[1]	Travel per revolution defines the distance, either linear or rotational, that the load moves per revolution of the motor. *Range*: 0.0001…8388607. *Default*:1.0 user unit.
Direction	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.

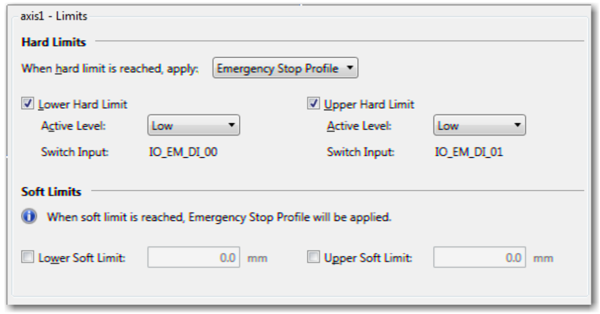
(1) The parameter is set as REAL (float) value in Connected Components Workbench. To learn more about conversions and rounding of REAL values, see Real Data Resolution on page 153.

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 136.

Limits Parameters

Parameter[1]	Value
Hard Limits	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: • Forced PTO Hardware Stop • Emergency Stop Profile
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.
Soft Limits	Defines upper and lower soft limits values.
Lower Soft Limit[2]	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[2]	

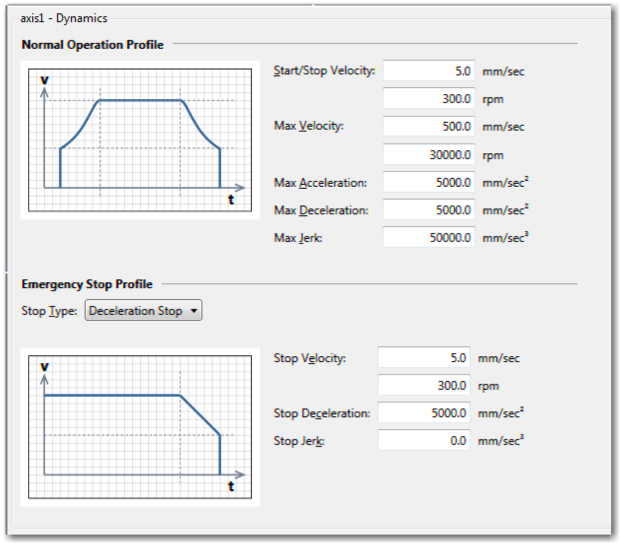
(1) To convert from user units to pulse:

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

(2) 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 153.

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.

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



Dynamics Parameters

Parameter	Values
Start/Stop Velocity[1] [2] Start/Stop Velocity in rpm[1] [2]	*Range*: 1…100,000 pulse/sec *Default*: 5.0 mm/sec (300 rpm) For example, you can configure the value from 0.005…500 user units for steps per revolution of 200.[3] Rpm value is automatically populated when a value in user units is specified, but the user can also initially enter an rpm value. Start/stop velocity should not be greater than maximum velocity.
Max Velocity[1] [2]	*Range*: 1…10,000,000 pulse/sec *Default*: 100,000.0 pulse/sec
Max Acceleration[1]	*Range*: 1…10,000,000 pulse/sec^2 *Default*: 10,000,000 pulse/sec^2 (50,000 mm/sec^2)
Max Deceleration[1]	*Range*: 1…100,000 pulse/sec^2 *Default*: 10,000,000 pulse/sec^2 (50,000 mm/sec^2)
Max Jerk[1]	*Range*: 0…10,000,000 pulse/sec^3 *Default*: 10,000,000 pulse/sec^3 (50,000 mm/sec^3)
Emergency Stop Profile	Defines stop type, velocity, deceleration and jerk values.
Stop Type	Set as Deceleration Stop (default) or Immediate Stop.
Stop Velocity[1]	*Range*: 1…100,000 pulse/sec *Default*: 1,000.0 pulse/sec = 5.0 mm/sec = 300.0 rpm
Stop Deceleration[1]	*Range*: 1…10,000,000 pulse/sec *Default*: 1,000,000 pulse/sec = 5,000.0 mm/sec^2 = 300.0 rpm^2
Stop Jerk[1]	*Range*: 0 ...10,000,000 pulse/sec^3 *Default*: 0.0 (step/sec3) = 0.0 (mm/sec^3)

(1) 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 153.

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

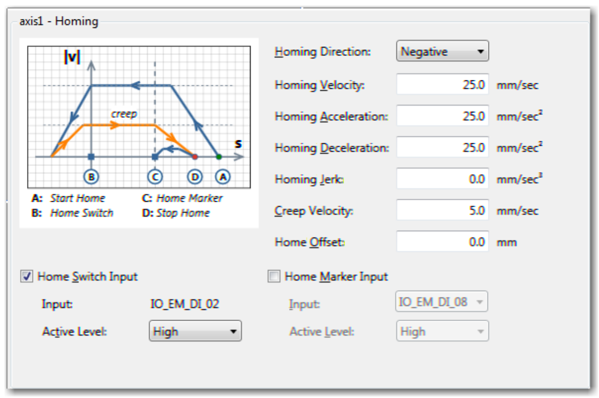
$$v\ (\text{in rpm}) = \frac{v\ (\text{in user unit/sec}) \times 60\ \text{s}}{\text{travel per revolution (in user unit)}}$$

(3) 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(1)	*Range*: 1…100,000 pulse/sec *Default*: 5,000.0 pulse/sec (25.0 mm/sec) **NOTE**: Homing Velocity should not be greater than the maximum velocity.
Homing Acceleration(1)	*Range*: 1…10,000,000 pulse/sec^2 *Default*: 5000.0 pulse/sec^2 (25.0 mm/sec^2) **NOTE**: Homing Acceleration should not be greater than Maximum Acceleration.
Homing Deceleration(1)	*Range*: 1…10,000,000 pulse/sec^2 *Default*: 5000.0 pulse/sec^2 (25.0 mm/sec^2) **NOTE**: Homing Deceleration should not be greater than Maximum Deceleration.
Homing Jerk(1)	*Range*: 0…10,000,000 pulse/sec^3 *Default*: 0.0 pulse/sec^3 (0.0 mm/sec^3) **NOTE**: Homing Jerk should not be greater than Maximum Jerk.
Creep Velocity(1)	*Range*: 1…5,000 pulse/sec *Default*: 1000.0 pulse/sec (5.0 mm/sec) **NOTE**: Homing Creep Velocity should not be greater than Maximum Velocity.
Homing Offset(1)	*Range*: -1073741824…1073741824 pulse *Default*: 0.0 pulse (0.0 mm)

Homing Parameters

Parameter	Value range
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.

(1) 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 153.

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: [1]

Parameter	Actual Value Entered by User	Converted Value in Connected Components Workbench	Tooltip Error Value[1]
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.

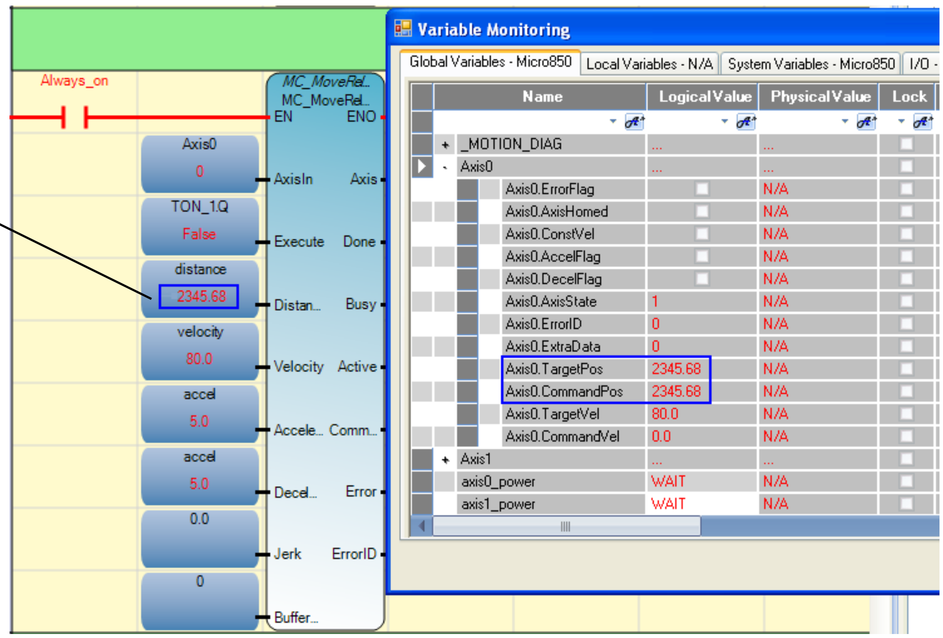
(1) On the axis configuration page in Connected Components Workbench, an input field with a red border indicates that the value that has been entered is invalid. A tooltip message should let you know the expected range of values for the parameter. The range of values presented in the tooltip messages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

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

Variable Monitor Example

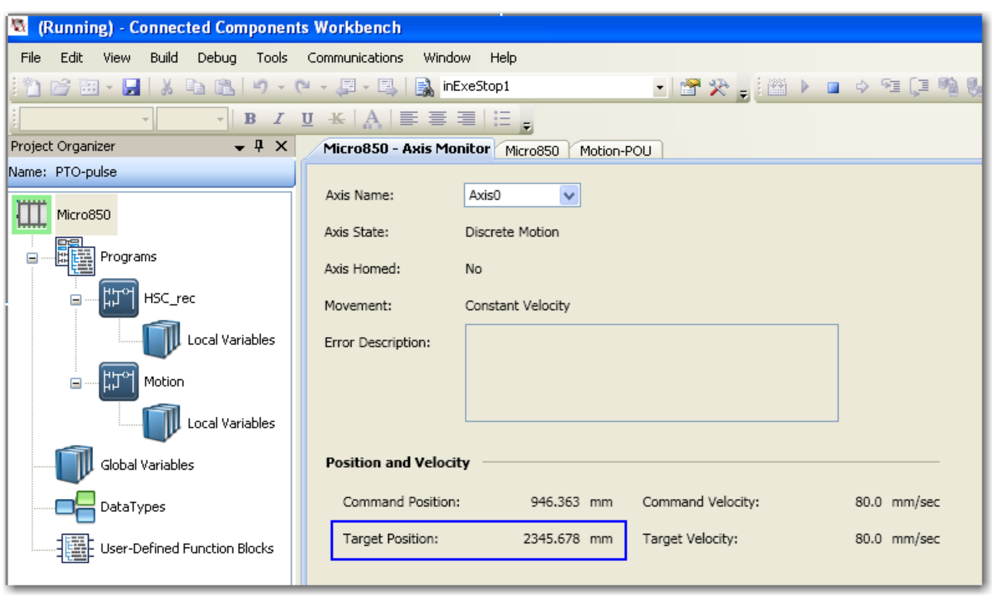
The Variable Monitor displays six significant digits with rounding, although the real data type still contains seven significant digits.

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.



Axis Monitor Example

The Axis Monitor displays seven significant digits with rounding.

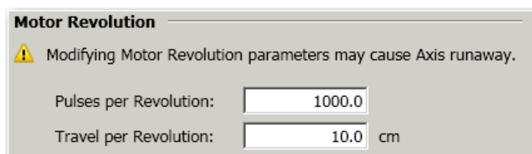


ATTENTION: See Motion Axis Configuration in Connected Components Workbench on page 145 to learn more about the different axis configuration parameters.

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 cm/sec^3 is the same as setting Jerk as 4.501 cm/sec^3, as both are rounded off to 4.5 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

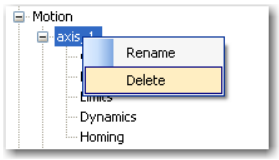
Besides falling within the pre-determined absolute range, motion axis parameters are validated based on relationships with other parameters. These relationships or rules are listed below. Error is flagged whenever there is violation to these relationships.

- 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.

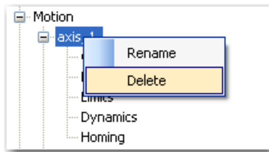
- Homing creep velocity should not be greater than maximum velocity.

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 and Micro850 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 158) 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 $\rightarrow$ Off edge;
4. Once home switch On $\rightarrow$ 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 $\rightarrow$ Off edge;
2. Once home switch On $\rightarrow$ 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 $\rightarrow$ Off edge;
4. Once Lower Limit switch On $\rightarrow$ 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 $\rightarrow$ Off edge;
2. Once Lower Limit switch On $\rightarrow$ 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 the High-Speed Counter and Programmable Limit Switch

High-Speed Counter Overview

All Micro830 and Micro850 controllers, except for 2080-LCxx-AWB, support up to six high speed counter (HSC) inputs. 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 image 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 255) 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 191.

What is High-Speed Counter?

High-Speed Counter is used to detect and store 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

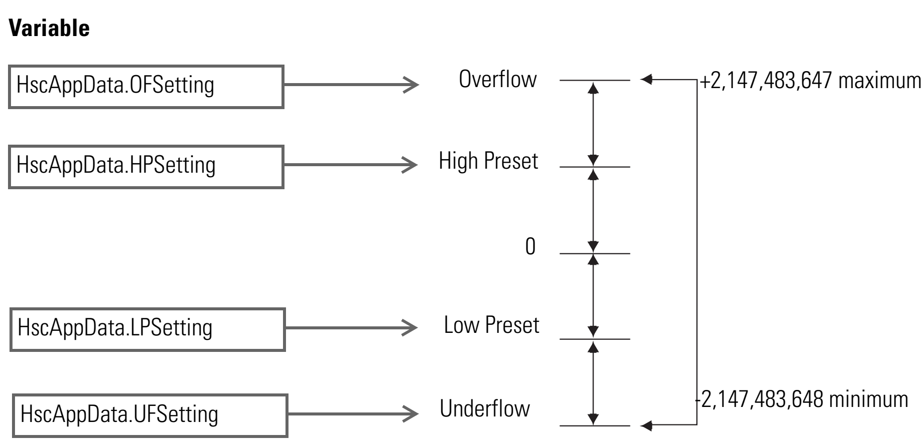
The HSC is extremely versatile; you can select or configure the master HSC for any one of ten (10) modes and the sub HSC for any one of five (5) modes of operation. See HSC Mode (HSCAPP.HSCMode) on page 172 for more information.

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

- 100 kHz operation
- High-speed direct control of outputs
- 32-bit signed integer data (count range of ± 2,147,483,647)
- Programmable High and Low presets, and Overflow and Underflow setpoints
- Automatic Interrupt processing based on accumulated count
- Run-time editable parameters (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 171.

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 172.

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 and Micro850 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 and Micro850 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…3
HSC1	2, 3
HSC2	4…7
HSC3	6, 7
HSC4	8…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 and Micro850 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
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 24-point Controller HSC Input Wiring Mapping

Modes of Operation	Input 0 (HSC0) Input 2 (HSC1) Input 4 (HSC2) Input 6 (HSC3)	Input 1 (HSC0) Input 3 (HSC1) Input 5 (HSC2) Input 7 (HSC3)	Input 2 (HSC0) Input 6 (HSC2)	Input 3 (HSC0) Input 7 (HSC2)	Mode Value in User Program
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

Modes of Operation	Input 0 (HSC0) Input 2 (HSC1) Input 4 (HSC2) Input 6 (HSC3) Input 8 (HSC4) Input 10 (HSC5)	Input 1 (HSC0) Input 3 (HSC1) Input 5 (HSC2) Input 7 (HSC3) Input 9 (HSC4) Input 11 (HSC5)	Input 2 (HSC0) Input 6 (HSC2) Input 10 (HSC4)	Input 3 (HSC0) Input 7 (HSC2) Input 11 (HSC4)	Mode Value in User Program
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

Modes of Operation	Input 0 (HSC0) Input 2 (HSC1) Input 4 (HSC2) Input 6 (HSC3) Input 8 (HSC4) Input 10 (HSC5)	Input 1 (HSC0) Input 3 (HSC1) Input 5 (HSC2) Input 7 (HSC3) Input 9 (HSC4) Input 11 (HSC5)	Input 2 (HSC0) Input 6 (HSC2) Input 10 (HSC4)	Input 3 (HSC0) Input 7 (HSC2) Input 11 (HSC4)	Mode Value in User Program
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

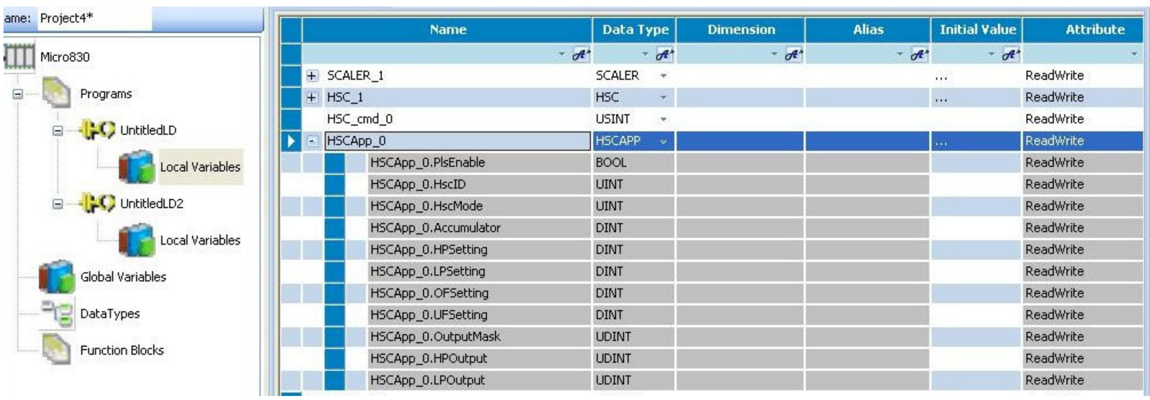
High Speed Counter (HSC) Data Structures

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.



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 191 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 167.

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**					
Example 1	⇑																on (1)	HSC Accumulator + 1 count
Example 2	⇑	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**					
Example 1	⇑									on (1)	⇓	off (0)				off (0)	on (1)	HSC Accumulator + 1 count
Example 2										on (1)	⇓	off (0)		on (1)				Hold accumulator value
Example3										on (1)	⇓	off (0)					off (0)	Hold accumulator value
Example 4		on (1)	⇓	off (0)						on (1)	⇓	off (0)						Hold accumulator value
Example 5									⇑									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**					
Example 1	⇑							off (0)									on (1)	HSC Accumulator + 1 count
Example 2	⇑					on (1)											on (1)	HSC Accumulator - 1 count
Example3																	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**					
Example 1	⇑							off (0)		on (1)	⇓	off (0)				off (0)	on (1)	HSC Accumulator + 1 count
Example 2	⇑					on (1)				on (1)	⇓	off (0)				off (0)	on (1)	HSC Accumulator - 1 count
Example3										on (1)	⇓	off (0)		on (1)				Hold accumulator value
Example 4										on (1)	⇓	off (0)					off (0)	Hold accumulator value
Example 5		on (1)	⇓	off (0)						on (1)	⇓	off (0)						Hold accumulator value
Example 6									⇑									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**					
Example 1	⇑					on (1)	⇓	off (0)									on (1)	HSC Accumulator + 1 count
Example 2		on (1)	⇓	off (0)	⇑												on (1)	HSC Accumulator - 1 count
Example3																	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**					
Example 1	⇑					on (1)	⇓	off (0)		on (1)	⇓	off (0)				off (0)	on (1)	HSC Accumulator + 1 count
Example 2		on (1)	⇓	off (0)	⇑					on (1)	⇓	off (0)				off (0)	on (1)	HSC Accumulator - 1 count
Example3										on (1)	⇓	off (0)		on (1)				Hold accumulator value
Example 4										on (1)	⇓	off (0)					off (0)	Hold accumulator value
Example 5		on (1)	⇓	off (0)						on (1)	⇓	off (0)						Hold accumulator value
Example 6									⇑									Clear accumulator (=0)

Blank cells = don't care, ⇑ = rising edge, ⇓= falling edge

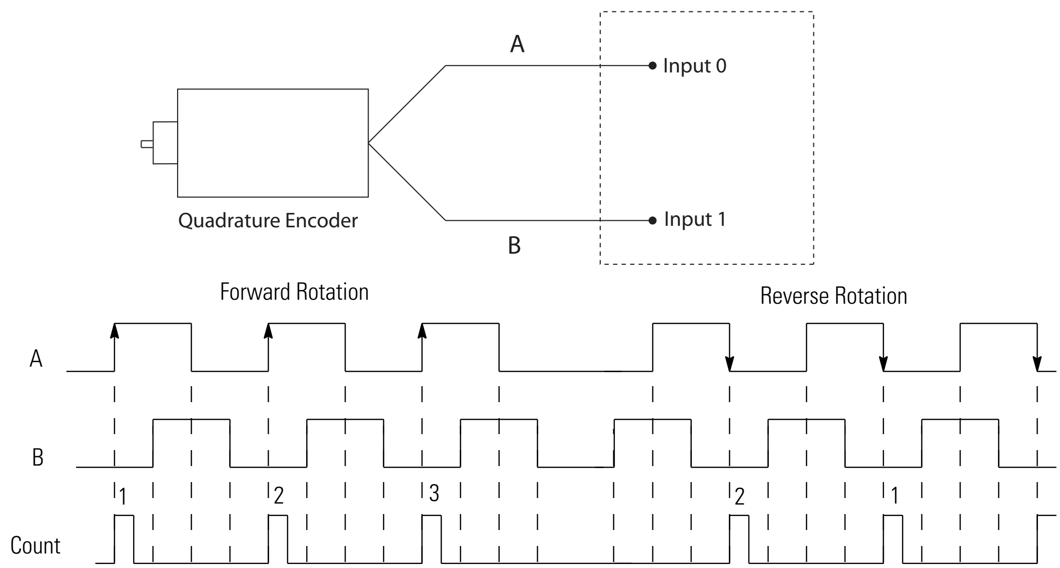
TIP Inputs 0…11 are available for use as inputs to other functions regardless of the HSC being used.

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**
Function	**Count A**				**Count B**				**Not Used**				**Not Used**					
Example 1(1)	⇑							off (0)									on (1)	HSC Accumulator + 1 count
Example 2(2)			⇓					off (0)									on (1)	HSC Accumulator - 1 count
Example3				off (0)														Hold accumulator value
Example 4		on (1)																Hold accumulator value
Example 5						on (1)												Hold accumulator value
Example 6																	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**					
Example 1[(1)]	⇑							off (0)								off (0)	on (1)	HSC Accumulator + 1 count
Example 2[(2)]			⇓					off (0)				off (0)				off (0)	on (1)	HSC Accumulator - 1 count
Example3			⇓	off (0)				off (0)		on (1)								Reset accumulator to zero
Example 4		on (1)																Hold accumulator value
Example 5						on (1)												Hold accumulator value
Example 6												off (0)		on (1)				Hold accumulator value
Example 7												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.

This table illustrates this relationship:

Effect of HSC Output Mask on Base Unit 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
Embedded output (48-point)		0	1								0	1				0	1			0	1

Effect of HSC Output Mask on Base Unit 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

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 180.

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)

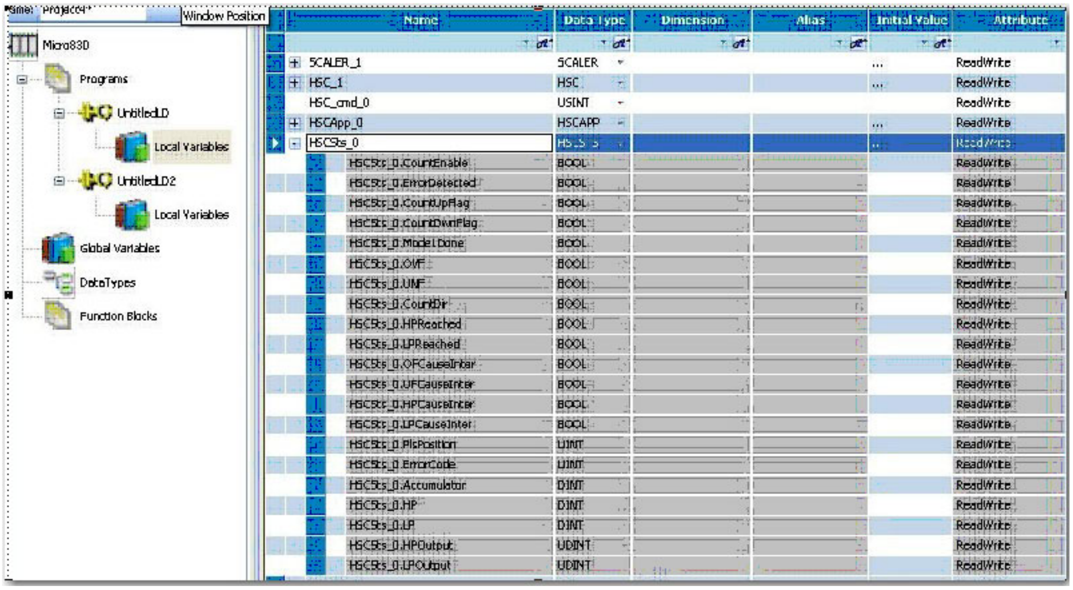
Description	Data Format	User Program Access
HSCAPP.LPOutput	long word (32-bit binary)	read/write

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 180 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(1)	User Program Access
HSCSTS.CountEnable	bit	0…9	read only

(1) For Mode descriptions, see HSC Mode (HSCAPP.HSCMode) on page 172.

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(1)	User Program Access
HSCSTS.ErrorDetected	bit	0…9	read/write

(1) For Mode descriptions, see HSC Mode (HSCAPP.HSCMode) on page 172.

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(1)	User Program Access
HSCSTS.CountUpFlag	bit	0…9	read only

(1) For Mode descriptions, see HSC Mode (HSCAPP.HSCMode) on page 172.

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(1)	User Program Access
SCSTS.CountDownFlag	bit	2…9	read only

(1) For Mode descriptions, see HSC Mode (HSCAPP.HSCMode) on page 172.

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(1)	User Program Access
HSCSTS.Mode1Done	bit	0 or 1	read/write

(1) For Mode descriptions, see HSC Mode (HSCAPP.HSCMode) on page 172.

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(1)	User Program Access
HSCSTS.OVF	bit	0…9	read/write

(1) For Mode descriptions, see HSC Mode (HSCAPP.HSCMode) on page 172.

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(1)	User Program Access
HSCSTS.UNF	bit	0…9	read/write

(1) For Mode descriptions, see HSC Mode (HSCAPP.HSCMode) on page 172.

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(1)	User Program Access
HSCSTS.CountDir	bit	0…9	read only

(1) For Mode descriptions, see HSC Mode (HSCAPP.HSCMode) on page 172.

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(1)	User Program Access
HSCSTS.HPReached	bit	2…9	read/write

(1) For Mode descriptions, see Count Down (HSCSTS.CountDownFlag) on page 183.

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(1)	User Program Access
HSCSTS.LPReached)	bit	2…9	read only

(1) For Mode descriptions, see HSC Mode (HSCAPP.HSCMode) on page 172.

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(1)	User Program Access
HSCSTS.OFCauseInter	bit	0…9	read/write

(1) For Mode descriptions, see HSC Mode (HSCAPP.HSCMode) on page 172.

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(1)	User Program Access
HSCSTS.UFCauseInter	bit	2…9	read/write

(1) For Mode descriptions, see HSC Mode (HSCAPP.HSCMode) on page 172.

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(1)	User Program Access
HSCSTS.HPCauseInter	bit	0…9	read/write

(1) For Mode descriptions, see HSC Mode (HSCAPP.HSCMode) on page 172.

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(1)	User Program Access
HSCSTS.LPCauseInter	bit	2…9	read/write

(1) For Mode descriptions, see HSC Mode (HSCAPP.HSCMode) on page 172.

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(1)	User Program Access
HSCSTS.PLSPosition	Word (INT)	0…9	read only

(1) For Mode descriptions, see HSC Mode (HSCAPP.HSCMode) on page 172.

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(1)	User Program Access
HSCSTS.ErrorCode	Word (INT)	0…9	read only

(1) For Mode descriptions, see HSC Mode (HSCAPP.HSCMode) on page 172.

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 180 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)

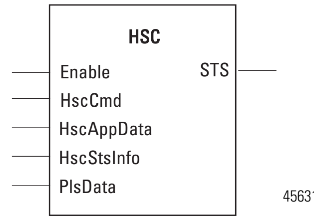
Description	Data Format	User Program Access
HSCSTS.LPOutput	long word (32-bit binary))	read only

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 180 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 190
HscAppData	Input	See HSC APP Data Structure on page 171	HSC application configuration. Only initial configuration is needed usually.
PlsData	Input	See array of Programmable Limit Switch (PLS) Function on page 191	Programmable Limit Switch (PLS) Data
HscStsInfo	Output	See HSC STS (HSC Status) Data Structure on page 182	HSC dynamic status. Status info is usualy 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.

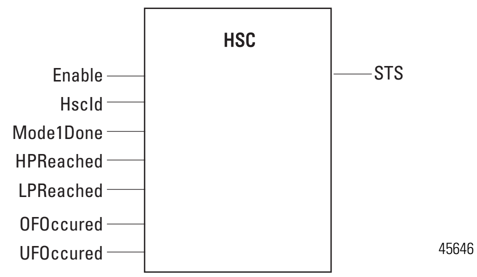
HSC Commands

HSC Command	Description
0x00	Reserved
0x01	HSC RUN • Start HSC (if HSC in Idle mode and Rung is Enabled) • Update HSC Status Info only (if HSC already in RUN mode and Rung is Enabled) • Update HSC status Info only (if Rung is disabled)
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: HPSetting, LPSetting, HPOutput, LPOutput, 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 171	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 190 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

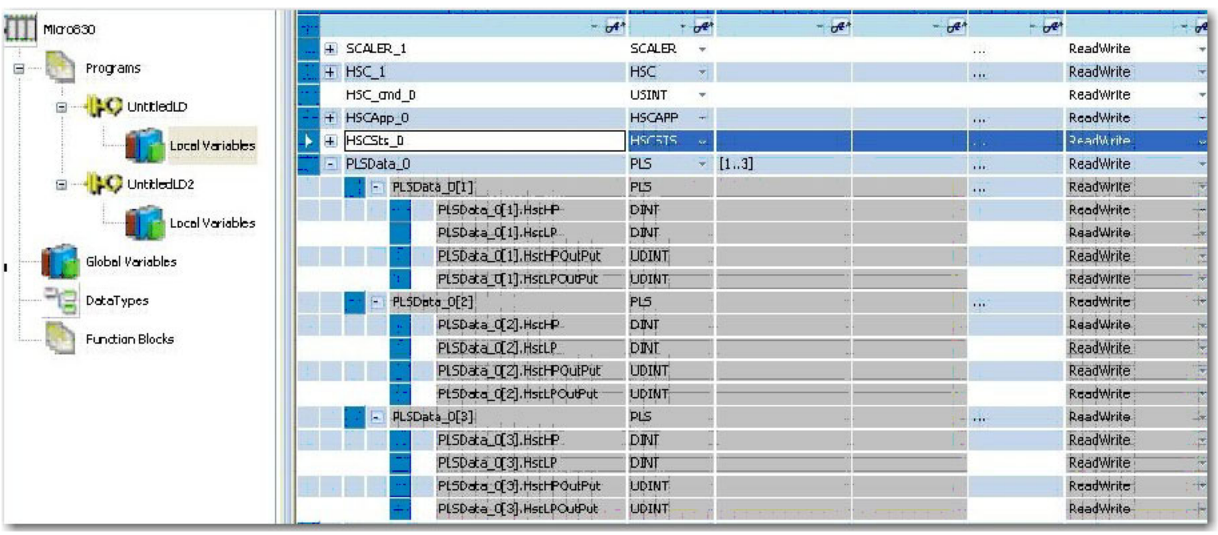
The Programmable Limit Switch function is an additional set of operating modes for the High Speed Counter. When operating in these modes, the preset and output data values are updated using user supplied data each time one of the presets is reached. These modes are programmed by providing a PLS data 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 (HSCHP or HSCLP) defined in the PLS data, the output source data (HSCHPOutput or HSCLPOutput) is written through the HSC mask (HSCAPP.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 HSCHPOutput is only written when HSCHP is reached. The HSCLPOutput 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.

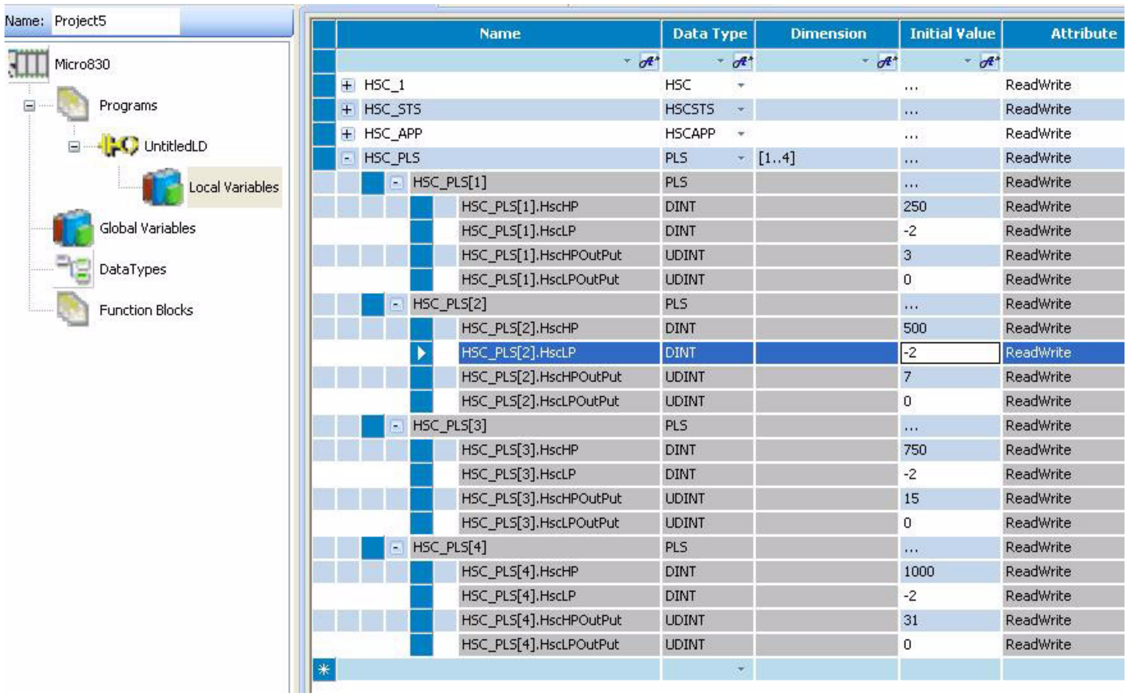
PLS Example

Setting Up the PLS data

Using Connected Components Workbench, define the PLS data HSC_PLS's dimension as [1..4].

PLS Data Definition

Data	Description	Data Format
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

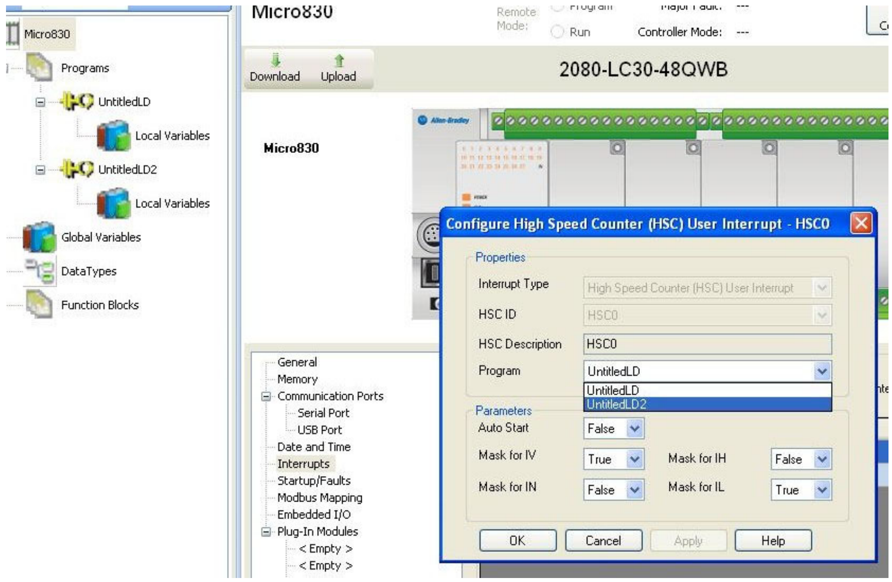
When HSCSTS.Accumulator = 250, the HSC_PLS[1].HscHPOutput is sent through the HSCAPP.OutputMask and energizes the outputs 0 and 1.

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 and Micro850 controllers provide to execute selected user logic at a pre-configured event.

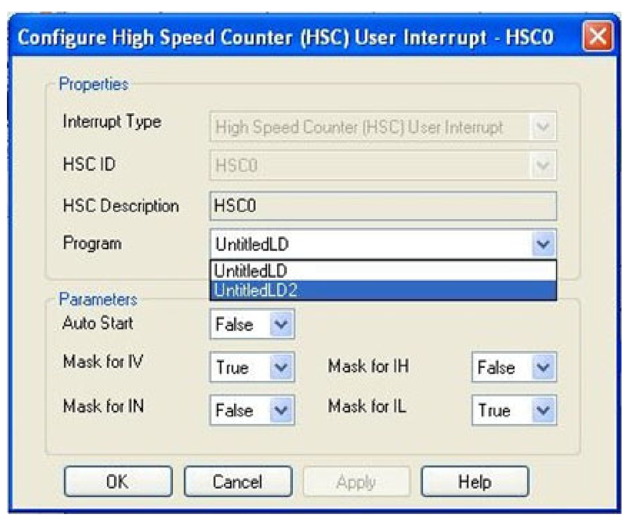


HSC0 is used in this document to define how HSC interrupts work.

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(1)	User Program Access
AS - Auto Start	bit	0…9	read only

(1) For Mode descriptions, see Count Down (HSCSTS.CountDownFlag) on page 183.

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(1)	User Program Access
MV - Overflow Mask	bit	0…9	read only

(1) For Mode descriptions, see Count Down (HSCSTS.CountDownFlag) on page 183..

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(1)	User Program Access
MN - Underflow Mask	bit	2…9	read only

(1) For Mode descriptions, see Count Down (HSCSTS.CountDownFlag) on page 183.

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(1)	User Program Access
MH - High Preset Mask	bit	0…9	read only

(1) For Mode descriptions, see Count Down (HSCSTS.CountDownFlag) on page 183.

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(1)	User Program Access
ML - Low Preset Mask	bit	2…9	read only

(1) For Mode descriptions, see Count Down (HSCSTS.CountDownFlag) on page 183.

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(1)	User Program Access
HSC0.Enabled	bit	0…9	read only

(1) For Mode descriptions, see Count Down (HSCSTS.CountDownFlag) on page 183.

The Enabled bit is used to indicate HSC interrupt enable or disable status.

User Interrupt Executing (HSC0.EX)

Description	Data Format	HSC Modes(1)	User Program Access
HSC0.EX	bit	0…9	read only

(1) For Mode descriptions, see Count Down (HSCSTS.CountDownFlag) on page 183.

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(1)	User Program Access
HSC0.PE	bit	0…9	read only

(1) For Mode descriptions, see Count Down (HSCSTS.CountDownFlag) on page 183.

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(1)	User Program Access
HSC0.LS	bit	0…9	read/write

(1) For Mode descriptions, see Count Down (HSCSTS.CountDownFlag) on page 183.

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 270.

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 are shipped with no password but a password can be set through the Connected Components Workbench software (revision 2 or later).

The controller password is also backed up to the memory backup module — that is, 2080-MEMBAK-RTC for Micro830 and Micro850 and 2080-LCD for Micro810 controllers. If the password in the backup module is different from the memory backup module, then restore operation will fail.

TIP	For instructions on how to set, change, and clear controller passwords, see Configure Controller Password on page 267.

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 255 for instructions.

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. On the Device Toolbox, expand Catalog by clicking the + sign.
3. Select the target controller.
4. Select Upload.
5. When requested, provide the controller password.

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. On the Device Toolbox, 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.

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. On the Device Toolbox, open Discover and click Browse Connections.
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 267.

Back Up 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. On the Device Toolbox, open Discover. Click Browse Connections.
2. Select the target controller.
3. When requested, enter the controller password.
4. Back up controller contents from the memory module.

Configure Controller Password

To set, change, and clear controller password, see the quickstart instructions Configure Controller Password on page 267.

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 and Micro850 controllers, or the 2080-LCD for Micro810 controllers. Then, ControlFlash can be used to update the controller firmware, which also clears the controller memory.

ATTENTION: The project in the controller will be lost but a new project can be downloaded.

Specifications

Micro830 Controllers

Micro830 10-Point Controllers

General – 2080-LC30-10QWB, 2080-LC30-10QVB

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^2 (26…14 AWG) solid copper wire or 0.14…1.5 mm^2 (26…14 AWG) stranded copper wire rated @ 90 °C (194 °F) insulation max	
Wiring category(1)	2 – on signal ports 2 – on power ports	
Wire type	Use copper conductors only	
Terminal screw torque	0.6 Nm (4.4 lb-in) max (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	3.6 W (without plug-ins)	
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 @ 720 V 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 @ 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	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 re-configure the filter setting for each input group)	

Isolated AC Inputs (2080-LC30-10QWB, 2080-LC30-12QVB) (Inputs 0…3)

Attribute	Value
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 205	4.0 A every 1 s @ 30 °C; every 2 s @ 65 °C[1]	

Outputs

Attribute	2080-LC30-10QWB	2080-LC30-10QVB	
	Relay Output	**Hi-Speed Output (Outputs 0…1)**	**Standard Output (Outputs 2…3)**
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	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				

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, non-operating	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, non-operating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): DIN mount: 25 g PANEL mount: 45 g
Emissions	CISPR 11 Group 1, Class A
ESD immunity	IEC 61000-4-2: 6 kV contact discharges 8 kV air discharges

Environmental Specifications

Attribute	Value
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 at 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM at 1890 MHz 10V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz
EFT/B immunity	IEC 61000-4-4: ±2 kV at 5 kHz on power ports ±2 kV at 5 kHz on signal ports
Surge transient immunity	IEC 61000-4-5: ±1 kV line-line(DM) and ±2 kV line-earth(CM) on power ports ±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

Certification (when product is marked)[1]	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 2004/108/EC 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 2006/95/EC LVD, compliant with: EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions

(1) See the Product Certification link at http://www.rockwellautomation.com/products/certification/ for Declaration of Conformity, Certificates, and other certification details.

Micro830 16-Point Controllers

General – 2080-LC30-16AWB, 2080-LC30-16QWB, 2080-LC30-16QVB

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^2 (26…14 AWG) solid copper wire or 0.14…1.5 mm^2 (26…14 AWG) stranded copper wire rated @ 90 °C (194 °F) insulation max		

General – 2080-LC30-16AWB, 2080-LC30-16QWB, 2080-LC30-16QVB

Attribute	**2080-LC30-16AWB**	**2080-LC30-16QWB**	**2080-LC30-16QVB**
Wiring category[(1)]	2 – on signal ports 2 – on power ports		
Wire type	Use Copper Conductors only		
Terminal screw torque	0.6 Nm (4.4 lb-in.) max (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	3.6 W		
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 2080-LC30-16AWB: Type tested for 60 s @ 3250V DC I/O to Aux and Network, Inputs to Outputs 2080-LC30-16QWB: 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	**120V AC Input (2080-LC30-16AWB only)**	**High-Speed DC Input (2080-LC30-16QVB and 2080-LC30-16QWB only) (Inputs 0…3)**	**Standard DC Input (2080-LC30-16QVB and 2080-LC30-16QWB only) (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		

Inputs

Attribute	120V AC Input (2080-LC30-16AWB only)	High-Speed DC Input (2080-LC30-16QVB and 2080-LC30-16QWB only) (Inputs 0…3)	Standard DC Input (2080-LC30-16QVB and 2080-LC30-16QWB only) (Inputs 4…9)
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 kΩ @ 50 Hz 10 kΩ @ 60 Hz	3 kΩ	3.74 kΩ
Inrush current, max	250 mA @ 120V AC	—	
Input frequency, max	63 Hz	—	
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 re-configure the filter setting for each input group)		

Isolated AC Inputs (2080-LC30-16QWB, 2080-LC30-16QVB) (Inputs 0…3)

Attribute	Value
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	Relay Output (2080-LC30-16AWB, 2080-LC30-16QWB only)	Hi-Speed Output (2080-LC30-16QVB only) (Outputs 0…1)	Standard Output (2080-LC30-16QVB only) (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
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 209	4.0 A every 1 s @ 30 °C; every 2 s @ 65 °C(1)	
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				

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, non-operating	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: 45 g
Emissions	CISPR 11 Group 1, Class A
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 power ports ±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

Certification (when product is marked)[1]	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 2004/108/EC 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 2006/95/EC LVD, compliant with: EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions

(1) See the Product Certification link at http://www.rockwellautomation.com/products/certification/ for Declaration of Conformity, Certificates, and other certification details.

Micro830 24-Point Controllers

General Specifications – 2080-LC30-24QWB, 2080-LC30-24QVB, 2080-LC30-24QBB

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^2 (24…12 AWG) solid copper wire or 0.2…2.5 mm^2 (24…12 AWG) stranded copper wire rated @ 90 °C (194 °F) insulation max		
Wiring category[1]	2 – on signal ports 2 – on power ports		
Wire type	Use Copper Conductors only		
Terminal screw torque	0.6 Nm (4.4 lb-in) max (using a 2.5 mm (0.10 in.) flat-blade screwdriver)		
Input circuit type	24V DC sink/source (standard and 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	5.28 W		
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)	

General Specifications – 2080-LC30-24QWB, 2080-LC30-24QVB, 2080-LC30-24QBB

Attribute	2080-LC30-24QWB	2080-LC30-24QVB	2080-LC30-24QBB
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	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 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 re-configure the filter setting for each input group)	

Isolated AC Inputs (2080-LC30-24QWB, 2080-LC30-24QVB, 2080-LC30-24QBB) (Inputs 0…3)

Attribute	Value
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 212	4.0 A every 1 s @ 30 °C; every 2 s @ 65 °C(1)	
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				

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, non-operating	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

Environmental Specifications

Attribute	Value
Shock, non-operating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): DIN mount: 25 g PANEL mount: 35 g
Emissions	CISPR 11 Group 1, Class A
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 at 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM at 1890 MHz 10V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz
EFT/B immunity	IEC 61000-4-4: ±2 kV at 5 kHz on power ports ±2 kV at 5 kHz on signal ports
Surge transient immunity	IEC 61000-4-5: ±1 kV line-line(DM) and ±2 kV line-earth(CM) on power ports ±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

Certification (when product is marked)[1]	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 2004/108/EC 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 2006/95/EC LVD, compliant with: EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions

(1) See the Product Certification link at http://www.rockwellautomation.com/products/certification/ for Declaration of Conformity, Certificates, and other certification details.

Micro830 48-Point Controllers

General Specifications – 2080-LC30-48AWB, 2080-LC30-48QWB, 2080-LC30-48QVB, 2080-LC30-48QBB

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^2 (24…12 AWG) solid copper wire or 0.2…2.5 mm^2 (24…12 AWG) stranded copper wire rated @ 90 °C (194 °F) insulation max			
Wiring category(1)	2 – on signal ports 2 – on power ports			
Wire type	Use copper conductors only			
Terminal screw torque	0.6 Nm (4.4 lb-in) max (using a 2.5 mm (0.10 in.) flat-blade screwdriver)			
Input circuit type	120V AC	24V DC sink/source (standard and 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	10.56 W			
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 re-configure the filter setting for each input group)		

Isolated AC Inputs (2080-LC30-48QWB, 2080-LC30-48QVB, 2080-LC30-48QBB) (Inputs 0…3)

Attribute	**Value**
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-L30-48QWB**	**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-L30-48QWB	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 216	4.0 A every 1 s @ 30 °C; every 2 s @ 65 °C(1)	
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				

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, non-operating	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, non-operating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): DIN mount: 25 g PANEL mount: 35 g
Emissions	CISPR 11 Group 1, Class A
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

Environmental Specifications

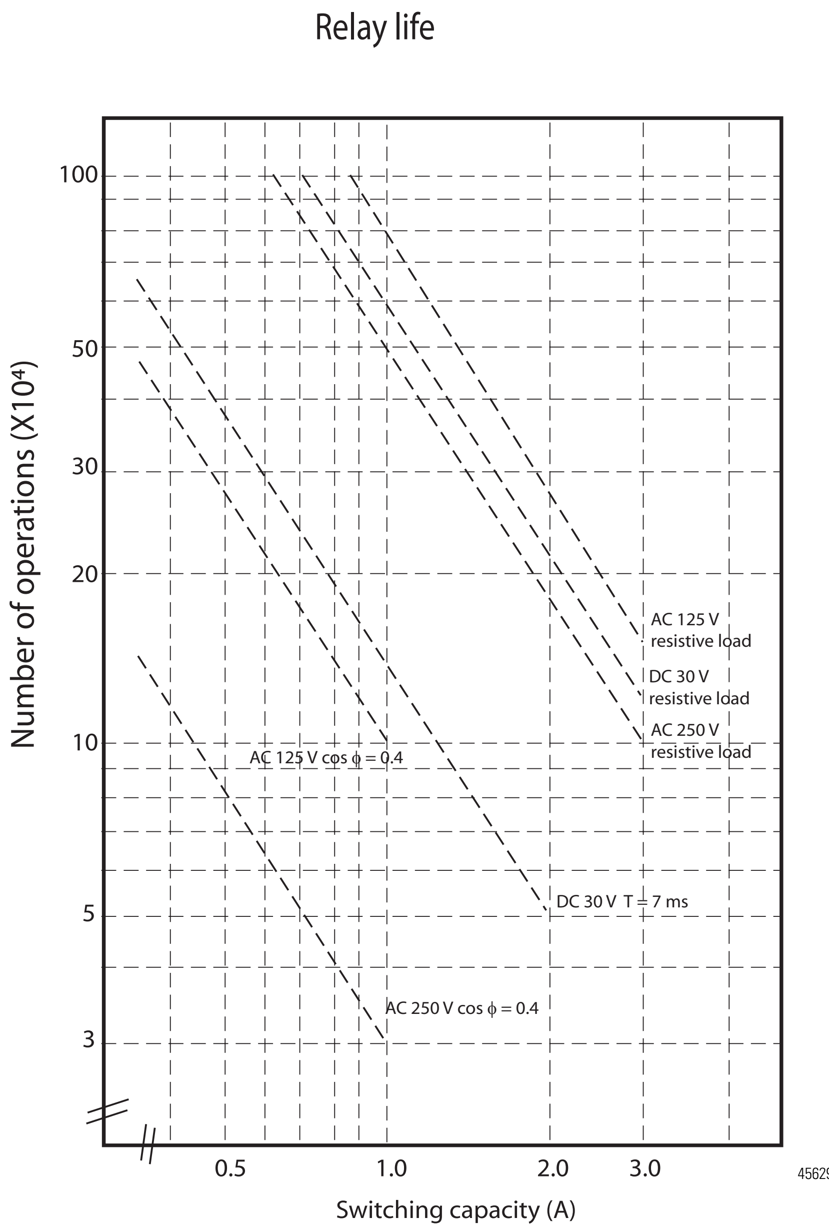
Attribute	Value
EFT/B immunity	IEC 61000-4-4: ±2 kV at 5 kHz on power ports ±2 kV at 5 kHz on signal ports
Surge transient immunity	IEC 61000-4-5: ±1 kV line-line(DM) and ±2 kV line-earth(CM) on power ports ±1 kV line-line(DM) and ±2 kV line-earth(CM) on signal ports
Conducted RF immunity	IEC 61000-4-6: 10V rms with 1 kHz sine-wave 80% AM from 150 kHz…80 MHz

Certifications

Certification (when product is marked)(1)	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 2004/108/EC 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 2006/95/EC LVD, compliant with: EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions

(1) See the Product Certification link at http://www.rockwellautomation.com/products/certification/ for Declaration of Conformity, Certificates, and other certification details.

Micro830 and Micro850 Relay Charts



Micro850 Controllers

The following tables provide specifications, ratings, and certifications for the 24-point and 48-point Micro850 controllers.

Micro850 24-Point Controllers

General Specifications – 2080-LC50-24AWB, 2080-LC50-24QWB, 2080-LC50-24QVB, 2080-LC50-24QBB

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^2 (24…12 AWG) solid copper wire or 0.2…2.5 mm^2 (24…12 AWG) stranded copper wire rated @ 90 °C (194 °F) insulation max			
Wiring category(1)	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	24V DC sink/source (standard and high-speed)			
Output circuit type	Relay		24V DC sink (standard and high-speed)	24V DC source (standard and high-speed)
Power consumption	28 W			
Power supply voltage range	20.4…26.4V DC Class 2			
I/O rating	Input 120V AC 16 mA Output 2 A, 240V AC, 2A, 24V DC	Input 24V, 8.8 mA Output 2 A, 240V AC 2A, 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, 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 – 2080-LC50-24QBB, 2080-LC50-24QVB, 2080-LC50-24QWB

Attribute	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	5V DC, max	
Off-state current	1.5 mA, max	
On-state current	5.0 mA @ 16.8V DC, min 7.6 mA @ 24V DC, nom 12.0 mA @ 30V DC, max	1.8 mA @ 10V DC, min 6.15 mA @ 24V DC, nom 12.0 mA @ 30V DC, max
Nominal impedance	3 kΩ	3.74 kΩ
IEC input compatibility	Type 3	

AC Input Specifications – 2080-LC50-24AWB

Attribute	Value
Number of Inputs	14
On-state voltage	79 V AC, min 132V AC, max
On-state current	5 mA, min 16 mA, max
Input frequency	50/60 Hz, nom 47 Hz, min 63 Hz, max
Off-state voltage	20V AC @ 120V AC, max
Off-state current	2.5 mA @ 120V AC, max
Inrush current	250 mA @ 120V AC, max
Inrush delay time constant max	22 ms
IEC input compatibility	Type 3

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		

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)**
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 212	4.0 A for 10 ms every 1 s @ 30 °C; every 2 s @ 65 °C(1)	
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				

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, non-operating	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, non-operating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): DIN mount: 25 g PANEL mount: 35 g
Emissions	CISPR 11 Group 1, Class A

Environmental Specifications

Attribute	Value
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 power ports ±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

Isolated AC Inputs (2080-LC50-24QWB, 2080-LC50-24QVB, 2080-LC50-24QBB) (Inputs 0…3)

Attribute	Value
On-state voltage, nom	12/24V AC @ 50/60 Hz
Off-state voltage, min	4V AC @ 50/60Hz
Operating frequency, nom	50/60 Hz

Micro850 48-Point Controllers

General Specifications – 2080-LC50-48AWB, 2080-LC50-48QWB, 2080-LC50-48QVB, 2080-LC50-48QBB

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^2 (24…12 AWG) solid copper wire or 0.2…2.5 mm^2 (24…12 AWG) stranded copper wire rated @ 90 °C (194 °F) insulation max			
Wiring category[(1)]	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	24V sink/source (standard and high-speed)		

General Specifications – 2080-LC50-48AWB, 2080-LC50-48QWB, 2080-LC50-48QVB, 2080-LC50-48QBB

Attribute	2080-LC50-48AWB	2080-LC50-48QWB	2080-LC50-48QVB	2080-LC50-48QBB
Output circuit type	Relay		24V DC sink (standard and high-speed)	24V DC source (standard and high-speed)
Power consumption	33 W			
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

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)**
IEC input compatibility	Type 3		
Inrush current, max	250 mA @ 120V AC	–	
Input frequency, max	63 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 216	4.0 A for 10 ms every 1 s @ 30 °C; every 2 s @ 65 °C(1)	
Current, per common, max	5A	–	–
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

Isolated AC Inputs (2080-LC50-48QWB, 2080-LC50-48QVB, 2080-LC50-48QBB) (Inputs 0…3)

Attribute	Value
On-state voltage, nom	12/24V AC @ 50/60 Hz
Off-state voltage, min	4V AC @ 50/60Hz
Operating frequency, nom	50/60 Hz

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				

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, non-operating	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, non-operating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): DIN mount: 25 g PANEL mount: 35 g
Emissions	CISPR 11 Group 1, Class A
ESD immunity	IEC 61000-4-2: 4 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 power ports ±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

Certification (when product is marked)(1)	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 2004/108/EC 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 2006/95/EC LVD, compliant with: EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
EtherNet/IP	ODVA conformance tested to EtherNet/IP specifications.
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: Article 58-2 of Radio Waves Act, Clause 3.

(1) See the Product Certification link at http://www.rockwellautomation.com/products/certification for Declaration of Conformity, Certificates, and other certification details.

For the Micro850 relay chart, see Micro830 and Micro850 Relay Charts on page 218.

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	0.34 kg (0.75 lb)
Supply voltage range(1)	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	24A @ 132V for 10 ms 40A @ 263V for 10 ms
Power consumption (Output power)	38.4W @ 100V AC, 38.4W @ 240V AC
Power dissipation (Input power)	45.1W @ 100V AC, 44.0W @ 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, 1.6A, 38.4W

General Specifications

Attribute	Value
Enclosure type rating	Meets IP20
Wire size	0.32... 2.1 mm² (22...14 AWG) solid copper wire or 0.32... 1.3 mm² (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(2)	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.

Micro800 Plug-In Modules

Micro800 digital and analog plug-in modules specifications are listed below.

Digital Plug-Ins

Output Specifications – 2080-OB4, 2080-OV4, 2080-IQ4OB4, 2080-IQ4OV4

Attribute	Value
Power supply voltage	10.8V DC, min 30V DC, max
On-state voltage	10V DC, min 24V DC, nom 30V DC, max
On-state current	5.0 mA @ 10V DC, min 0.5 A max, steady state 2 A surge, 2 s min

General Specifications, 2080-OB4, 2080-OV4, 2080-IQ4OB4, 2080-IQ4OV4

Attribute	Value
Mounting torque	0.2 Nm (1.48 lb-in.)
Status indicators	For input or output modules – 4 yellow For combination modules – 8 yellow
Terminal base screw torque	0.22…0.25 Nm (1.95…2.21 lb-in.) using a 2.5 mm (0.10 in.) flat-blade screwdriver
Enclosure type rating	None (open-style)
Isolation voltage	**For input modules** 50V (continuous), Basic Insulation Type, Inputs to Backplane Type tested for 60 s @ 720 V DC, Inputs to Backplane **For combination or output modules** 50V (continuous), Basic Insulation Type, Inputs to Outputs, I/Os to Backplane Type tested for 60 s at 720 V DC, I/Os to Backplane
Wire size	0.2... 2.5 mm^2 (24...12 AWG) solid or stranded copper wire rated @ 90 °C (194 °F), or greater, insulation max
Wire category	2 – on signal ports 2 – on power ports
North American temp code	T4

Environmental Specifications – 2080-OB4, 2080-OV4, 2080-IQ4OB4, 2080-IQ4OV4

Attribute	Value
Temperature, operating	IEC60068-2-1 (Test Ad, Operating Cold), IEC60068-2-2, (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, non-operating	IEC60068-2-1 (Test Ad, Operating Cold), IEC60068-2-2, (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock): -40...85 °C (-40…185 °F)

Environmental Specifications – 2080-OB4, 2080-OV4, 2080-IQ4OB4, 2080-IQ4OV4

Attribute	Value
Relative humidity	IEC 60068-2-30 (Test Db, Unpackaged Damp Heat): 5…95% noncondensing
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, non-operating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): 25 g
Emissions	CISPR 11: Group 1, Class A
ESD Immunity	IEC 61000-4-2: 4 kV contact discharges 8 kV air discharges
Radiated RF immunity	IEC 61000-4-3: 10 V/M with 1 kHz sine-wave 80%AM from 80…2000 MHz 10 V/M with 200 Hz 50% Pulse 100%AM @ 900 MHz 10 V/M with 200 Hz 50% Pulse 100%AM @1890 MHz 10 V/M with 1 kHz sine-wave 80%AM from 2000…2700 MHz
EFT/B immunity	±2 kV @ 5 kHz on signal ports
Surge transient immunity	±1 kV line-line(DM) and ±2 kV line-earth(CM) on signal ports
Conducted RF immunity	10V rms with 1 kHz sine-wave 80%AM from 150 kHz…80 MHz

Certifications – 2080-OB4, 2080-OV4, 2080-IQ4OB4, 2080-IQ4OV4

Certification (when product is marked)(1)	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 2004/108/EC 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)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: Article 58-2 of Radio Waves Act, Clause 3

(1) See the Product Certification link at http://www.rockwellautomation.com/products/certification/ for Declarations of Conformity, Certificates, and other certification details.

General Specifications – 2080-OW4I Digital Relay Output Plug-in Module

Attribute	Value
Mounting torque	0.2 Nm (1.48 lb-in.)
Status indicators	4 yellow
Terminal base screw torque, max	0.19 Nm (1.7 lb-in.) using a 2.5 mm [0.10 in.] flat-blade screwdriver
Wire size	0.05…1.31 mm2 (30…16 AWG) solid copper wire rated @ 90 °C (194 °F) insulation max
Enclosure type rating	None (open-style)
Isolation voltage	240V (continuous), Reinforce Insulation Type, between Output Channels and Output channels to Backplane Type tested for 60 s @ 1480 V AC Outputs to Outputs, Outputs to Backplane
Insulation stripping length	5 mm
Wiring category	2 – on signal ports 2 – on power ports
Wire type	Copper
North American temp code	T4
Inrush current	<120 mA @ 3.3V <120 mA @ 24V
Backplane power	3.3 VDC, 38 mA
Output current, resistive	2 A @ 5…30V DC 0.5 A @ 48V DC 0.22 A @ 125V DC 2 A @ 125V AC 2 A @ 240V AC
Output current, inductive	1.0 A steady state @ 5…28V DC 0.93 A steady state @ 30V DC 0.5 A steady state @ 48V DC 0.22 A steady state @ 125V DC 2.0 A steady state, 15 A make @ 125V AC, PF – cos θ = 0.4 2.0 A steady state, 7.5 A make @ 240V AC, PF – cos θ = 0.4
Output power, resistive, max	250 VA for 125V AC resistive loads 480 VA for 240V AC resistive loads 60 VA for 30V DC resistive loads 24 VA for 48V DC resistive loads 27.5 VA for 125V DC resistive loads
Relay contact, (0.35 power factor)	

<table>
<tr><th rowspan="2">Maximum Volts</th><th colspan="2">Amperes</th><th rowspan="2">Amperes Continuous</th><th colspan="2">Volt-Amperes</th></tr>
<tr><th>Make</th><th>Break</th><th>Make</th><th>Break</th></tr>
<tr><td>120V AC</td><td>15 A</td><td>1.5 A</td><td rowspan="2">2.0 A</td><td rowspan="2">1800 VA</td><td rowspan="2">180 VA</td></tr>
<tr><td>240V AC</td><td>7.5 A</td><td>0.75 A</td></tr>
<tr><td>24V DC</td><td colspan="2">1.0 A</td><td rowspan="2"></td><td colspan="2" rowspan="2">28 VA</td></tr>
<tr><td>125V DC</td><td colspan="2">0.22 A</td></tr>
</table>

General Specifications – 2080-OW4I Digital Relay Output Plug-in Module

Attribute	Value
Pilot duty rating	C300, R150
Minimum load, per point	10 mA
Initial contact resistance of relay, max	30 mΩ
Output delay time, max	10 ms ON or OFF

Environmental Specifications – 2080-OW4I

Attribute	Value
Temperature, operating	IEC60068-2-1 (Test Ad, Operating Cold), IEC60068-2-2, (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, non-operating	IEC60068-2-1 (Test Ad, Operating Cold), IEC60068-2-2, (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock): -40...85 °C (-40…185 °F)
Relative humidity	IEC 60068-2-30 (Test Db, Unpackaged Damp Heat): 5…95% noncondensing
Vibration	IEC 60068-2-6 (Test Fc, Operating): 2 g @ 10…500 Hz
Shock, operating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): 10 g
Shock, non-operating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): DIN rail mounting: 25 g Panel mounting: 35 g
ESD Immunity	IEC 61000-4-2: 6kV contact 8 kV air
Radiated RF immunity	IEC 61000-4-3 10 V/M with 1 kHz sine-wave 80%AM from 80…2000 MHz 10 V/M with 200 Hz sine-wave 50% Pulse 100%AM @ 900 MHz 10 V/M with 200 Hz sine-wave 50% Pulse 100%AM @1890 MHz 10 V/M with 1 kHz sine-wave 80%AM from 2000…2700 MHz
EFT/B immunity	IEC 61000-4-4: ±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 – 2080-OW4I

Certification (when product is marked)(1)	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 2004/108/EC 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 2006/95/EC LVD, compliant with:EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: Article 58-2 of Radio Waves Act, Clause 3

(1) See the Product Certification link at http://www.rockwellautomation.com/products/certification/ for Declarations of Conformity, Certificates, and other certification details.

Analog Plug-In Modules

2080-IF2, 2080-IF4 Input Specifications

Attribute	2080-IF2	2080-IF4
Number of inputs, single ended	2	4
Analog normal operating ranges	Voltage: 0…10V DC Current: 0…20 mA	
Resolution, max.	12 bits unipolar, with software selected option for 50 Hz, 60 Hz, 250 Hz, 500 Hz	
Data range	0…65535	
Input impedance	Voltage Terminal: > 220K Ω, Current Terminal: 250 Ω	
Overall accuracy(1)	Voltage Terminal: ±1% full scale @ 25°C Current Terminal: ±1% full scale @ 25°C	
Non-linearity (in percent full scale)	±0.1%	
Repeatability(2)	±0.1%	
Module error over full temperature range, -20…65°C (-4…149°F)	Voltage: ± 1.5% Current: ± 2.0%	
Input channel configuration	Through configuration software screen or the user program	
Field input calibration	Not required	
Scan time	180 ms	
Input group to bus isolation	No isolation	
Channel to channel isloation	Non-isolation	
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, non-operating	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	
Operating altitude	2000 m	
Cable length, max.	10 m	

(1) Includes offset, gain, non-linearity and repeatability error terms.

(2) Repeatability is the ability of the input module to register the same reading in successive measurements for the same input signal.

2080-OF2 Output Specifications

Attribute	2080-OF2
Number of outputs, single ended	2
Analog normal operating ranges	Voltage: 10V DC Current: 0…20 mA
Resolution, max.	12 bits unipolar

2080-OF2 Output Specifications

Attribute	2080-OF2
Output count range	0…65535
D/A Conversion Rate (all channels), max.	2.5 ms
Step Response to 63%(1)	5 ms
Current Load In voltage output, max	10 mA
Resistive load on current output	0…500 Ω (includes wire resistance)
Load range on voltage output	> 1k Ω @ 10V DC
Max. inductive load (current outputs)	0.01 mH
Max. capacitive load (voltage outputs)	0.1 µF
Overall Accuracy(2)	Voltage Terminal: ±1% full scale @ 25 °C Current Terminal: ±1% full scale @ 25 °C
Non-linearity (in percent full scale)	± 0.1%
Repeatability (3)(3) (in percent full scale)	± 0.1%
Output error over full temperature range, -20…65°C (-4…149°F)	Voltage: ± 1.5% Current: ± 2.0%
Open and short-circuit protection	Yes
Output overvoltage protection	Yes
Input group to bus isolation	No isolation
Channel to channel isolation	Non-isolation
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, non-operating	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
Operating altitude	2000 m
Cable length, max.	10 m

(1) Step response is the period of time between when the D/A converter was instructed to go from minimum to full range until the device is at 63% of full range.

(2) Includes offset, gain, non-linearity and repeatability error terms.

(3) Repeatability is the ability of the output module to reproduce output readings when the same controller value is applied to it consecutively, under the same conditions and in the same direction.

2080-MEMBAK-RTC Specifications

Attribute	Value
Resolution READ_RTC()	1 sec
Accuracy	± 5 sec/month @ 25 °C ± 9 sec/month@ -20…65 °C
Power off	Battery — 3.5 years from date of manufacture @ 25…65 °C, 2.5 years from date of manufacture @ 0 °C
Temperature, operating	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): -20...65 °C (-4…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
Altitude, operating	2000 m

IMPORTANT Battery life does not include controller ON time. For example, if the Controller is ON for 16 hours every day for 365 days, if the module starts being used after 1 year of manufacturing, battery life is 8.5 years (1 year initial time + 2.5 years of Off time out of 7.5 years).

2080-TRIMPOT6 Specifications

Attribute	Value
Data range	0…255
No of trimpot	6
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, 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
Altitude, operating	2000 m

Thermocouple and RTD Plug-in Modules

2080-TC2 and 2080-RTD2 – General and Environmental Specifications

Attribute	2080-RTD2	2080-TC2
Mounting torque	0.2 Nm (1.48 lb-in.)	
Terminal screw torque	0.22…0.25 Nm (1.95…2.21 lb-in.) using a 2.5 mm (0.10 in.) flat-blade screwdriver	
Wire size	0.14…1.5 mm^2 (26…16 AWG) solid copper wire or 0.14…1.0 mm^2 (26…17 AWG) stranded copper wire rated @ 90 °C (194 °F) insulation max	
Input impedance	> 5 MΩ	> 300 KΩ
Common mode rejection ratio	100 dB 50/60Hz	
Normal mode rejection ratio	70 dB @ 50/60 Hz	
Resolution	14-bit	
CJC error	—	±1.2 °C @ 25 °C (77 °F) See CJC Channel Error on page 323.
Accuracy	±1.0 °C for TC and RTD @ 25 °C (77 °F)	
Channels	2, non-isolated	
RTD types supported	100 Ω Platinum 385 200 Ω Platinum 385 500 Ω Platinum 385 1000 Platinum 385 100 Ω Platinum 392 200 Ω Platinum 392, 500 Ω Platinum 392 1000 Ω Platinum 392 10 Ω Copper 427 120 Ω Nickel 672 604 Ω Nickel-Iron 518	—
Thermocouple types supported	—	J, K, N, T, E, R, S, B
Open circuit detection time	8…1212 ms	8…1515 ms
Power consumption	3.3 V, 40 mA	
Temperature, surrounding air, max.	65 °C (149 °F)	
Temperature, operating	IEC60068-2-1 (Test Ad, Operating Cold), IEC60068-2-2, (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock): -20...65 °C (-4…149 °F)	
Temperature, nonoperating	IEC60068-2-1 (Test Ad, Operating Cold), IEC60068-2-2, (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock): -40...85 °C (-40…185 °F)	
North American temp code	T4	

Certifications

Certification (when product is marked)(1)	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 2004/108/EC 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)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions

(1) See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

Event Input Interrupt Support

EII Inputs

Micro800 Controller	Number of inputs supporting EII	All inputs support EII
2080 10-point	6 (inputs 0…5)	Yes
2080 16-point	10 (inputs 0…9)	
2080 24-point	14 (inputs 0…13)	
2080 48-point	16 (inputs 0…15)	No

HSC Support

HSC Inputs

Micro800 Controller	Number of 4-input HSC	Number of 2-input HSC
2080 10-point	1 (HSC0)	2 (HSC0/1)
2080 16-point		
2080 24-point	2 (HSC0/2)	4 (HSC0/1/2/3)
2080 48-point	3 (HSC0/2/4)	6 (HSC0/1/2/3/4/5)

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				

HSC Input Wiring Mapping

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

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
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 24-point controller HSC Input Wiring Mapping

Modes of Operation	Input 0 (HSC0) Input 2 (HSC1) Input 4 (HSC2) Input 6 (HSC3)	Input 1 (HSC0) Input 3 (HSC1) Input 5 (HSC2) Input 7 (HSC3)	Input 2 (HSC0) Input 6 (HSC2)	Input 3 (HSC0) Input 7 (HSC2)	Mode Value in User Program
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

Micro830/Micro850 24-point controller HSC Input Wiring Mapping

Modes of Operation	Input 0 (HSC0) Input 2 (HSC1) Input 4 (HSC2) Input 6 (HSC3)	Input 1 (HSC0) Input 3 (HSC1) Input 5 (HSC2) Input 7 (HSC3)	Input 2 (HSC0) Input 6 (HSC2)	Input 3 (HSC0) Input 7 (HSC2)	Mode Value in User Program
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

Modes of Operation	Input 0 (HSC0) Input 2 (HSC1) Input 4 (HSC2) Input 6 (HSC3) Input 8 (HSC4) Input 10 (HSC5)	Input 1 (HSC0) Input 3 (HSC1) Input 5 (HSC2) Input 7 (HSC3) Input 9 (HSC4) Input 11 (HSC5)	Input 2 (HSC0) Input 6 (HSC2) Input 10 (HSC4)	Input 3 (HSC0) Input 7 (HSC2) Input 11 (HSC4)	Mode Value in User Program
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

Expansion I/O

The following tables provide specifications for digital and analog expansion I/O modules.

Discrete Expansion I/O

2085-IQ16 and 2085-IQ32T DC Sink/Source Input Modules(1)

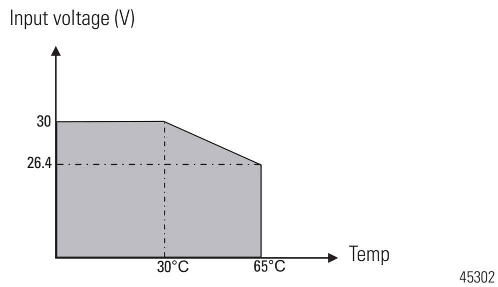
Attribute	2085-IQ16	2085-IQ32T
Number of inputs	16 sink/source	32 sink/source
Dimensions, HxWxD	44.5 x 90 x 87 mm (1.75 x 3.54 x 3.42 in.)	
Shipping weight, approx.	220 g (7.76 oz)	
Bus current draw, max	170 mA @ 5V DC	190 mA @ 5V DC
Wire size	0.25... 2.5 mm^2 (22...14 AWG) solid or stranded copper wire rated @ 75 °C (167 °F), or greater, 1.2 mm (3/64 in.) insulation max	
Wiring category(2)	2 – on signal ports	
Terminal screw torque, max	0.5…0.6 Nm (4.4…5.3 lb-in.)(3)	
Input circuit type	24V AC/DC sink/source	
Power dissipation, total	4.5 W	7 W
Power supply	24V DC	
Status indicators	16 yellow indicators	32 yellow indicators
Isolation voltage	50V (continuous), Reinforced Insulation Type, channel to system Type tested @ 720V DC for 60 s	
Enclosure type rating	Meets IP20	
North American temp code	T4	
Operating voltage range	10…30V DC, Class 2 21.6…26.4V AC, Class 2 See Derating Curve for 2085-IQ16 and Derating Curve for 2085-IQ32T on page 241	
Off-state voltage, max	5V DC	
Off-state current, max	1.5 mA	1.2 mA
On-state current, min	1.8 mA @ 10V DC	
On-state current, nom	6.0 mA @ 24V DC	5.2 mA @ 24V DC
On-state current, max	8.0 mA @ 30V DC	7.0 mA @ 30V DC
Input impedance, max	3.9 kΩ	4.6 kΩ
IEC input compatibility	Type 3	Type 1

(1) Meets IEC Type 1 24V DC Input Specifications.

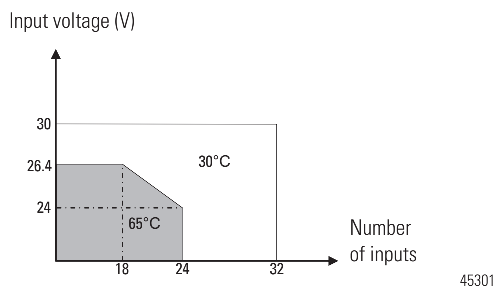
(2) Use this Conductor Category information for planning conductor routing. Refer to Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

(3) RTB hold down screws should be tightened by hand. They should not be tightened using a power tool.

Derating Curve for 2085-IQ16



Derating Curve for 2085-IQ32T



2085-OV16 Sink and 2085-OB16 Source DC Output Module

Attribute	2085-OV16	2085-OB16
Number of outputs	16 sinking	16 sourcing
Operating voltage range	10…30V DC	
On-state voltage, min	10V DC	
On-state voltage, nom	24V DC	
On-state voltage, max	30V DC	
On-state current, max	0.5 A @ 30V DC, per output 8 A, per module	
Dimensions, HxWxD	44.5 x 90 x 87 mm (1.75 x 3.54 x 3.42 in.)	
Shipping weight, approx.	220 g (7.76 oz)	
Bus current draw, max	200 mA @ 5V DC	
Wire size	0.25... 2.5 mm^2 (22...14 AWG) solid or stranded copper wire rated at 75 °C (167 °F), or greater, 1.2 mm (3/64 in.) insulation max	
Wiring category[(1)]	2 – on signal ports	
Terminal screw torque, max	0.5…0.6 Nm (4.4…5.3 lb-in.)[(2)]	
Output circuit type	24V DC sink	24V DC source
Power dissipation, total	5 W	
Power supply	24V DC, Class 2	
Status indicators	16 Yellow channel indicators	

2085-OV16 Sink and 2085-OB16 Source DC Output Module

Attribute	2085-OV16	2085-OB16
Isolation voltage	50V (continuous), Reinforced Insulation Type, channel to system Type tested @ 720V AC for 60 s	
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.

(2) RTB hold down screws should be tightened by hand. They should not be tightened using a power tool.

2085-IA8, 2085-IM8, 2085-OA8 AC Input/Output Modules

Attribute	2085-IA8	2085-IM8	2085-OA8
Number of inputs	8		
Dimensions, HxWxD	28 x 90 x 87 mm (1.10 x 3.54 x 3.42 in.)		
Shipping weight, approx.	140 g (4.93 oz)		
Bus current draw, max	5V DC, 150 mA		5V DC, 180 mA
Wire size	0.25... 2.5 mm^2 (22...14 AWG) solid or stranded copper wire rated @ 75 °C (167 °F), or greater, 1.2 mm (3/64 in.) insulation max		
Insulation stripping length	10 mm (0.39 in.)		
Wiring category[1]	2 – on signal ports		
Wire type	Copper		
Terminal screw torque, max	0.5…0.6 Nm (4.4…5.3 lb-in.)[2]		
Input/output circuit type	120V AC input	240V AC input	120V/240V AC output
Power supply	120V AC	240V AC	120V/240V AC
Power dissipation, total	2.36 W	2.34 W	5.19 W
Enclosure type rating	Meets IP20		
Status indicators	8 yellow indicators		
Isolation voltage	150V (continuous), Reinforced Insulation Type, channel to system Type tested @ 1950V DC for 60 s	240V (continuous), Reinforced Insulation Type, channel to system Type tested @ 3250V DC for 60 s	
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.

(2) RTB hold down screws should be tightened by hand. They should not be tightened using a power tool.

Input Specifications – 2005-IA8 and 2085-IM8

Attribute	2085-IA8	2085-IM8
Number of Inputs	8	
Voltage category	120V AC	240V AC
Operating voltage range	74…120V AC	159…240V AC
Off-state voltage, max	20V AC	40V AC
Off-state current, max	2.5 mA	
On-state current, min	5.0 mA @ 74V AC	4.0 mA @ 159V AC
On-state current, max	12.5 mA @ 120V AC	7.0 mA @ 240V AC
Input impedance, max	22.2 kΩ	
Inrush current, max	450 mA	
Input filter time Off to On On to Off	≤ 20 ms	
IEC type compliance	Type 3	

Output Specifications – 2085-OA8

Attribute	2085-OA8
Number of Inputs	8
Voltage category	120V/230V AC
Operating voltage range	120…240V AC
Output voltage, min	85V AC
Output voltage, max	240V AC
Off-state current, max	2.5 mA
On-state current, min	10 mA per output
On-state current, max	0.5 A per output
On-state current, per module, max	4 A
Off-state voltage drop, max	1.5V AC @ 0.5 A 2.5V AC @10 mA
Fusing	Not protected. A suitable rating fuse is recommended to protect outputs.
Output signal delay Off to On On to Off	 9.3 ms for 60 Hz, 11 ms for 50 Hz 9.3 ms for 60 Hz, 11 ms for 50 Hz
Surge current, max	5 A

2085-OW8 and 2085-OW16 Relay Output Module

Attribute	2085-OW8	2085-OW16
Number of outputs	8, relay	16, relay
Dimensions, HxWxD	28 x 90 x 87 mm (1.10 x 3.54 x 3.42 in.)	44.5 x 90 x 87 mm (1.75 x 3.54 x 3.42 in.)
Shipping weight, approx.	140 g (4.93 oz)	220 g (7.76 oz)
Wire size	0.25... 2.5 mm^2 (22...14 AWG) solid or stranded copper wire rated @ 75 °C (167 °F), or greater, 1.2 mm (3/64 in.) insulation max	
Insulation strip length	10 mm (0.39 in.)	

2085-OW8 and 2085-OW16 Relay Output Module

<table>
<tr><th>Attribute</th><th>2085-OW8</th><th>2085-OW16</th></tr>
<tr><td>Wiring category[1]</td><td colspan="2">2 – on signal ports</td></tr>
<tr><td>Wire type</td><td colspan="2">Copper</td></tr>
<tr><td>Terminal screw torque. max</td><td colspan="2">0.5…0.6 Nm
(4.4…5.3 lb-in.)[2]</td></tr>
<tr><td>Bus current draw, max</td><td>5V DC, 120 mA
24V DC, 50 mA</td><td>5V DC, 160 mA
24V DC, 100 mA</td></tr>
<tr><td>Load current, max</td><td colspan="2">(refer to Relay contact, (0.35 power factor) below)</td></tr>
<tr><td>Power dissipation, total</td><td>2.72 W</td><td>5.14 W</td></tr>
<tr><td>Relay contact, (0.35 power factor)</td><td colspan="2">
<table>
<tr><th rowspan="2">Max Volts</th><th colspan="2">Amperes</th><th>Amperes</th><th colspan="2">Volt Amperes</th></tr>
<tr><th>Make</th><th>Break</th><th>Continuous</th><th>Make</th><th>Break</th></tr>
<tr><td>120V AC</td><td>15 A</td><td>1.5 A</td><td>2.0 A</td><td rowspan="2">1800V A</td><td rowspan="2">180V A</td></tr>
<tr><td>240V AC</td><td>7.5 A</td><td>0.75 A</td><td></td></tr>
<tr><td>24V DC</td><td colspan="2">1.0 A</td><td rowspan="2">1.0 A</td><td colspan="2" rowspan="2">28V A</td></tr>
<tr><td>125V DC</td><td colspan="2">0.22 A</td></tr>
</table>
</td></tr>
<tr><td>Minimum load, per point</td><td colspan="2">10 mA per point</td></tr>
<tr><td>Off-state leakage, max</td><td colspan="2">1.5 mA</td></tr>
<tr><td>Status indicators</td><td>8 yellow indicators</td><td>16 yellow indicators</td></tr>
<tr><td>Isolation voltage</td><td colspan="2">240V (continuous), Reinforced Insulation Type, channel to system
Type tested @ 3250V DC for 60 s</td></tr>
<tr><td>Pilot duty rating</td><td colspan="2">C300, R150</td></tr>
<tr><td>Enclosure type rating</td><td colspan="2">Meets IP20</td></tr>
<tr><td>North American temp code</td><td colspan="2">T4</td></tr>
</table>

(1) Use this Conductor Category information for planning conductor routing. Refer to Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

(2) RTB hold down screws should be tightened by hand. They should not be tightened using a power tool.

Analog Expansion I/O

2085-IF4, 2085-IF8, 2085-OF4 Analog Input and Output Modules

Attribute	2085-IF4	2085-OF4	2085-IF8
Number of I/O	4		8
Dimensions, HxWxD	28 x 90 x 87 mm (1.1 x 3.54 x 3.42 in.)		44.5 x 90 x 87 mm (1.75 x 3.54 x 3.42 in.)
Shipping weight, approx.	140 g (4.93 oz)		220 g (7.76 oz)
Bus current draw, max	5V DC, 100 mA 24V DC, 50 mA	5V DC, 160 mA 24V DC, 120 mA	5V DC, 110 mA 24V DC, 50 mA

2085-IF4, 2085-IF8, 2085-OF4 Analog Input and Output Modules

Attribute	2085-IF4	2085-OF4	2085-IF8
Wire size	0.25... 2.5 mm^2 (22...14 AWG) solid or stranded copper wire rated @ 75 °C (167 °F), or greater, 1.2 mm (3/64 in.) insulation max		
Wiring category(1)	2 – on signal ports		
Wire type	Shielded		
Terminal screw torque	0.5…0.6 Nm (4.4…5.3 lb-in.)(2)		
Power dissipation, total	1.7 W	3.7 W	1.75 W
Enclosure type rating	Meets IP20		
Status indicators	1 green health indicator	1 green health indicator	1 green health indicator 8 red error indicators
Isolation voltage	50V (continuous), Reinforced Insulation Type, channel to system and channel to channel. Type tested @ 720V DC for 60 s		
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.

(2) RTB hold down screws should be tightened by hand. They should not be tightened using a power tool.

Input Specifications – 2085-IF4 and 2085-IF8

Attribute	2085-IF4	2085-IF8
Number of inputs	4	8
Resolution Voltage Current	14 bits (13 bits plus sign bit) 1.28 mV/cnt unipolar; 1.28 mV/cnt bipolar 1.28 µA/cnt	
Data format	Left justified, 16 bit 2s complement	
Conversion type	SAR	
Update rate	< 2 ms per enabled channel without 50 Hz/60 Hz rejection, < 8 ms for all channel 8 ms with 50 Hz/60 Hz rejection	
Step response time up to 63% 2-point Moving Average Filter 4-point Moving Average Filter 8-point Moving Average Filter 50/60 Hz Rejection Filter	 4…16 ms (for 1…8 enabled channels) 6…24 ms (for 1…8 enabled channels) 12…60 ms (for 1…8 enabled channels) 600 ms (for 1…8 enabled channels)	
Input current terminal, user configurable	4…20 mA (default) 0…20 mA	
Input voltage terminal, user configurable	±10V 0…10V	
Input impedance	Voltage terminal >1 MΩ Current terminal <100 Ω	
Absolute accuracy	±0.10% Full Scale @ 25 ° C	
Accuracy drift with temp	Voltage terminal – 0.00428 % Full Scale/° C Current terminal – 0.00407 % Full Scale/° C	

Input Specifications – 2085-IF4 and 2085-IF8

Attribute	2085-IF4	2085-IF8
Calibration required	Factory calibrated. No customer calibration supported.	
Overload, max.	30V continuous or 32 mA continuous, one channel at a time.	
Channel diagnostics	Over and under range or open circuit condition by bit reporting	

Output Specifications – 2085-OF4

Attribute	2085-OF4
Number of outputs	4
Resolution Voltage Current	12 bits unipolar; 11 bits plus sign bipolar 2.56 mV/cnt unipolar; 5.13 mV/cnt bipolar 5.13 µA/cnt
Data format	Left justified, 16 bit 2s complement
Step response time up to 63%	2 ms
Conversion rate, max	2 ms per channel
Output current terminal, user configurable	0 mA output until module is configured 4…20 mA (default) 0…20 mA
Output voltage terminal, user configurable	±10V 0…10V
Current load on voltage output, max	3 mA
Absolute accuracy Voltage terminal Current terminal	 0.133 % Full Scale @ 25 ° C or better 0.425 % Full Scale @ 25 ° C or better
Accuracy drift with temp	Voltage terminal – 0.0045 % Full Scale/° C Current terminal – 0.0069 % Full Scale/° C
Resistive load on mA output	15…500 ohm @ 24V DC

Specialty Expansion I/O

2085-IRT4 Temperature Input Module

Attribute	2085-IRT4
Number of inputs	4
Dimensions, HxWxD	44.5 x 90 x 87 mm (1.75 x 3.54 x 3.42 in.)
Shipping weight, approx.	220 g (7.76 oz)
Bus current draw, max	5V DC, 160 mA 24V DC, 50 mA
Wire size	0.25... 2.5 mm^2 (22...14 AWG) solid or stranded copper wire rated @ 75 °C (167 °F), or greater, 1.2 mm (3/64 in.) insulation max
Wiring category(1)	2 – on signal ports
Terminal screw torque	0.5…0.6 Nm (4.4…5.3 lb-in.)(2)

2085-IRT4 Temperature Input Module

Attribute	2085-IRT4
Input type	Thermocouple type: B, C, E, J, K, TXK/XK (L), N, R, S, T RTD type: 100 Ω Pt α = 0.00385 Euro 200 Ω Pt α = 0.00385 Euro 100 Ω Pt α = 0.003916 U.S 200 Ω Pt α = 0.003916 U.S. 100 Ω Nickel 618 200 Ω Nickel 618 120 Ω Nickel 672 10 Ω Copper 427 mV range: 0…100 mV Ohm input: 0…500 Ω
Resolution	16 bits
Channel update time, typical	12…500 ms per enabled channel
Input impedance	> 10 M Ω
Accuracy	±0.5…±3.0 °C accuracy for Thermocouple inputs ±0.2…±0.6 °C accuracy for RTD inputs
Power dissipation, total	2 W
Enclosure type rating	Meets IP20
Status indicators	1 green health indicator
Isolation voltage	50V (continuous), Reinforced Insulation Type, channel to system. Type tested @ 720V DC for 60 s
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.

(2) RTB hold down screws should be tightened by hand. They should not be tightened using a power tool.

Environment Specifications

Environment Specifications for Micro850 Expansion I/O Modules

Attribute	Value
Temperature, operating	IEC60068-2-1 (Test Ad, Operating Cold), IEC60068-2-2, (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock): -20...65 °C (-4…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)
Temperature, surrounding air, max.	65 °C (149 °F)
Relative humidity	IEC 60068-2-30 (Test Db, Unpackaged Damp Heat): 5…95% noncondensing
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): 25 g for DIN Rail Mounting 35 g for Panel Mounting

Environment Specifications for Micro850 Expansion I/O Modules

Attribute	Value
Emissions	CISPR 11: Group 1, Class A
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 signal ports
Surge Transient Immunity	IEC 61000-4-5: ±1 kV line-line(DM) and ±2 kV line-earth(CM) on power ports ±2 kV line-earth(CM) on shielded ports
Conducted RF Immunity	IEC 61000-4-6: 10V rms with 1 kHz sine-wave 80% AM from 150 kHz…80 MHz

Certifications – All Micro800 Expansion I/O Modules

Certification (when product is marked)[1]	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 2004/108/EC 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)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: Article 58-2 of Radio Waves Act, Clause 3

(1) See the Product Certification link athttp://www.rockwellautomation.com/products/certification/ for Declaration of Conformity, Certificates, and other certification details.

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.

Only Modbus RTU over a serial port is supported.

In addition, the Micro850 controller supports Modbus TCP 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: Arrays and 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 Discrete Inputs are mapped from 00001…09999, Coils are mapped from 10001…19999, Input Registers are mapped from 30001…39999, and Holding Registers are mapping from 40001…49999.

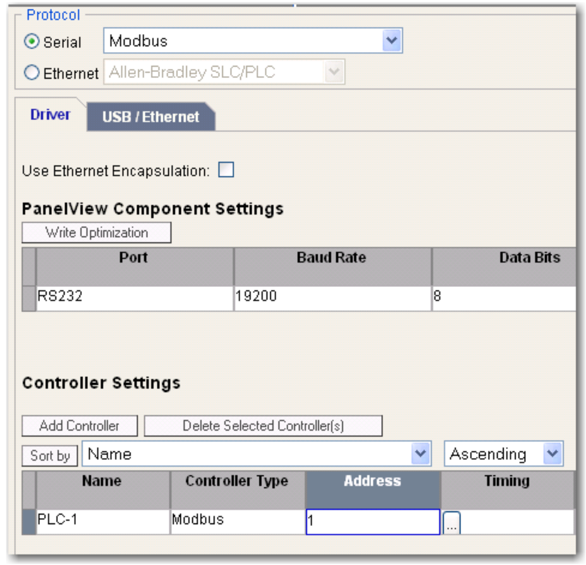
Example 1, PanelView Component HMI (Master) to Micro800 (Slave)

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.

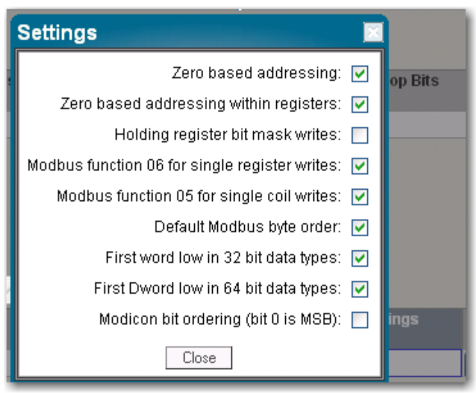
The HMI is typically configured for Master and the Micro800 embedded serial port is configured for Slave.

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.

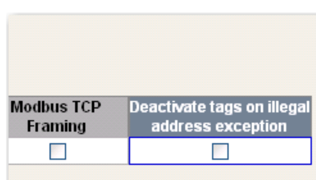
1. Change from DF1 to Modbus protocol.



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.

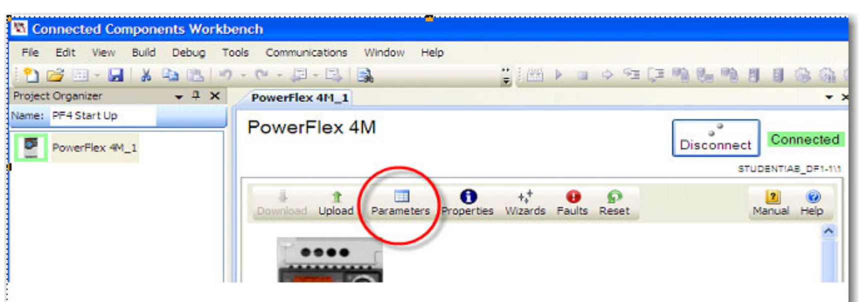
Parameter numbers listed in this section are for a PowerFlex 4M and will be different if you are using another PowerFlex 4-Class drive.

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		

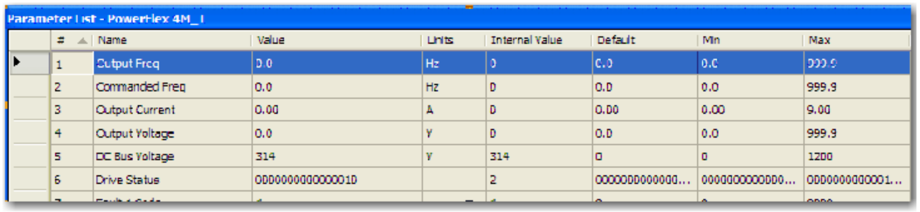
- Connect the 1203-USB to the PowerFlex Drive and to the Computer.
- Launch Connected Components Workbench, Connect to the Drive and set parameters.

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.



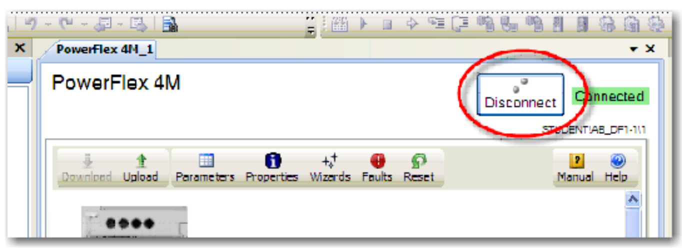
6. The Parameter window opens. Resize it to view the parameters. From this window, you can view and set data values of Parameters.



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 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 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	255
Establish Communications Between RSLinx and a Micro830/Micro850 Controller through USB	260
Configure Controller Password	267
Use the High Speed Counter	270
Forcing I/Os	283

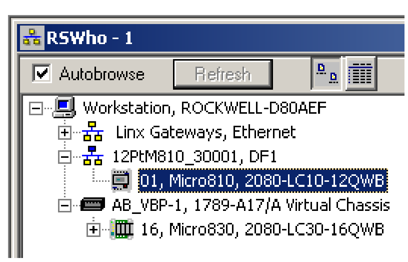
Flash Upgrade Your Micro800 Firmware

This quick start will show you how to flash update the firmware in a Micro800 controller using ControlFLASH. ControlFLASH is installed or updated with the latest Micro800 firmware when Connected Components Workbench software is installed on your computer.

ATTENTION: All Ethernet settings are reverted to factory default after a ControlFlash firmware upgrade. For users who need to use the same static IP address as previously set, for example, use the Memory Module to store project settings prior to a flash upgrade so that you can have the option to restore your original Ethernet settings.

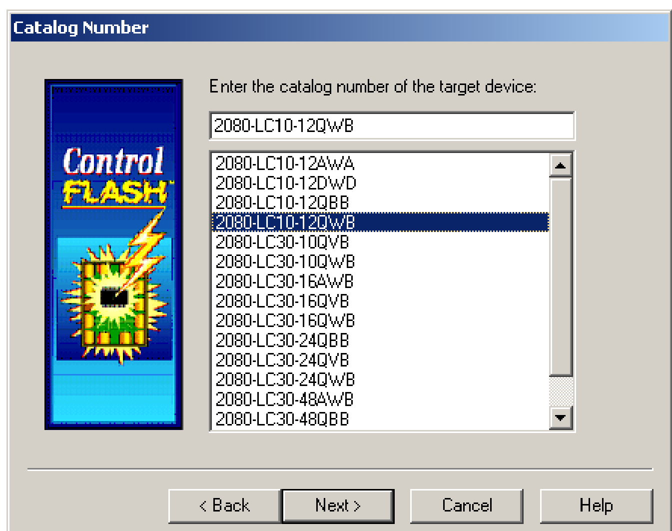
On Micro850 controllers, users can use flash upgrade their controllers through the Ethernet port, in addition to the USB.

1. **Through USB**: Verify successful RSLinx Classic communications with your Micro800 controller by USB using RSWho. Micro810 12-pt. controller uses the 12PtM810_xxxxx driver and the Micro830/Micro850 uses the AB_VBP-x driver.

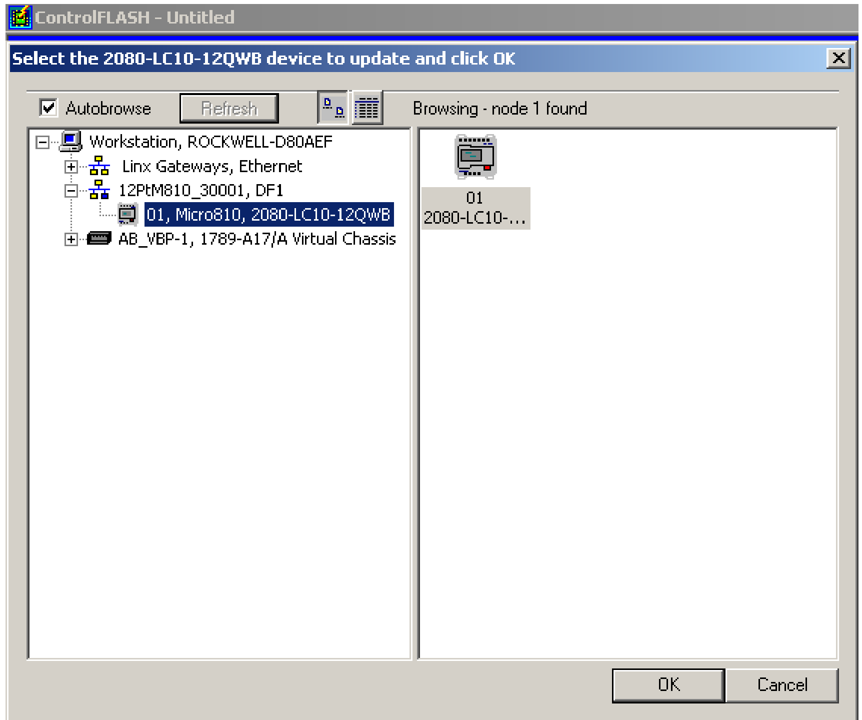


2. Start ControlFLASH and click Next.

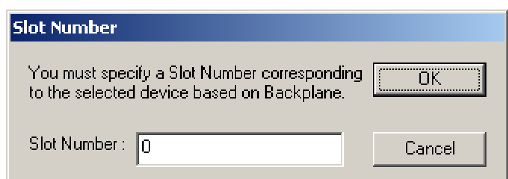
3. Select the catalog number of the Micro800 controller that you are updating and click Next.



4. Select the controller in the browse window and click OK.

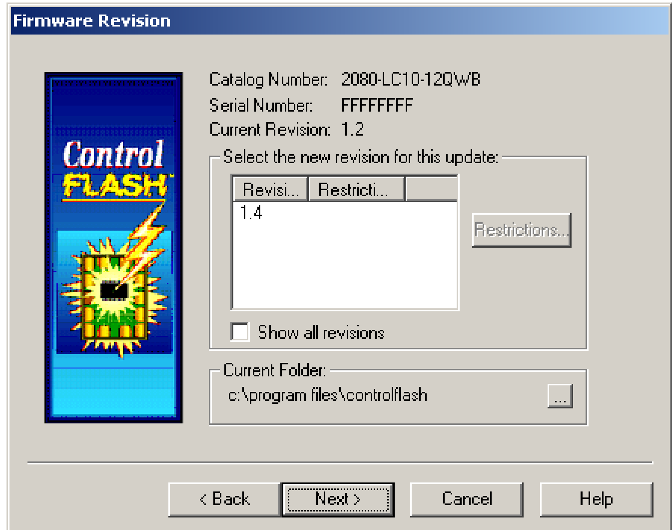


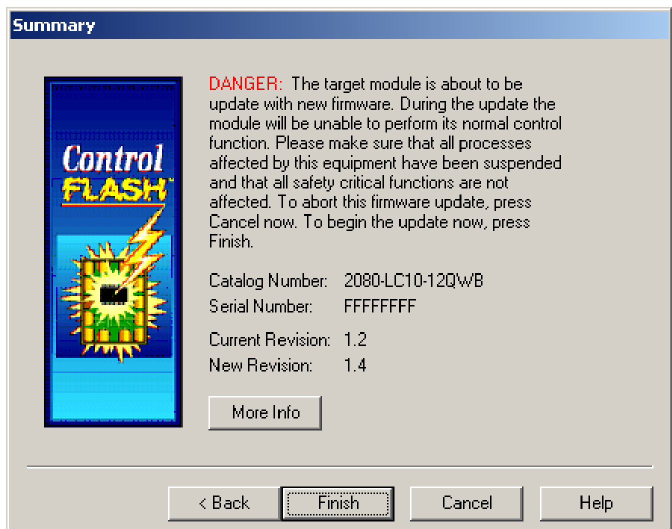
5. If you see the following dialog, leave the Slot Number at 0 and click OK.



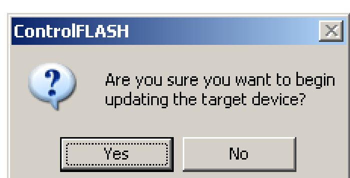
This screen is available only for Micro810 controllers.

6. Click Next to continue, and verify the revision. Click Finish.

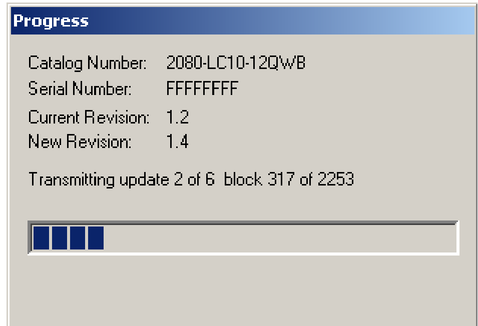




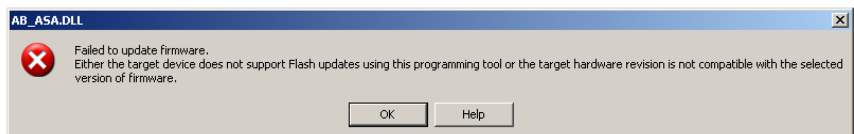
7. Click Yes to initiate the update.



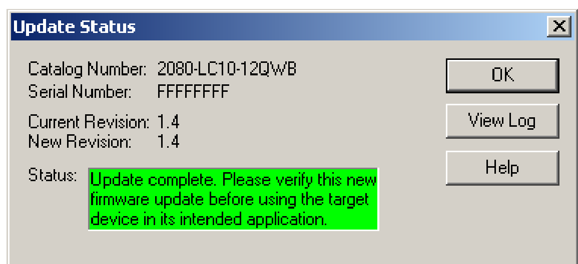
The next screen shows the download progress.



If you see the following error message instead, check to see if the controller is faulted or in Run mode. If so, clear the fault or switch to Program mode, click OK and try again.



8. When the flash update is complete, you see a status screen similar to the following. Click OK to complete the update.

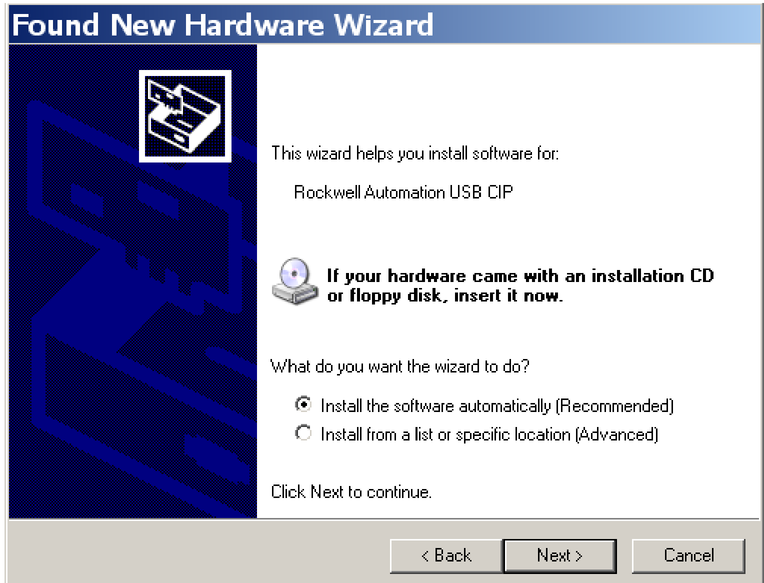


Establish Communications Between RSLinx and a Micro830/Micro850 Controller through USB

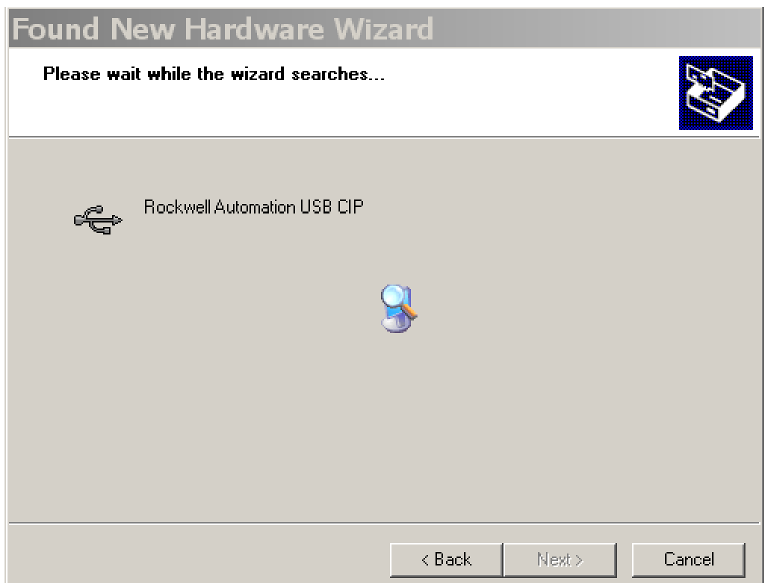
This quick start shows you how to get RSLinx RSWho to communicate with a Micro830 or Micro850 controller through a USB.

1. 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).
2. Power up the Micro830/Micro850 controller.
3. Plug USB A/B cable directly between your PC and the Micro830/Micro850 controller.
4. Windows should discover the new hardware. Click No, not this time and then click Next.

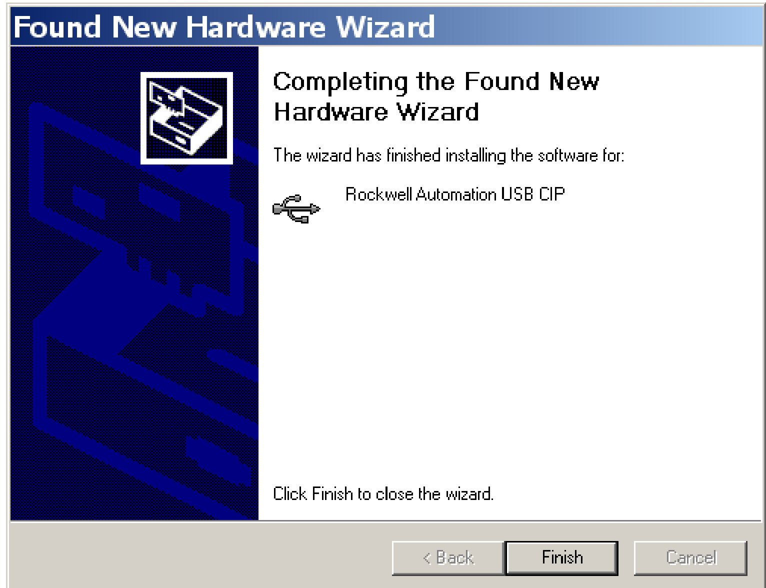
5. Click Install the software automatically (Recommended), and then click Next.

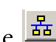


The Wizard searches for new hardware.

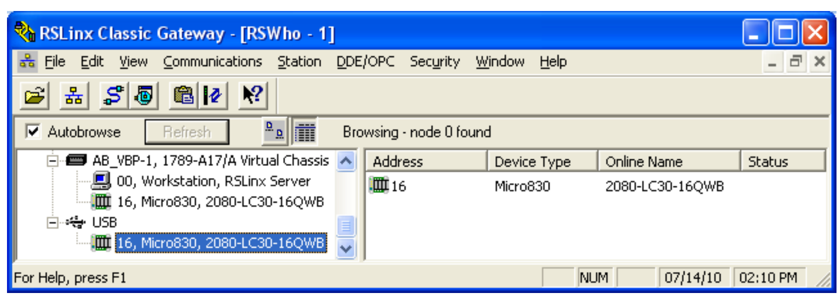


6. Click Finish when the wizard completes the installation.

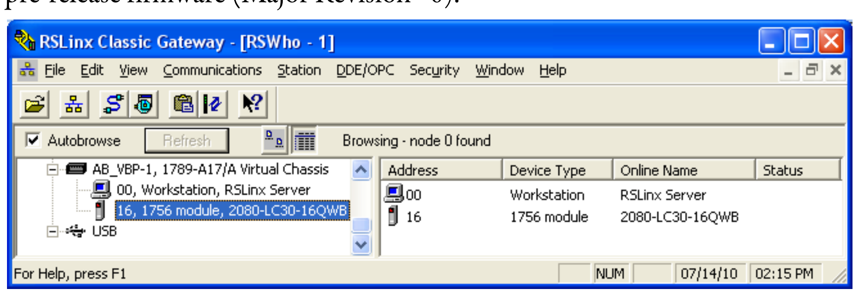


7. Open RSLinx Classic and run RSWho by clicking the  icon.

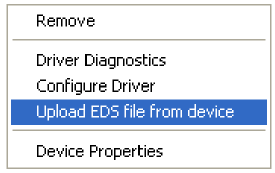
   If the proper EDS file is installed, the Micro830/Micro850 controller should be properly identified and show up under both the Virtual Backplane (VBP) driver and the USB driver, which was automatically created.



   If instead the Micro830/Micro850 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).

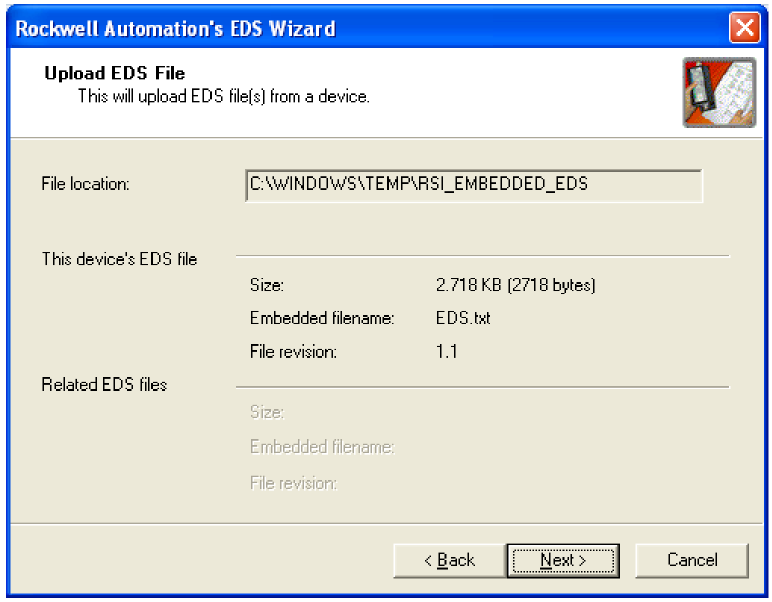


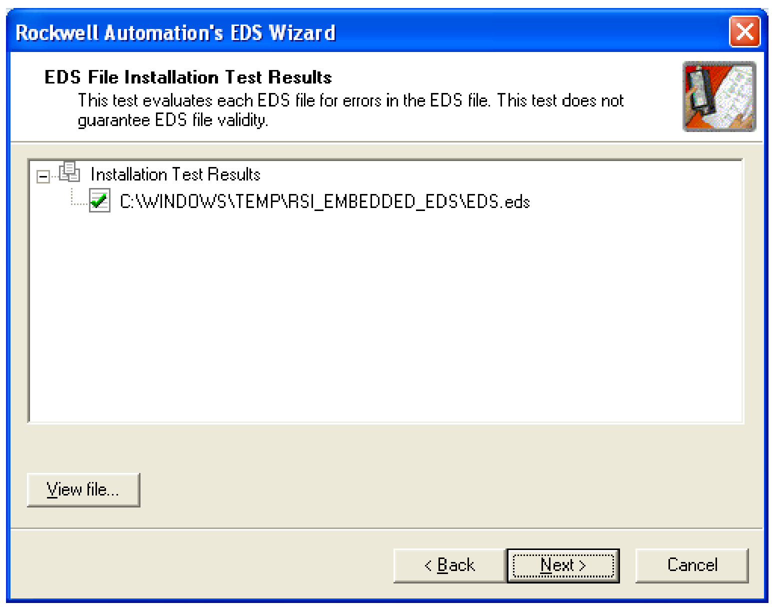
Since Micro830/Micro850 controllers support embedded EDS files, right click this device and select Upload EDS file from device.

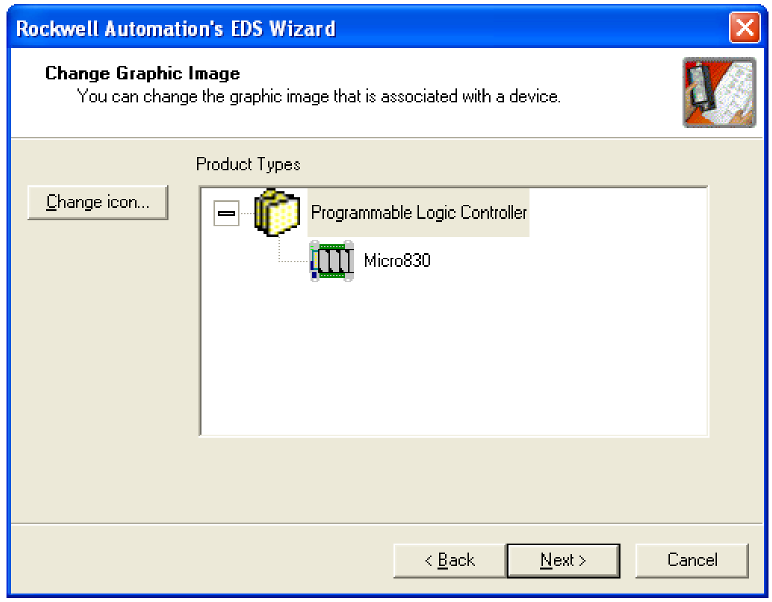


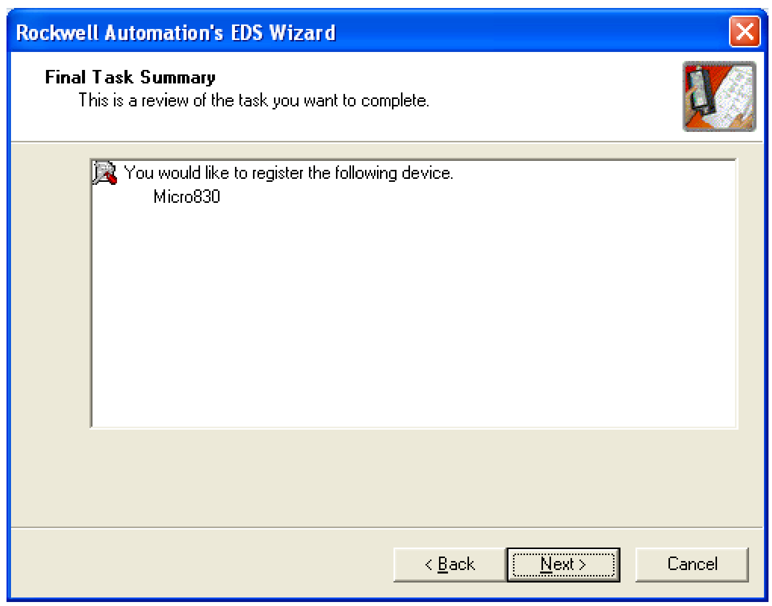
8. On the EDS wizard that appears , click Next to continue.

9. Follow the prompts to upload and install the EDS file.



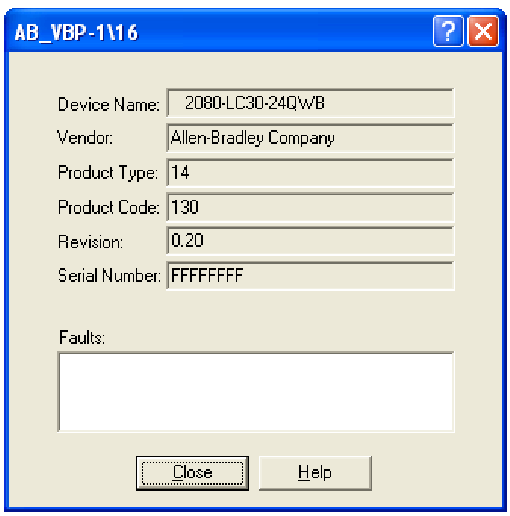



Rockwell Automation's EDS Wizard
Change Graphic Image
You can change the graphic image that is associated with a device.
Product Types
Change icon...
Programmable Logic Controller
Micro830
< Back
Next >
Cancel


Rockwell Automation's EDS Wizard
Final Task Summary
This is a review of the task you want to complete.
You would like to register the following device.
Micro830
< Back
Next >
Cancel

10. Click Finish to complete.

If the Micro830/Micro850 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.

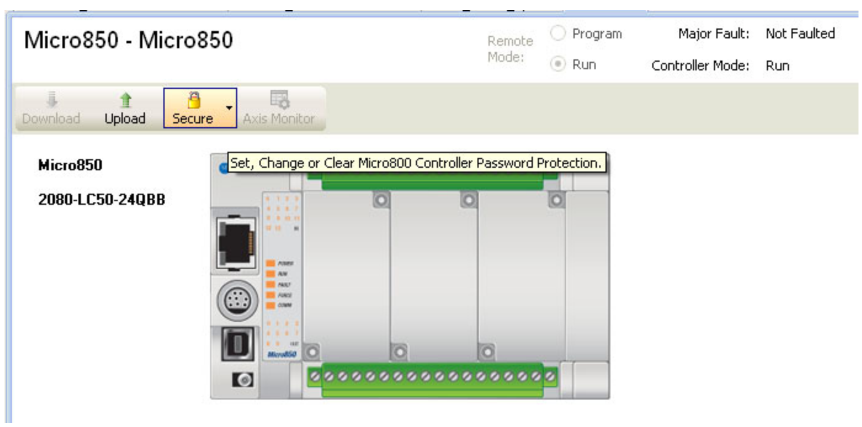
IMPORTANT	The following instructions are supported on Connected Components Workbench revision 2 and Micro800 controllers with firmware revision 2. For more information about the controller password feature on Micro800 controllers, see Controller Security on page 235.

Set Controller Password

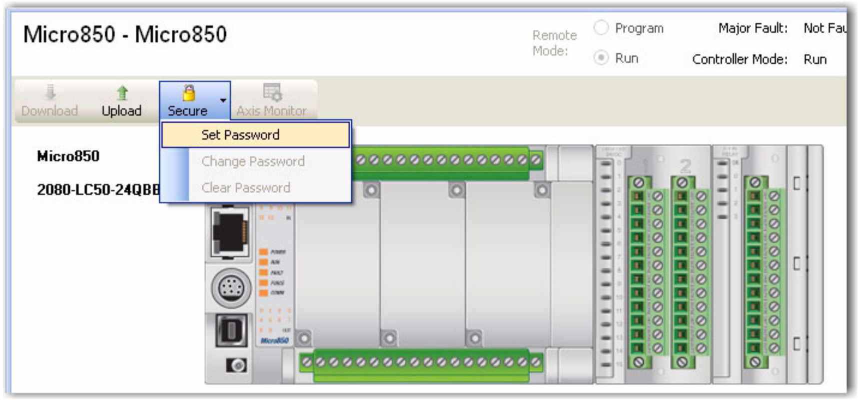
IMPORTANT	After creating or changing the controller password, you need to power down the controller in order for the password to be saved.

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.

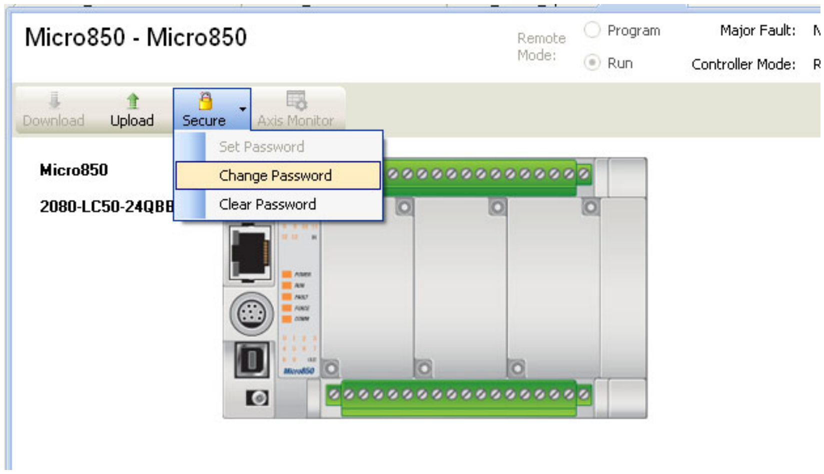
TIP Passwords must have at least eight characters to be valid.

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.

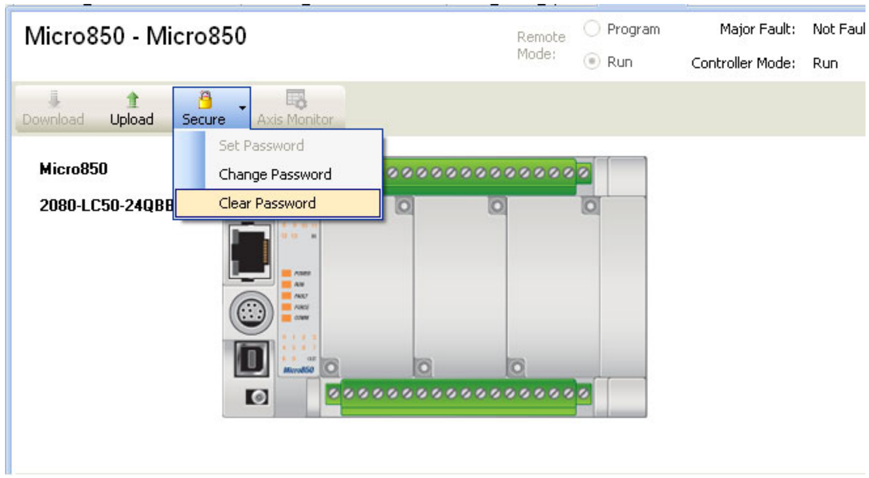
3. Click OK.

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.

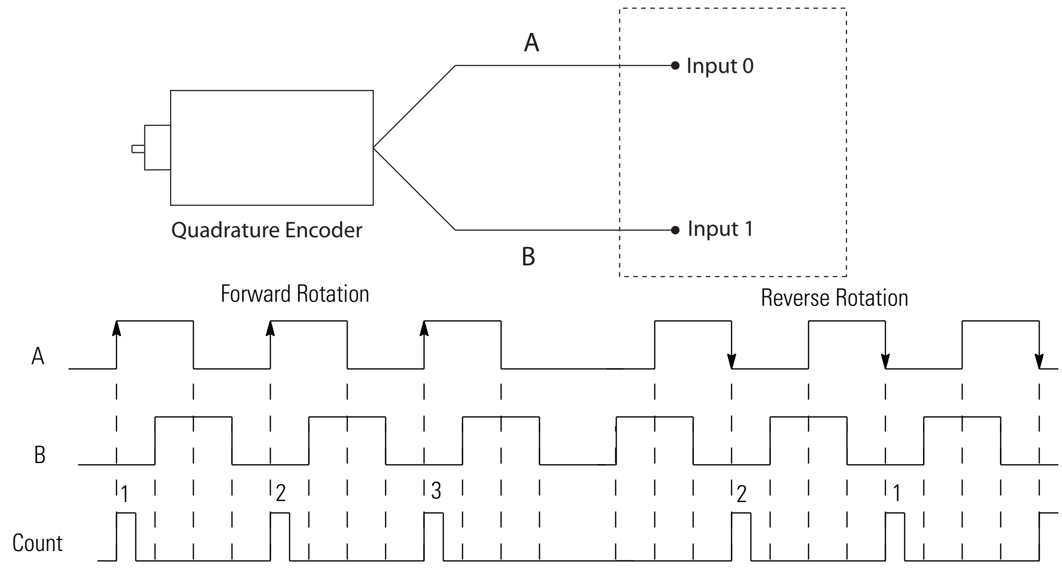
Use the High Speed Counter

To use HSC, you first need to establish the HSC counting mode required by your application. See HSC Mode (HSCAPP.HSCMode) on page 172 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.

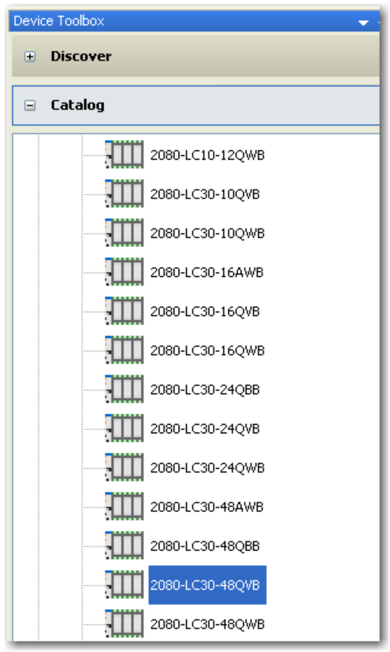


This quickstart includes the following sections:

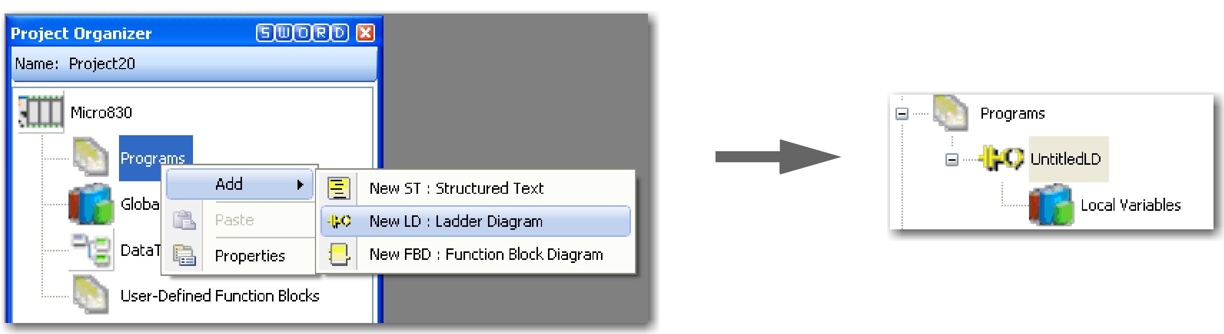
- Create the HSC Project and Variables on page 272
- Assign Values to the HSC Variables on page 275
- Assign Variables to the Function Block on page 278
- Run the High Speed Counter on page 279
- Use the Programmable Limit Switch (PLS) Function on page 281

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[1] or drag and drop it onto the Project Organizer windows.

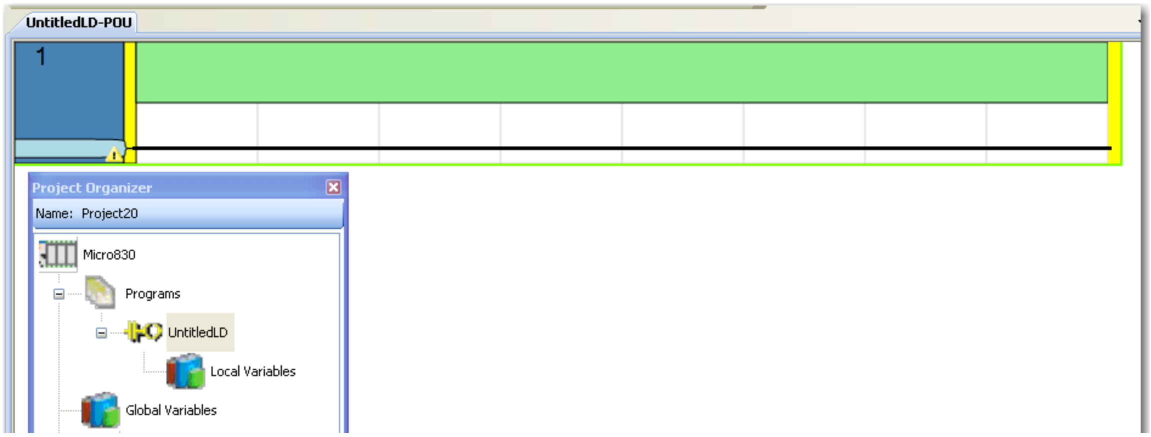


2. Under Project Organizer, right-click Programs. Click Add New LD: Ladder Diagram to add a new ladder logic program.

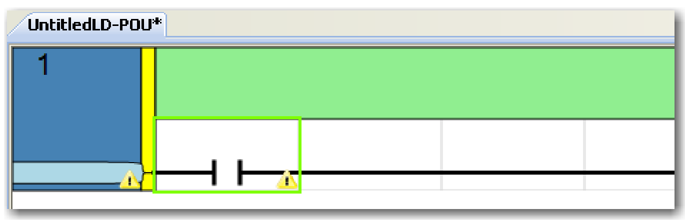


(1) The HSC is supported on all Micro830 and Micro850 controllers, except on 2080-LCxx-xxAWB types.

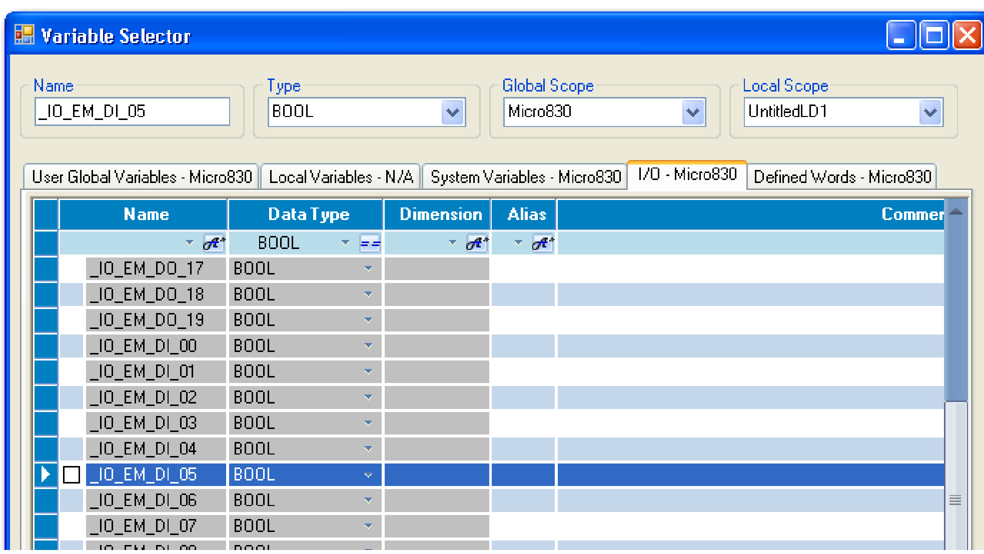
3. Right-click UntitledLD and select Open.



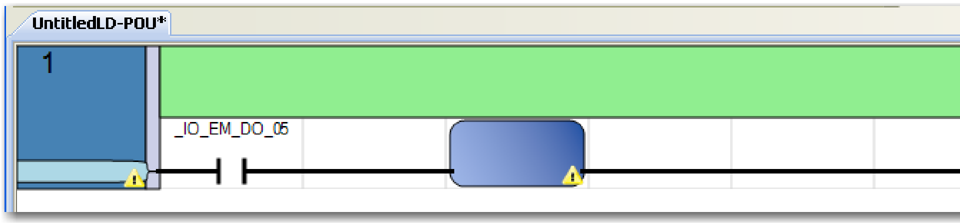
4. From the Toolbox, double-click Direct Contact to add it to the rung or drag and drop Direct Contact onto the Rung.



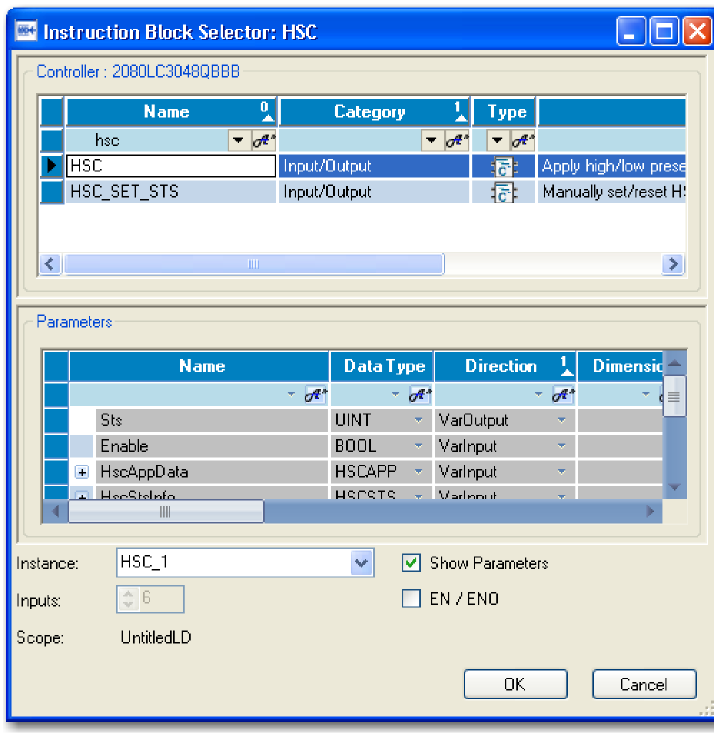
5. Double-click the Direct Contact you have just added to bring up the Variable Selector dialog. Click I/O Micro830 tab. Assign the Direct Contact to input 5 by selecting _IO_EM_DI_05. Click OK.



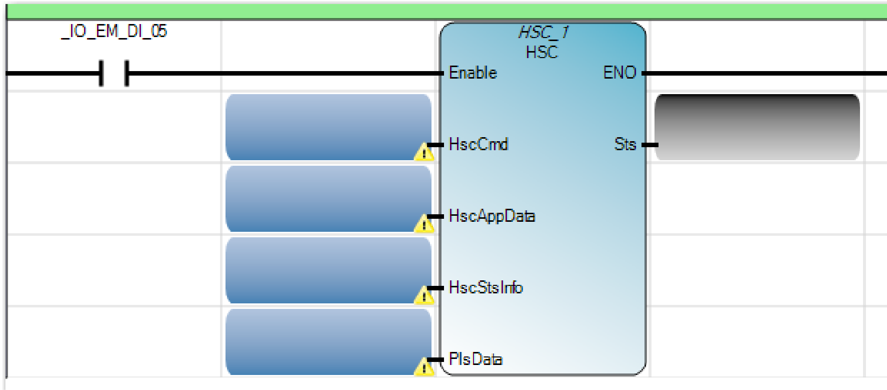
6. To the right of the Direct Contact, add a function block by double-clicking function block from the Toolbox or dragging and dropping the function block onto the rung.



7. 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.



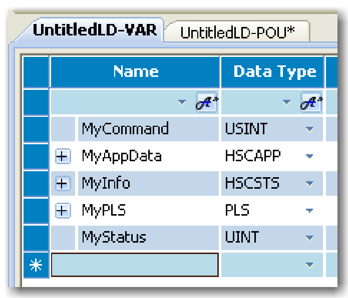
Your ladder rung should appear as shown below:



8. 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:



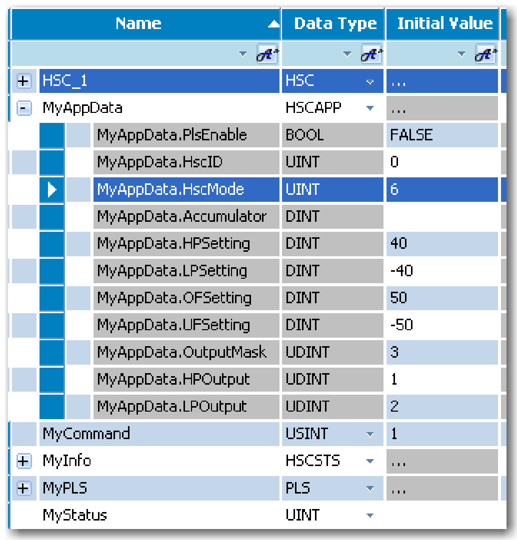
Assign Values to the HSC Variables

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 189 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 171 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 167 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.

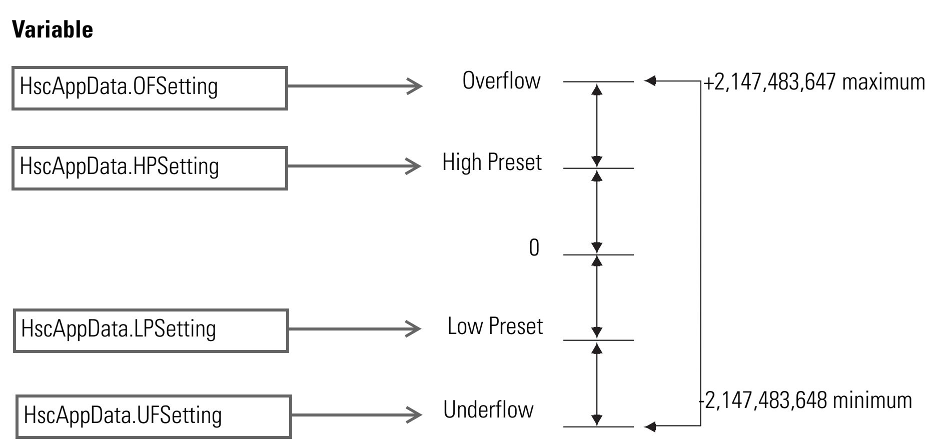
MyAppData.HscMode allows the user to specify the type of operation in which the HSC will use to count. See HSC Mode (HSCAPP.HSCMode) on page 172 for more information about HSC modes. You can also quickly refer to the table below for the list of ten available modes.

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.



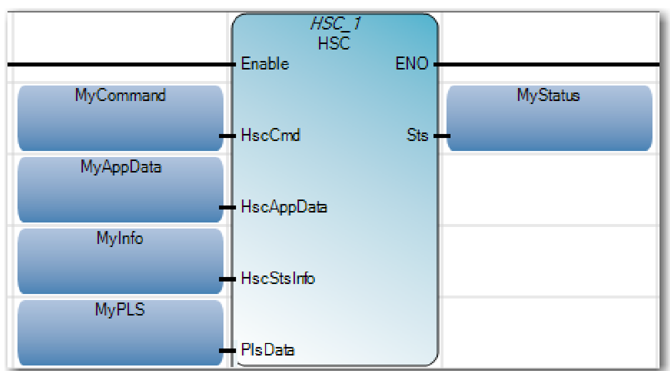
MyAppData.OutputMask along with **MyAppData.HPOutput** and **MyAppData.LPOutput** allows the user to specify which embedded outputs can be turned on when a High Preset or Low Preset is reached. These variables use a combination of decimals and binary numbers to specify the embedded outputs that are able 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.

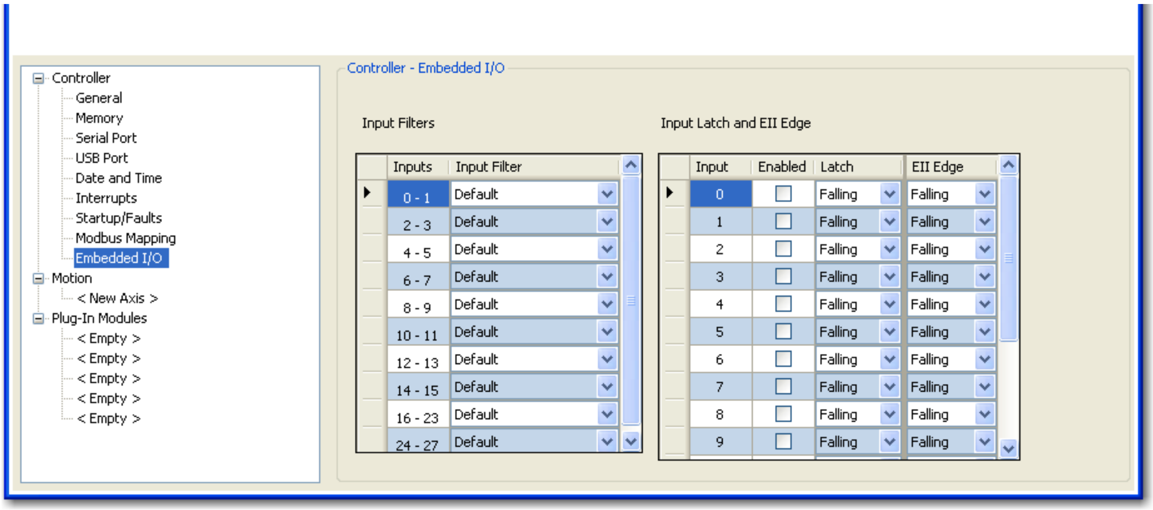
Assign Variables to the Function Block

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.)

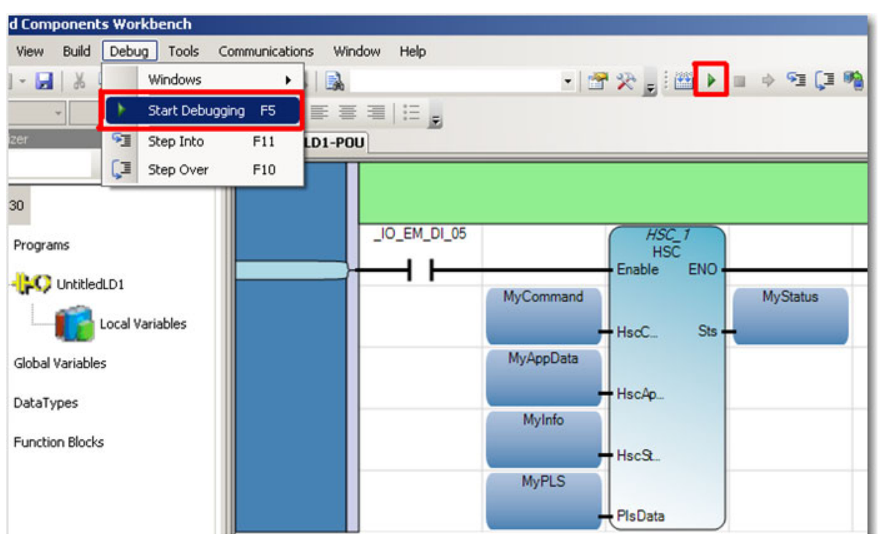
2. Next, click the Micro830 controller under the Project Organizer pane to bring up the Micro830 Controller Properties pane. Under Controller Properties, click Embedded I/O. Set the input filters to a correct value depending on the characteristics of your encoder.



3. Make sure that your encoder is connected to the Micro830 controller.
4. 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

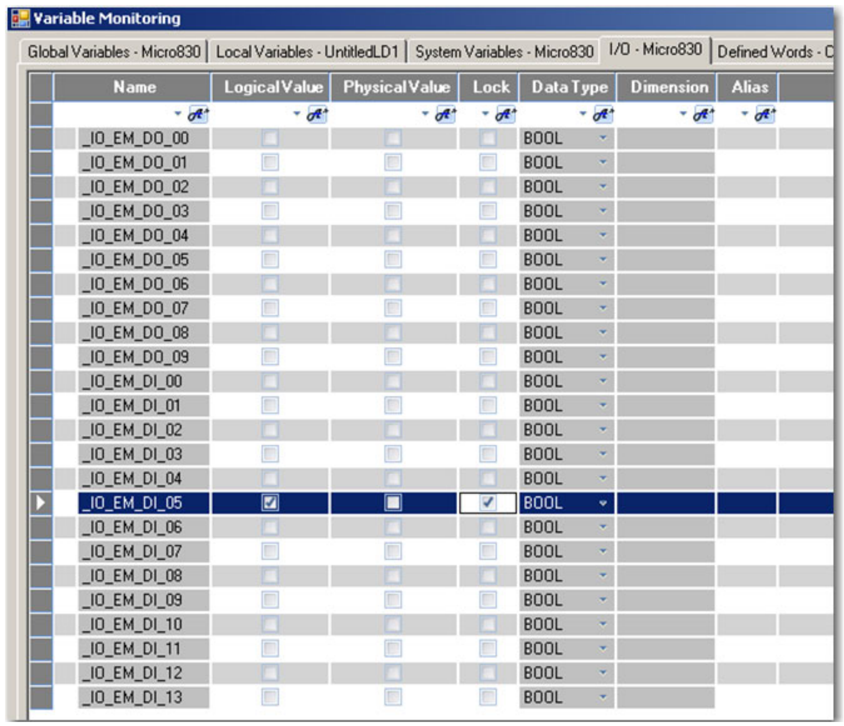
1. To test the program, go into debug mode by doing any of the following:
   - Click Debug menu, then choose Start Debugging,
   - Click the green play button below the menu bar, or
   - Hit the F5 windows key.



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.

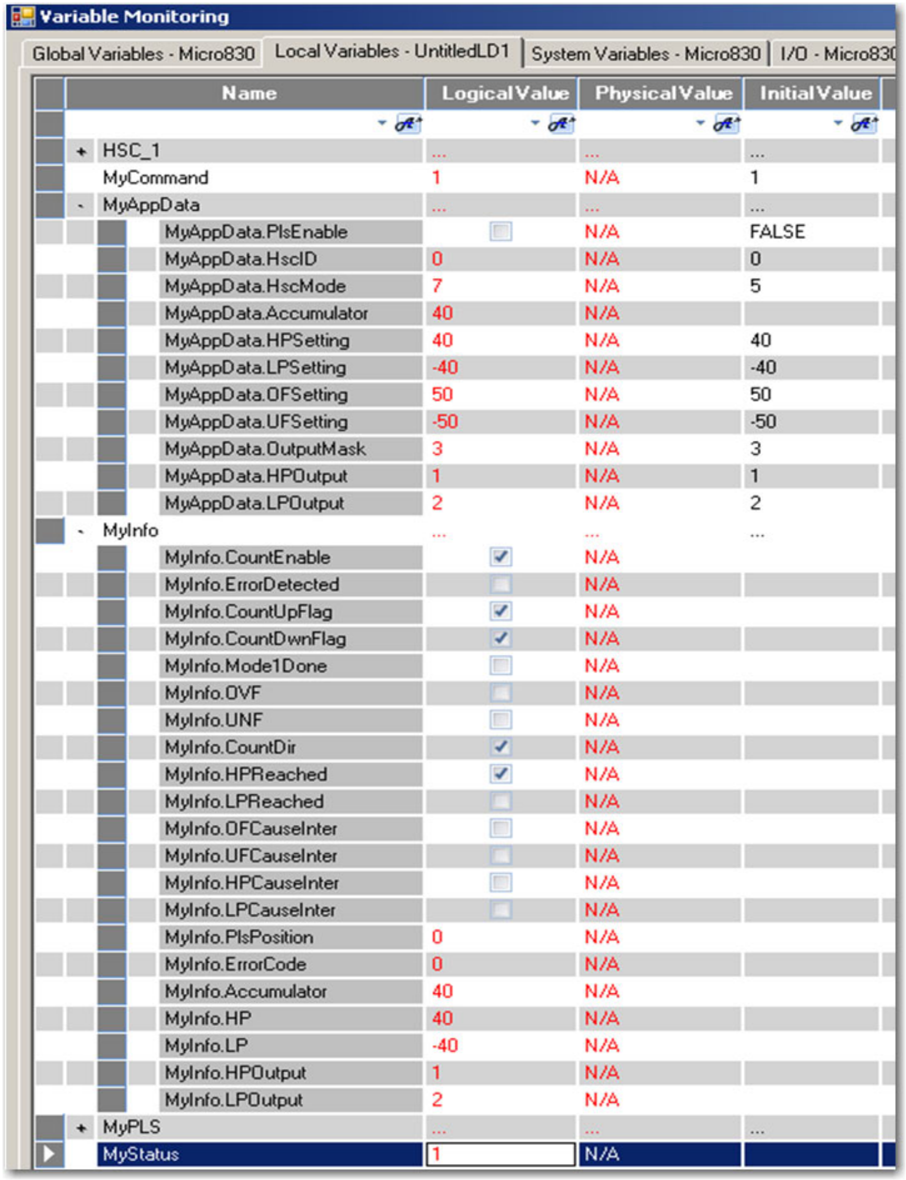
3. Click the I/O Micro830 tab. Select the _IO_EM_DI_05 row. Check the boxes Lock and Logical Value so that this input will be forced in the ON position.



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 190 for the complete list of status codes. For example, if the MyStatus value is 04, a configuration error exists and the controller will . You need to check your parameters in this case.



Variable Monitoring

Global Variables - Micro830 | Local Variables - UntitledLD1 | System Variables - Micro830 | I/O - Micro830

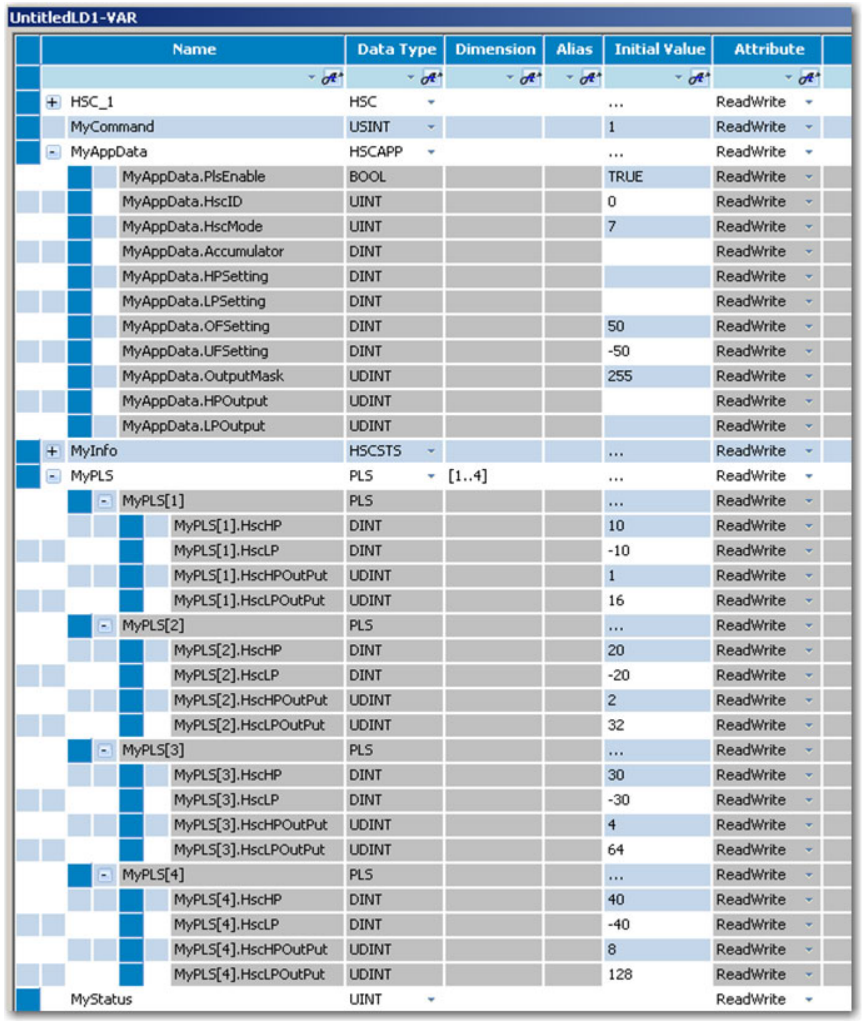
	Name	Logical Value	Physical Value	Initial Value
+	HSC_1	...	...	...
	MyCommand	1	N/A	1
-	MyAppData	...	...	...
	MyAppData.PlsEnable	☐	N/A	FALSE
	MyAppData.HscID	0	N/A	0
	MyAppData.HscMode	7	N/A	5
	MyAppData.Accumulator	40	N/A	
	MyAppData.HPSetting	40	N/A	40
	MyAppData.LPSetting	-40	N/A	-40
	MyAppData.OFSetting	50	N/A	50
	MyAppData.UFSetting	-50	N/A	-50
	MyAppData.OutputMask	3	N/A	3
	MyAppData.HPOutput	1	N/A	1
	MyAppData.LPOutput	2	N/A	2
-	MyInfo	...	...	...
	MyInfo.CountEnable	☑	N/A	
	MyInfo.ErrorDetected	☐	N/A	
	MyInfo.CountUpFlag	☑	N/A	
	MyInfo.CountDwnFlag	☑	N/A	
	MyInfo.Mode1Done	☐	N/A	
	MyInfo.OVF	☐	N/A	
	MyInfo.UNF	☐	N/A	
	MyInfo.CountDir	☑	N/A	
	MyInfo.HPReached	☑	N/A	
	MyInfo.LPReached	☐	N/A	
	MyInfo.OFCauseInter	☐	N/A	
	MyInfo.UFCauseInter	☐	N/A	
	MyInfo.HPCauseInter	☐	N/A	
	MyInfo.LPCauseInter	☐	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.HPOutput	1	N/A	
	MyInfo.LPOutput	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 HPReached flag turns on. Once the Accumulator reaches a Low Preset value of -40, output 1 turns on and the LPReached 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:



UntitledLD1-VAR

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.

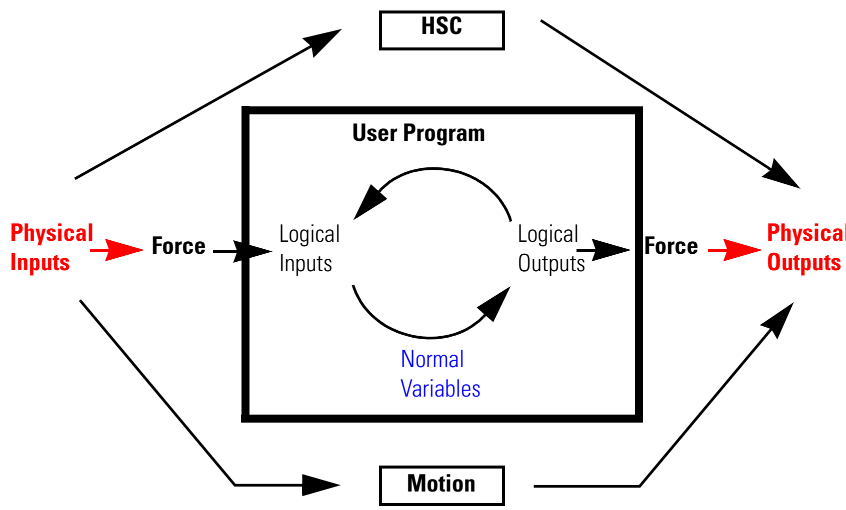
Forcing I/Os

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.

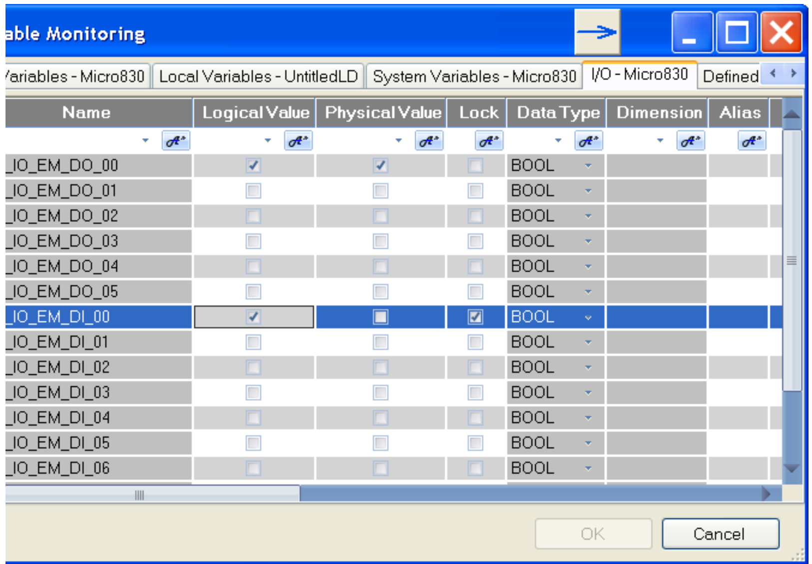


- LED status indicators always match the physical value of I/O
- Normal, non-physical internal variables cannot be forced
- Special functions such as HSC and Motion cannot be forced

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.

```
(* Read System Information including Force Enable bit *)
SYS_INFO_1(TRUE);

(* Turn on Warning Light if Forces are Enabled *)
If SYS_INFO_1.Sts.ForcesInstall = TRUE THEN
    _IO_EM_DO_05 := TRUE;
ELSE
    _IO_EM_DO_05 := FALSE;
END_IF;
```

If the front of the controller is visible, and not blocked by the cabinet enclosure, Micro830 and Micro850 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.

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 is arranged as follows:

Topic	Page
Information About Using Interrupts	285
User Interrupt Instructions	290
Using the Selectable Timed Interrupt (STI) Function	296
Selectable Time Interrupt (STI) Function Configuration and Status	297
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 165.

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 controller supports 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:

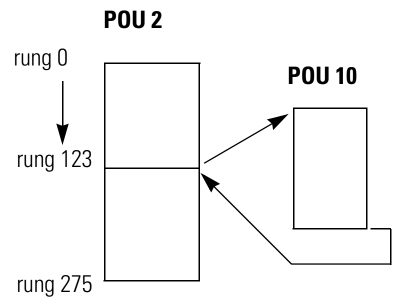
1. suspends its execution of the current POU,
2. performs a pre-defined POU based upon which interrupt occurred, and
3. returns to the suspended operation.

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/FBs if the specified POU calls a subsequent FB).
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.

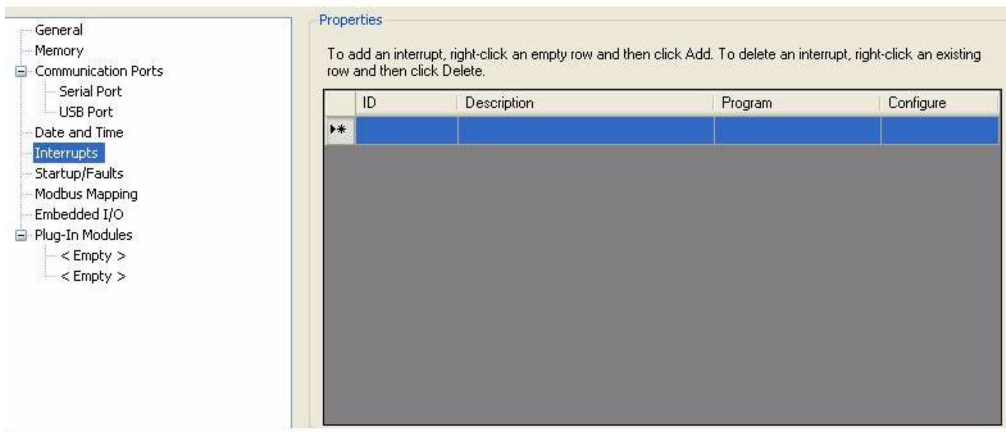
If an interrupt occurs while a higher priority interrupt is being serviced (executed), and the pending bit has been set for the lower priority interrupt, the currently executing interrupt routine continues to completion. Then the lower priority interrupt runs before returning to normal processing.

The priorities from highest to lowest are:

User Fault Routine	**highest priority**
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	**lowest priority**

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.

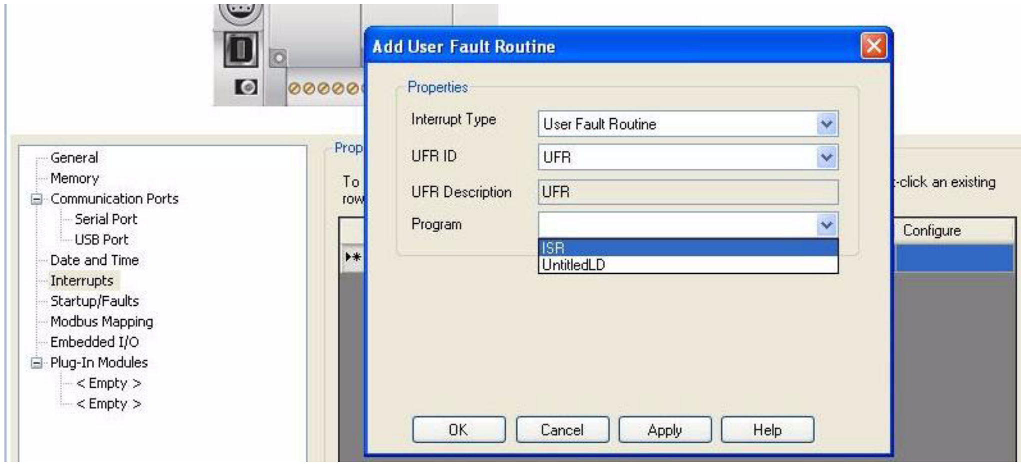
The controller goes to Fault mode after a User Fault Routine is executed, and the User Program execution stops.

Creating a User Fault Subroutine

To use the user fault subroutine:

1. Create a POU.

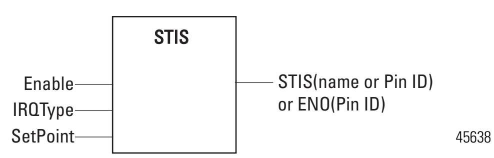
2. In the User Interrupt Configuration window, configure this POU as a User Fault routine.



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.	290
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		293
UIF – User Interrupt Flush	Use the UIF instruction to remove selected pending interrupts from the system.	294
UIC – User Interrupt Clear	Use this function to clear Interrupt Lost bit for the selected User Interrupt(s).	295

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)

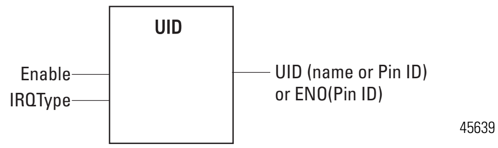
The STIS instruction can be used to start and stop the STI function or to change the time interval between STI user interrupts. The STI instruction has two operands:

- **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

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 disable interrupt(s):

1. Select which interrupts you want to disable.

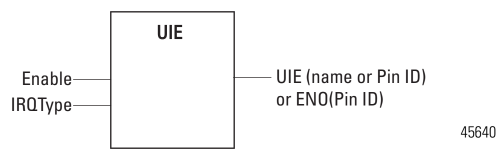
2. Find the Decimal Value for the interrupt(s) you selected.

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

Types of Interrupts Enabled by the UIE Instruction

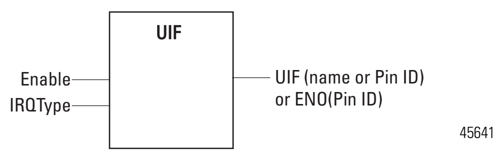
Interrupt Type	Element	Decimal Value	Corresponding Bit
EII - Event Input Interrupt	Event 1	4	bit 2
EII - Event Input Interrupt	Event 0	2	bit 1
		1	bit 0 (reserved)

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

Types of Interrupts Disabled by the UIF Instruction

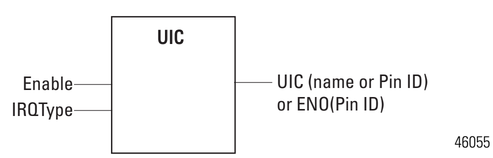
Interrupt Type	Element	Decimal Value	Corresponding Bit
STI - Selectable Timed Interrupt	STI0	32768	bit 15
EII - Event Input Interrupt	Event 7	16384	bit 14
EII - Event Input Interrupt	Event 6	8192	bit 13
EII - Event Input Interrupt	Event 5	4096	bit 12
EII - Event Input Interrupt	Event 4	2048	bit 11
HSC - 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



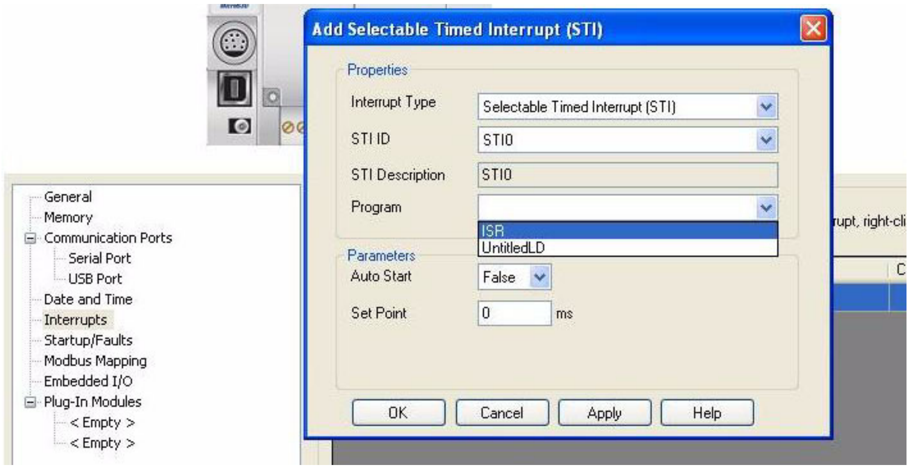
This C function clears Interrupt Lost bit for the selected User Interrupt(s).

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 POUplus 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 (STI0.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 (STI0.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 (STI0.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 (STI0.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.

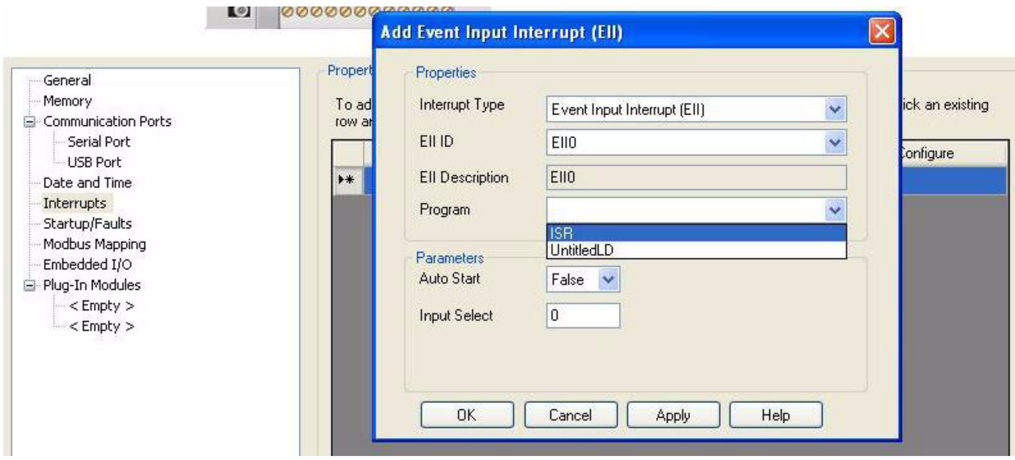
Using the Event Input Interrupt (EII) Function

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 (EII0.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 (EII0.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 (EII0.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 (EII0.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)

Sub-Element Description	Data Format	User Program Access
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.

System Loading

Micro830 and Micro850 Power Requirements

Controller/Module	Power Requirement
Micro830 and Micro850 (without plug-in/expansion I/O) 10/16-point 24-point 48-point	 5 W 8 W 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 Controller

To calculate Total Power for your Micro830 and Micro850 controller, use the following formula:

> **Total Power** =Main Unit Power + No. of Plug-ins * Plug-in Power + Sum of Expansion I/O Power

Example 1:
Derive Total Power for a 24-point Micro830 controller with two plug-ins.

> **Total Power** = 8 W+ 1.44 W * 2 + 0 = **10.88 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.

> **Total Power** = 11 W + 3*1.44 W + 0.85 W + 1.7 W = **17.87 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 with2 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:

Total loading for AC power supply = 17.87W + 6W = **23.87 W**

ATTENTION: Maximum loading to AC Power Supply is limited to 38.4 W with maximum surrounding ambient temperature limited to 65 °C.

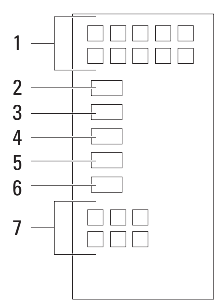
Troubleshooting

Status Indicators on the Controller

Micro830 Controllers

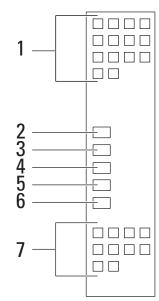
Status Indicators

10/16 Point Controllers



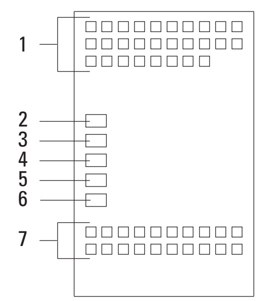
45031a

24 Point Controllers



45017a

48 Point Controllers



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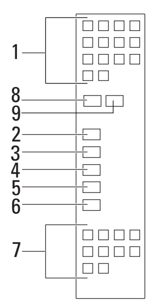
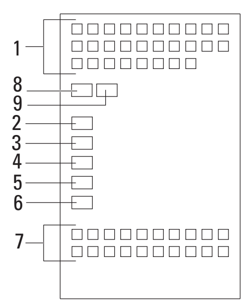
Micro850 Controllers



45934



45935

Status Indicator Description

	Description	State	Indicates
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 module transfer in progress

Status Indicator Description

	Description	State	Indicates
4	Fault status	Off	No fault detected
		Red	Controller hard fault
		Flashing red	Application fault detected
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
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
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.

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 Conditions

If an error exists within the controller, the controller indicators operate as described in the following table.

Indicator Behavior	Probable Error	Probable Cause	Recommended Action
All indicators off	No input power or power supply error	No line power	Verify proper line voltage and connections to the controller.
		Power supply overloaded	This problem can occur intermittently if power supply is overloaded when output loading and temperature varies.
Power and FAULT indicators on solid	Hardware faulted	Processor hardware error	Cycle power. Contact your local Allen-Bradley representative if the error persists.
		Loose wiring	Verify connections to the controller.
Power on with solid indicator and FAULT indicator flashing	Application fault	Hardware/software major fault detected	For error codes and status information, refer to the Connected Components Workbench online Help
Power on with solid indicator and FAULT indicator flashing	Operating system fault	Firmware upgrade unsuccessful	See Flash Upgrade Your Micro800 Firmware on page 255.

Error codes

This section lists possible error codes for your controller, as well as recommended actions for recovery.

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

List of Error Codes for Micro800 controllers

Error Code	Description	Recommended Action
0xF000	The controller was unexpectedly reset due to a noisy environment or an internal hardware failure. • A **Micro800 controller revision 2.xx** attempts to save the program and clear the user data. If the system variable _SYSVA_USER_DATA_LOST 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. • A **Micro800 controller revision 1.xx** clears the program. Note that the system variable _SYSVA_USER_DATA_LOST is not available on Micro800 controllers revision 1.xx.	Perform one of the following: • Download the program through Connected Components Workbench. • Refer to Wiring Requirements and Recommendation on page 29 If the fault persists, contact your local Rockwell Automation technical support representative. For contact information, see: http://support.rockwellautomation.com/MySupport.asp.
0xF001	The controller program has been cleared. This happened because: • a power-down occurred during program download or data transfer from the memory module. • the cable was removed from the controller during program download. • the RAM integrity test failed.	Perform one of the following: • Download the program using Connected Components Workbench. • Transfer the program using the memory module restore utility. If the fault persists, contact your local Rockwell Automation technical support representative. For contact information, see: http://support.rockwellautomation.com/MySupport.asp.
0xF002	The controller hardware watchdog was activated. • A **Micro800 controller revision 2.xx** attempts to save the program and clear the user data. If the system variable _SYSVA_USER_DATA_LOST 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. • A **Micro800 controller revision 1.xx** clears the program. Note that the system variable _SYSVA_USER_DATA_LOST is not available on Micro800 controllers revision 1.xx.	Perform the following: • Establish a connection to the Micro800 controller. • Download the program using Connected Components Workbench. If the fault persists, contact your local Rockwell Automation technical support representative. For contact information, see: http://support.rockwellautomation.com/MySupport.asp.
0xD00F	A particular hardware type (for example, embedded I/O) was selected in the user program configuration, but did not match the actual hardware base.	Perform one of the following: • Connect to the hardware that is specified in the user program. • Reconfigure the program to match the target hardware type.

List of Error Codes for Micro800 controllers

Error Code	Description	Recommended Action
0xF003	One of the following occurred: • The memory module hardware faulted. • The memory module connection faulted. • The memory module was incompatible with the Micro800 controller's firmware revision.	Perform one of the following: • Remove the memory module and plug it in again. • Obtain a new memory module. • Upgrade the Micro800 controller's firmware revision to be compatible with the memory module. For more information on firmware revision compatibility, go to http://www.rockwellautomation.com/support/firmware.html
0xF004	A failure occurred during the memory module data transfer.	Attempt the data transfer again. If the error persists, replace the memory module.
0xF005	The user program failed an integrity check while the Micro800 controller was in Run mode.	Perform one of the following: • Cycle power on your Micro800 controller. Then, download your program using Connected Components Workbench and start up your system. • Refer to the Wire Your Controller on page 29.
0xF006	The user program is incompatible with the Micro800 controller's firmware revision.	Perform one of the following: • Upgrade the Micro800 controller's firmware revision using ControlFlash. • Contact your local Rockwell Automation technical support representative for more information about firmware revisions for your Micro800 controller. For more information on firmware revision compatibility, go to http://www.rockwellautomation.com/support/firmware.html
0xF010	The user program contains a function/ function block that is not supported by the Micro800 controller.	Perform the following: • Modify the program so that all functions/function blocks are supported by the Micro800 controller. • Build and download the program using Connected Components Workbench. • Put the Micro800 controller into Run mode.
0xF014	A memory module memory error occurred.	Reprogram the memory module. If the error persists, replace the memory module.
0xF015	An unexpected software error occurred.	Perform the following: 1. Cycle power on your Micro800 controller. 2. Build and download your program using Connected Components Workbench, and then reinitialize any necessary data. 3. Start up your system. • Refer to the Wire Your Controller on page 29.
0xF016	An unexpected hardware error occurred.	Perform the following: 1. Cycle power on your Micro800 controller. 2. Build and download your program using Connected Components Workbench, and then reinitialize any necessary data. 3. Start up your system. • Refer to the Wire Your Controller on page 29.
0xF020	The base hardware faulted or is incompatible with the Micro800 controller's firmware revision.	Perform one of the following: • Upgrade the Micro800 controller's firmware revision using ControlFlash. • Replace the Micro800 controller. • Contact your local Rockwell Automation technical support representative for more information about firmware revisions for your Micro800 controller. For more information on firmware revision compatibility, go to http://www.rockwellautomation.com/support/firmware.html

List of Error Codes for Micro800 controllers

Error Code	Description	Recommended Action
0xF021	The I/O configuration in the user program is invalid or does not exist in the Micro800 controller.	Perform the following: • Verify that you have selected the correct Micro800 controller from the Device Toolbox. • Correct the plug-in I/O module configuration in the user program to match that of the actual hardware configuration. • Recompile and reload the program. • Put the Micro800 controller into Run mode. • If the error persists, be sure to use Connected Components Workbench programming software to develop and download the program.
0xF022	The user program in the memory module is incompatible with the Micro800 controller's firmware revision.	Perform one of the following: • Upgrade the Micro800 controller's firmware revision using ControlFlash to be compatible with the memory module. • Replace the memory module. • Contact your local Rockwell Automation technical support representative for more information about firmware revisions for your Micro800 controller. For more information on firmware revision compatibility, go to http://www.rockwellautomation.com/support/firmware.html
0xF023	The controller program has been cleared. This happened because: • a power down occurred during program download or transfer from the memory module. • the Flash Integrity Test failed (Micro810 only).	• Download or transfer the program.
0xF050	The embedded I/O configuration in the user program is invalid.	Perform the following: • Correct the embedded I/O configuration in the user program to match that of the actual hardware configuration. • Build and download the program using Connected Components Workbench. • Put the Micro800 controller into Run mode. • If the error persists, be sure to use Connected Components Workbench programming software to develop and download the program.
0xF100	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: • Correct the axes configuration in the user program. • If fault is consistent, upgrade to the latest software revision of Connected Components Workbench. See Motion Axis Configuration in Connected Components Workbench on page 145.
0xF110	There is motion resource missing, such as Motion_DIAG variable not defined.	Perform the following: • Correct the axes configuration in the user program. • If fault is consistent, upgrade to the latest Connected Components Workbench software revision. See Motion Axis Configuration in Connected Components Workbench on page 145.

List of Error Codes for Micro800 controllers

Error Code	Description	Recommended Action
0xF12z (Note: z indicates the logic axis ID.)	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: • Remove all axes and re-configure motion with the guidance from the User Manual. • If fault is consistent, upgrade to the latest Connected Components Workbench software revision.
0xF15z (Note: z indicates the logic axis ID.)	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.	Perform the following: • Clear the fault, and switch the controller to RUN mode again. • If fault is consistent, do power cycle for whole motion setup, including controller, drive and moving mechanism. • Re-download the User Application.
0xF210	The expansion I/O terminator is missing.	Perform the following: • Power off the controller. • Attach the expansion I/O terminator on the last expansion I/O module on the system. • Power on the controller.
0xF230	The maximum number of expansion I/O modules has been exceeded.	Perform the following: • Power off the controller. • Check that the number of expansion I/O modules is not more than four. • Power on the controller.
0xF250	There is a non-recoverable error and the expansion I/O module(s) could not be detected.	Perform the following: • Cycle power to your Micro800 controller. If the error persists, contact your local Rockwell Automation technical support representative. For contact information, see http://support.rockwellautomation.com/MySupport.asp.
0xF26z (z indicates the slot number of the expansion I/O. If z=0, then the slot number cannot be identified.)	An expansion I/O master fault is detected on the system.	Perform the following: • Cycle power to your Micro800 controller. If the error persists, contact your local Rockwell Automation technical support representative. For contact information, see http://support.rockwellautomation.com/MySupport.asp.
0xF27z (z indicates the slot number of the expansion I/O. If z=0, then the slot number cannot be identified.)	A non-recoverable communication fault has occurred on the expansion I/O module.	Perform the following: • Cycle power to the Micro800 controller, or • Replace the slot number z module. If the error persists, contact your local Rockwell Automation technical support representative. For contact information, see http://support.rockwellautomation.com/MySupport.asp.
0xF28z (z indicates the slot number of the expansion I/O. If z=0, then the slot number cannot be identified.)	Expansion I/O baudrate error.	Perform the following: • Cycle power to the Micro800 controller, or • Replace the slot number z module. If the error persists, contact your local Rockwell Automation technical support representative. For contact information, see http://support.rockwellautomation.com/MySupport.asp.

List of Error Codes for Micro800 controllers

Error Code	Description	Recommended Action
0xF29z (z indicates the slot number of the expansion I/O. If z=0, then the slot number cannot be identified.)	A module fault is detected on your expansion I/O module.	Perform the following: • Cycle power the Micro800 controller, or • Replace the slot number z module. If the error persists, contact your local Rockwell Automation technical support representative. For contact information, see http://support.rockwellautomation.com/MySupport.asp.
0xF2Az (z indicates the slot number of the expansion I/O. If z=0, then the slot number cannot be identified.)	Expansion I/O power failure	Perform the following: • Cycle power the Micro800 controller, or • Replace the slot number z module. If the error persists, contact your local Rockwell Automation technical support representative. For contact information, see http://support.rockwellautomation.com/MySupport.asp.
0xF2Bz (z indicates the slot number of the expansion I/O. If z=0, then the slot number cannot be identified.)	Expansion I/O configuration fault.	Perform the following: • Correct the expansion IO module configuration in the user program to match that of the actual hardware configuration. • Check the expansion I/O module operation and condition. • Cycle power to the Micro800 controller. • Replace the expansion I/O module.

For the following four error codes, z is the slot number of the plug-in module. If z = 0, then the slot number cannot be identified		
0xF0Az	The plug-in I/O module experienced an error during operation.	Perform one of the following: • Check the condition and operation of the plug-in I/O module. • Cycle power to the Micro800 controller. • If the error persists, see Micro800 Plug-In Modules and Accessories on page 101.
0xF0Bz	The plug-in I/O module configuration does not match the actual I/O configuration detected.	Perform one of the following: • Correct the plug-in I/O module configuration in the user program to match that of the actual hardware configuration. • Check the condition and operation of the plug-in I/O module. • Cycle power to the Micro800 controller. • Replace the plug-in I/O module. • If the error persists, refer to Micro800 Plug-In Modules and Accessories on page 101.
0xF0Dz	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: • Correct the plug-in I/O module configuration in the user program. • Build and download the program using Connected Components Workbench. • Put the Micro800 controller into Run mode.
0xF0Ez	The plug-in I/O module configuration does not match the actual I/O configuration detected.	Perform the following: • Correct the plug-in I/O module configuration in the user program. • Build and download the program using Connected Components Workbench. • Put the Micro800 controller into Run mode.

List of Error Codes for Micro800 controllers

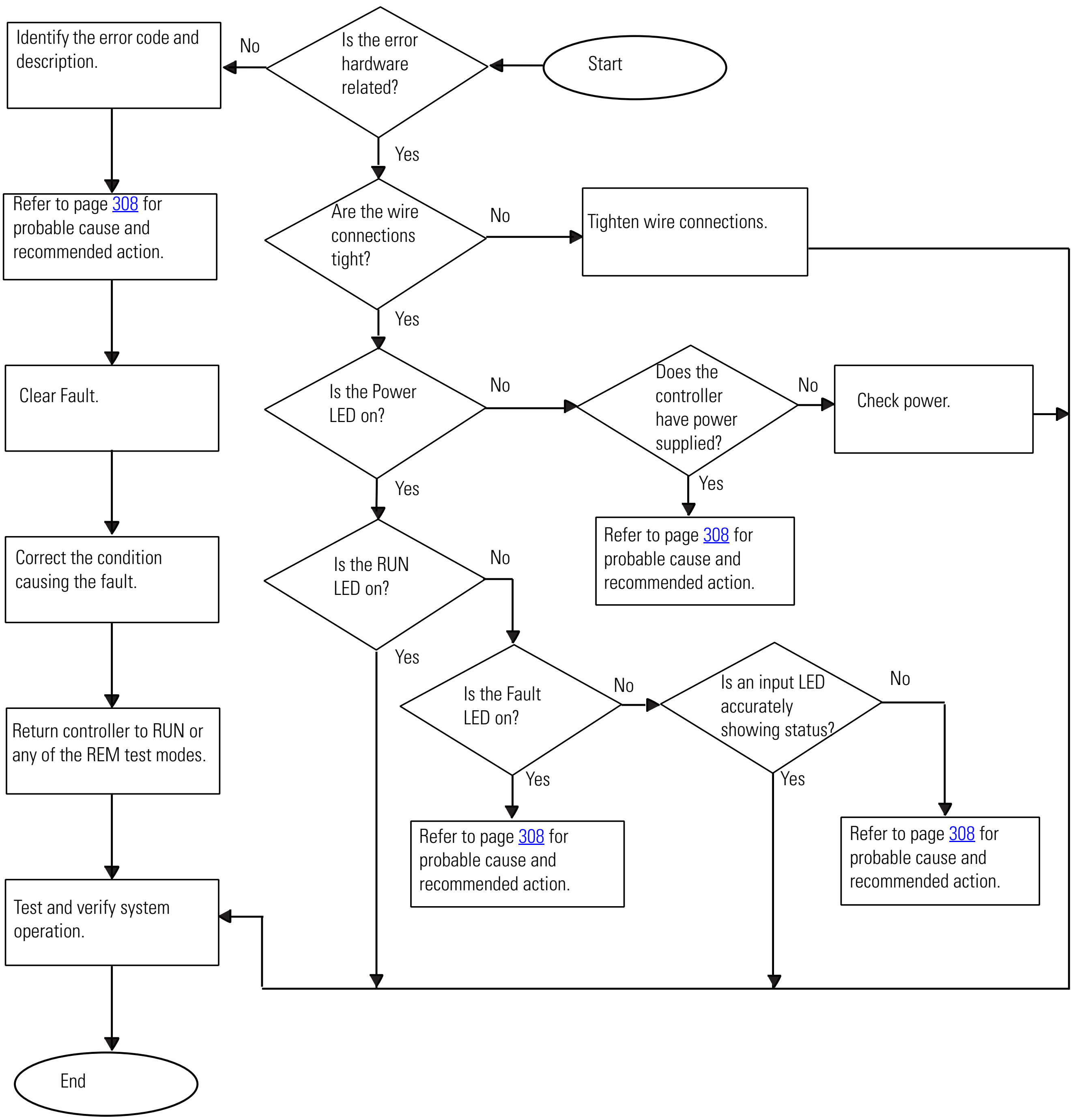
Error Code	Description	Recommended Action
0xD011	The program scan time exceeded the watchdog timeout value.	Perform one of the following: • Determine if the program is caught in a loop and correct the problem. • In the user program, increase the watchdog timeout value that is set in the system variable _SYSVA_TCYWDG and then build and download the program using Connected Components Workbench.
0xF830	An error occurred in the EII configuration.	Review and change the EII configuration in the Micro800 controller properties.
0xF840	An error occurred in the HSC configuration.	Review and change the HSC configuration in the Micro800 controller properties.
0xF850	An error occurred in the STI configuration.	Review and change the STI configuration in the Micro800 controller properties.
0xF860	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: • Correct the program to ensure that there is no data overflow. • Build and download the program using Connected Components Workbench. • Put the Micro800 controller into Run mode.
0xF870	An index address was out of data space.	Perform the following: • Correct the program to ensure that there is no index address out of data space. • Build and download the program using Connected Components Workbench. • Put the Micro800 controller into Run mode.
0xF880	A data conversion error occurred.	Perform the following: Correct the program to ensure that there is no data conversion error. • Build and download the program using Connected Components Workbench. • Put the Micro800 controller into Run mode.
0xF888	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.	Change the project to reduce the quantity of blocks being called within a block.
0xF898	An error occurred in the user interrupt configuration for the plug-in I/O module.	Correct the user interrupt configuration for plug-in I/O module in the user program to match that of the actual hardware configuration.

List of Error Codes for Micro800 controllers

Error Code	Description	Recommended Action
0xF8A0	The TOW parameters are invalid.	Perform the following: • Correct the program to ensure that there are no invalid parameters. • Build and download the program using Connected Components Workbench. • Put the Micro800 controller into Run mode.
0xF8A1	The DOY parameters are invalid.	Perform the following: • Correct the program to ensure that there are no invalid parameters. • Build and download the program using Connected Components Workbench. • Put the Micro800 controller into Run mode.
0xFFzz (Note: 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.)	A user-created fault from Connected Components Workbench has occurred.	Contact your local Rockwell Automation technical support representative if the error persists.

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

Non-isolated Thermocouple and RTD Plug-in Modules

Overview

This chapter describes the features, configuration, installation and wiring requirements for the Thermocouple (2080-TC2) and RTD (2080-RTD2) plug-in modules. These modules allow for temperature measurement and control when used with PID. This chapter includes the following sections:

Topic	Page
Thermocouple Module (2080-TC2)	317
Thermocouple Sensor Types and Ranges	318
RTD Module (2080-RTD2)	319
RTD Sensor Types and Ranges	319
Connected Components Workbench Global Variables Data Maps	320
Temperature Conversion – Data to Degree Celsius (°C)	321
Wire the 2080-TC2 Module	323
Type of CJC Sensor	323
Wire the CJC Thermistor on the 2080-TC2 Module	323
Wire the Thermocouple Module and Thermocouple Sensor in the Field	324
Wire the RTD Module	324
Wire the RTD Sensors	324
Wire the RTD Module and RTD Sensor in the Field	325
Recommended Cable Specifications	330

This plug-in can be used in any slot of your Micro830/850 controller. Removal and Insertion Under Power (RIUP) is not supported.

Thermocouple Module (2080-TC2)

The 2080-TC2 two-channel plug-in module supports thermocouple measurement. It digitally converts and transmits temperature data from any combination of up to eight types of thermocouple sensors. Each input channel is individually configurable through the Connected Components Workbench software for a specific sensor, filter frequency.

Thermocouple Sensor Types and Ranges

The module supports B, E, J, K, N, R, S, T types of thermocouple sensors. The module channels are referred to as Channel 0, Channel 1, and CJC, respectively. The cold junction compensation is provided by an external NTC thermistor, which comes with the module. The thermistor has to be fitted to the screw terminals A3 and B3 of the module. This CJC is common to channel 0 and 1 thermocouple sensors and provides open-circuit, overrange and underrange detection and indication.

Overrange and Underrange Conditions

If the channel temperature input is below the minimum value of its normal temperature range for the represented sensor, the module reports an underrange error through the Connected Components Workbench global variables. If the channel reads above the maximum value of its normal temperature range for the represented sensor, an over-range error is flagged.

The table below defines thermocouple types and their associated full-scale temperature ranges.

Thermocouple Sensor Types and Temperature Ranges

Thermocouple Type	Temperature Range ° C (°F)		Accuracy ° C (°F)		ADC Update Rate in Hz (Accuracy °C)
	Min	Max	±1.0 °C	±3.0 °C	
B	40 (104)	1820 (3308)	90…1700 (194…3092)	< 90 (194) > 1700 (3092)	4.17, 6.25, 10, 16.7 (±1.0) 19.6, 33, 50, 62, 123, 242, 470 (±3.0)
E	-270 (-454)	1000 (1832)	-200…930 (-328…1706)	< -200 (-328) > 930 (1706)	
J	-210 (-346)	1200 (2192)	-130…1100 (-202…2012)	< -130 (-202) > 1100 (2012)	
K	-270 (-454)	1370 (2498)	-200…1300 (-328…2372)	< -200 (-328) > 1300 (2372)	
N	-270 (-454)	1300 (2372)	-200…1200 (-328…2192)	< -200 (-328) > 1200 (2192)	
R	-50 (-58)	1760 (3200)	40…1640 (104…2984)	< 40 (104) > 1640 (2984)	
S	-50 (-58)	1760 (3200)	40…1640 (104…2984)	< 40 (104) > 1640 (2984)	
T	-270 (-454)	400 (752)	-220…340 (-364…644)	< -220 (-364) > 340 (644)	

To configure Thermocouple type and update rate in Connected Components Workbench software, refer to the section Configure the Plug-ins in Connected Components Workbench on page 326.

RTD Module (2080-RTD2)

The 2080-RTD2 module supports RTD measurement applications that support up to two channels. The module digitally converts analog data and transmits the converted data in its image table.

The module supports connections from any combination of up to eleven types of RTD sensors. Each channel is individually configurable through the Connected Components Workbench software. When configured for RTD inputs, the module can convert the RTD readings into temperature data. Refer to Temperature Conversion – Data to Degree Celsius (°C) on page 321, for converting temperature data to actual temperature degree.

RTD Sensor Types and Ranges

Each channel provides open-circuit (all wires), short-circuit (excitation and return wires only), and over- and under-range detection and indication. The 2080-RTD2 module supports 11 types of RTD sensors:

Pt100 385	PT1000 385	PT500 392	Ni120 672
PT200 385	PT100 392	PT1000 392	NiFe604 518
PT500 385	PT200 392	Cu10 427	

It supports 2- and 3-wire type of RTD sensor wiring.

RTD Compatibility

An RTD consists of a temperature-sensing element connected by two, three, or four wires that provide resistance input to the module. The following table lists the RTD types that you can use with the module, including their temperature range, accuracy, and ADC update rate.

Overrange and Underrange Conditions

If the channel temperature input is below the minimum value of its normal temperature range for the represented sensor, the module reports an underrange error through the Connected Components Workbench global variables. If the channel temperature input is above the maximum value of its normal temperature range for the represented sensor, an over-range error is flagged.

RTD Sensor Types and Temperature Ranges

RTD Type	Temperature Range ° C (°F)		Accuracy ° C (°F)		ADC Update Rate in Hz (Accuracy °C)
	Min	Max	±1.0 °C	±3.0 °C	
PT100 385	-200 (-328)	660 (1220)	-150…590 (-238…1094)	< -150 (-238) > 590 (1094)	**3-wire others** 4.17, 6.25, 10, 16.7,19.6, 33, 50 (±1.0) 62, 123, 242, 470 (±3.0) **2- and 3-wire Cu10(1)** 4.17, 6.25, 10, 16.7 (>±1.0 < ±3.0) 19.6, 33, 50, 62, 123, 242, 470 (> ±3.0) **2-wire others** 4.17, 6.25, 10, 16.7 (±1.0) 19.6, 33, 50, 62, 123, 242, 470 (±3.0)
PT200 385	-200 (-328)	630 (1166)	-150…570 (-238…1058)	< -150 (-238) > 570 (1058)	
PT500 385	-200 (-328)	630 (1166)	-150…580 (-238…1076)	< -150 (-238) > 580 (1076)	
PT1000 385	-200 (-328)	630 (1166)	-150…570 (-238…1058)	< -150 (-238) > 570 (1058)	
PT100 392	-200 (-328)	660 (1220)	-150…590 (-238…1094)	< -150 (-238) > 590 (1094)	
PT200 392	-200 (-328)	630 (1166)	-150…570 (-238…1058)	< -150 (-238) > 570 (1058)	
PT500 392	-200 (-328)	630 (1166)	-150…580 (-238…1076)	< -150 (-238) > 580 (1076)	
PT1000 392	-50 (-58)	500 (932)	-20…450 (-4…842)	< - 20 (-4) > 450 (842)	
Cu10 427(1)	-100 (-148)	260 (500)		< -70 (-94) > 220 (428)	
Ni120 672	-80 (-112)	260 (500)	-50…220 (-58…428)	< -50 (-58) > 220 (428)	
NiFe604 518	-200 (-328)	200 (392)	-170…170 (-274…338)	< -170 (-274) > 170 (338)	

(1) For Cu10 427, accuracy range is within >±1.0 < ±3.0 for -70…220 °C (-94…428 °F). Above this temperature range it is > ±3.0 °C as shown in the table.

To configure RTD type and update rate in Connected Components Workbench software, refer to the section Configure the Plug-ins in Connected Components Workbench on page 326.

Connected Components Workbench Global Variables Data Maps

The following bit/words describe the information read from the Thermocouple and RTD plug-in modules in the Connected Components Workbench Global Variables.

Mapping Table

Word Offset	Bit															
	15	**14**	**13**	**12**	**11**	**10**	**09**	**08**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
00 (example: _IO_P1_AI_00)	Channel 0 Temperature Data															
01 (example: _IO_P1_AI_01)	Channel 1 Temperature Data															

Mapping Table

Word Offset	Bit															
	15	**14**	**13**	**12**	**11**	**10**	**09**	**08**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
02 (example: _IO_P1_AI_02)	Channel 0 Information															
	UKT	UKR	Reserved				Reserved		OR	UR	OC	DI	CC	Reserved		
03 (example: _IO_P1_AI_03)	Channel 1 Information															
	UKT	UKR	Reserved				Reserved		OR	UR	OC	DI	CC	Reserved		
04 (example: _IO_P1_AI_04)	System Information															
	Reserved				SOR	SUR	COC	CE	Reserved							

Bit Definitions

Bit Name	Description
Channel Temperature Data	The temperature count mapped from temperature Celsius degree with one decimal. Please check the section, Temperature Conversion – Data to Degree Celsius (°C) on page 321, for the mapping formula.
UKT (Unknown Type)	Bit set to report an unknown sensor type error in configuration.
UKR (Unknown Rate)	Bit set to report an unknown update rate error in configuration.
OR (Overrange)	Bit set to indicate overrange on channel input. The Channel Temperature Data shows maximum temperature count for individual type of sensor used and the value does not change until overrange error is clear.
UR (Underrange)	Bit set to indicate the channel input underrange happens. The Channel Temperature Data will show minimum temperature count for individual type of sensor used and the value does not change until underrange error is clear.
OC (Open Circuit)	Bit set to indicate open-circuit on the channel input sensor.
DI (Data illegal)	The data in the channel data field is illegal and cannot be used by user. This bit is set when temperature data is not ready for use.
CC (Code Calibrated)	Bit set indicates temperature data is calibrated by the system calibration coefficient.
SOR (System Overrange)	Bit set to indicate system overrange error with environment temperature over 70 °C.
SUR (System Underrange)	Bit set to indicate system underrange error with environment temperature under -20 °C.
COC (CJC open-circuit)	Bit set to indicate CJC sensor not connected for thermocouple module, open circuit. This bit is for thermocouple module only.
CE (Calibration Error)	Bit set indicates that the module is not accurate. This bit is set to 0 by default and should remain as 0. Contact Technical Support when the value is otherwise.

Temperature Conversion – Data to Degree Celsius (°C)

To keep the precision of temperature value from the Thermocouple and RTD plug-in modules, there is a general data mapping conversion in the firmware before the actual temperature is sent to the Connected Components Workbench software.

The following equation shows how the Connected Components Workbench software data count is mapped from temperature Celsius degree by the firmware:

Connected Components Workbench software Data Count = (Temp (°C) + 270.0)*10;

IMPORTANT	This conversion formula applies to all types of Thermocouple and RTD sensors.

This equation illustrates how the Connected Components Workbench data count does not use full range of 0…65535 of data word.

Derive Actual Temperature °C From Connected Components Workbench Data Count:

The following formula shows how to derive temperature Celsius degree from temperature data word in the Connected Components Workbench software:

Temp (°C) = (Data - 2700)/10;

These sample equations show how actual temperature is derived by applying the formula above:

1234 $\rightarrow$ (1234 - 2700)/10 $\rightarrow$ -146.6 °C
8000 $\rightarrow$ (8000 - 2700)/10 $\rightarrow$ 530.0°C

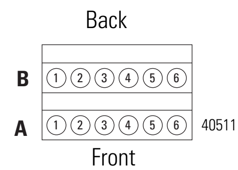
IMPORTANT	Underrange, overrange error reporting checking is **not** based on Connected Components Workbench temperature data count, but the actual temperature (°C) or the voltage going into the plug-in module.

TIP	We recommend the use of the conversion formula above to calculate for actual temperature instead of using scalar function. When scalar function block is used in a program, the input must be correctly given according to the data count range based on different sensor types.

Wire the 2080-TC2 Module

Follow the pinout wiring diagrams that comes with your plug-in module package.

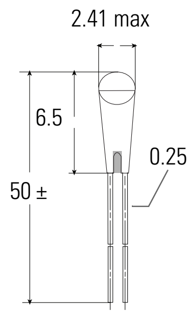
12-Pin Female Terminal Block



Note: A refers to Channel 0 and B refers to Channel 1.

(View into terminal block)
Pin A1 CH0+
Pin A2 CH0-
Pin A3 CJC+
Pin A4 No connection
Pin A5 No connection
Pin A6 No connection

Pin B1 CH1+
Pin B2 CH1-
Pin B3 CJC-
Pin B4 No connection
Pin B5 No connection
Pin B6 No connection



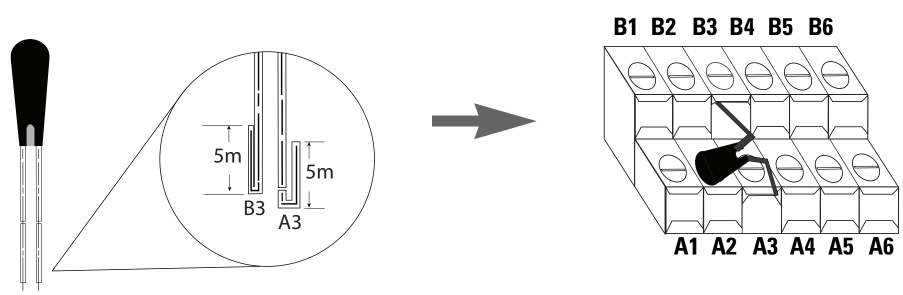
Type of CJC Sensor

The CJC sensor is a non-polarized, passive negative temperature co-efficient thermistor (EPCOS B57869S0502F140). It is readily available in the market with most third party suppliers/vendors.

CJC Channel Error

The CJC channel on 2080-TC2 has a worst-case error of ±1.2 °C @ 25 °C. This error does not include the manufacturer-specified sensor error ±0.2 °C @ 25 °C.

Wire the CJC Thermistor on the 2080-TC2 Module



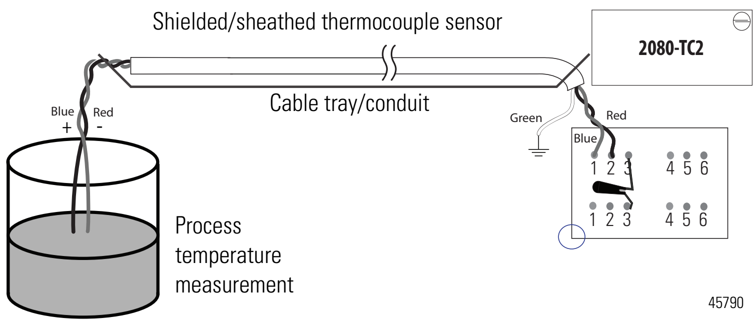
1. Connect the thermocouples to channel 0 and 1, respectively. Then, connect and screw the thermistor to terminals A3 and B3.
2. Once fitted, bend the black bead of the thermistor such that it makes contact with the A2 screw securely.

The position for the thermistor, as illustrated, helps to compensate for thermoelectric voltages developed at screw junction equally for thermocouples connected to channels 0 and 1. If the bead is not in proper contact with the screw, there will be deviation in readings due to inadequate isothermal compensation.

Wire the Thermocouple Module and Thermocouple Sensor in the Field

Connect the thermocouple sensors directly to the module terminals.

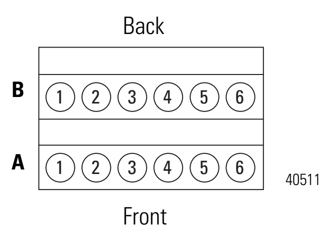
Direct sensor wiring



ATTENTION: Direct wiring is the preferred method of wiring for thermocouples.

Wire the RTD Module

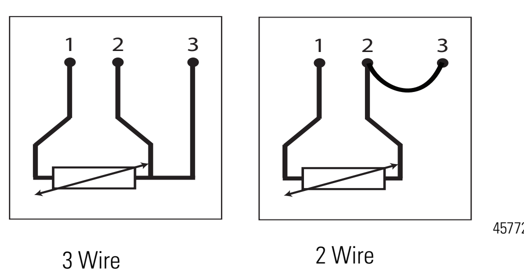
12-Pin Female Terminal Block



(View into terminal block)

Pin A1 CH0+	Pin B1 CH1+
Pin A2 CH0-	Pin B2 CH1-
Pin A3 CH0L (Sense)	Pin B3 CH1L (Sense)
Pin A4 No connection	Pin B4 No connection
Pin A5 No connection	Pin B5 No connection
Pin A6 No connection	Pin B6 No connection

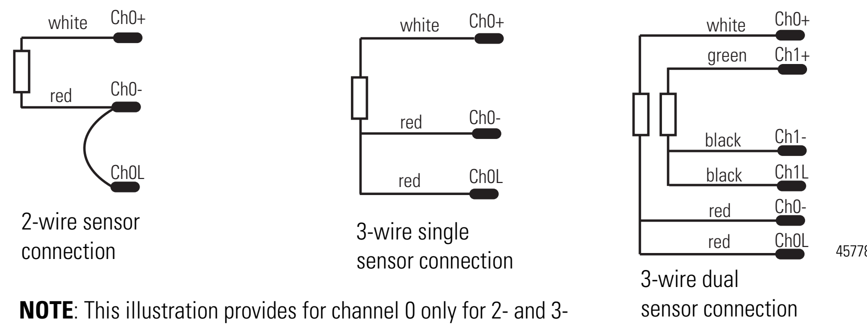
Note: A refers to Channel 0 and B refers to Channel 1.



Wire the RTD Sensors

In an RTD sensor, the sensing element is always connected between two wires of different colors. Wires of the same color are shorted and form the compensation leads. Measuring resistance between these wires confirms the position of sensing element and compensation elements. Compensation elements will always show 0 ohms.

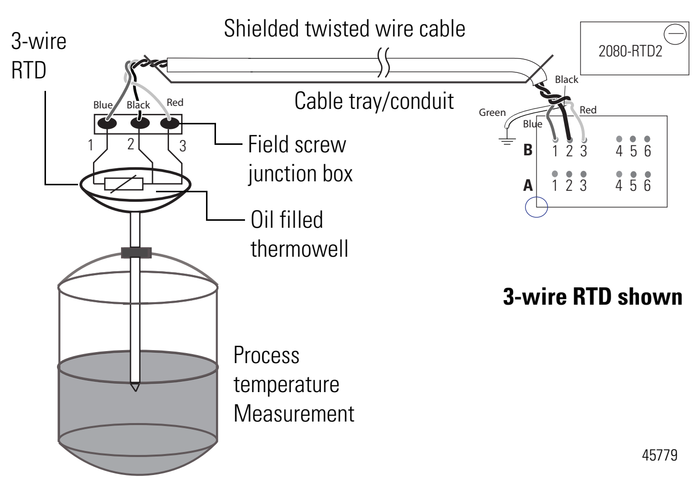
Wire the Sensors



NOTE: This illustration provides for channel 0 only for 2- and 3-wire single sensor connections. The wire colors illustrate a particular type of RTD sensor available in market.

For better accuracy in noisy industrial environments, 3- or 4-wire RTD sensors are mostly used. While using these sensors, the resistance added by lead lengths is compensated by an additional third wire in case of 3-wire RTD and two additional wires, in bridge configuration, in case of 4-wire RTD. For 2-wire RTD sensor in this module, this lead compensation is provided by using an external 50 mm 22 AWG shorting wire between terminals A2, A3 and B2, B3 for channel 0 and 1, respectively. Shielded twisted pair cables are to be utilized for remote use of these sensors with cable shield grounded at controller end. For more information, see Recommended Cable Specifications on page 330.

Wire the RTD Module and RTD Sensor in the Field



The RTD sensing element should always be connected between terminals B1(+) and B2(-) for channel 1, and A1(+) and A2(-) for channel 0 in the module. Terminals B3 and A3 should always be shorted to B2 and A2, respectively, to complete the constant current loop. Mismatch in wiring can cause erroneous, over, or underrange readings.

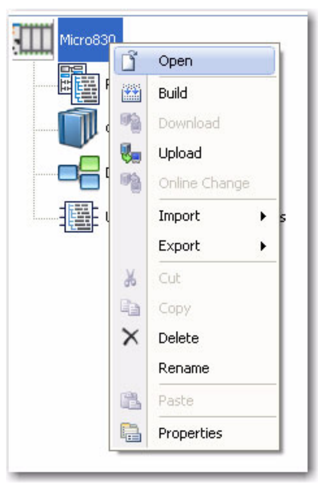
Configure the Plug-ins in Connected Components Workbench

This section shows you how to configure the 2080-TC2 and 2080-RTD2 plug-ins through the Connected Components Workbench software.

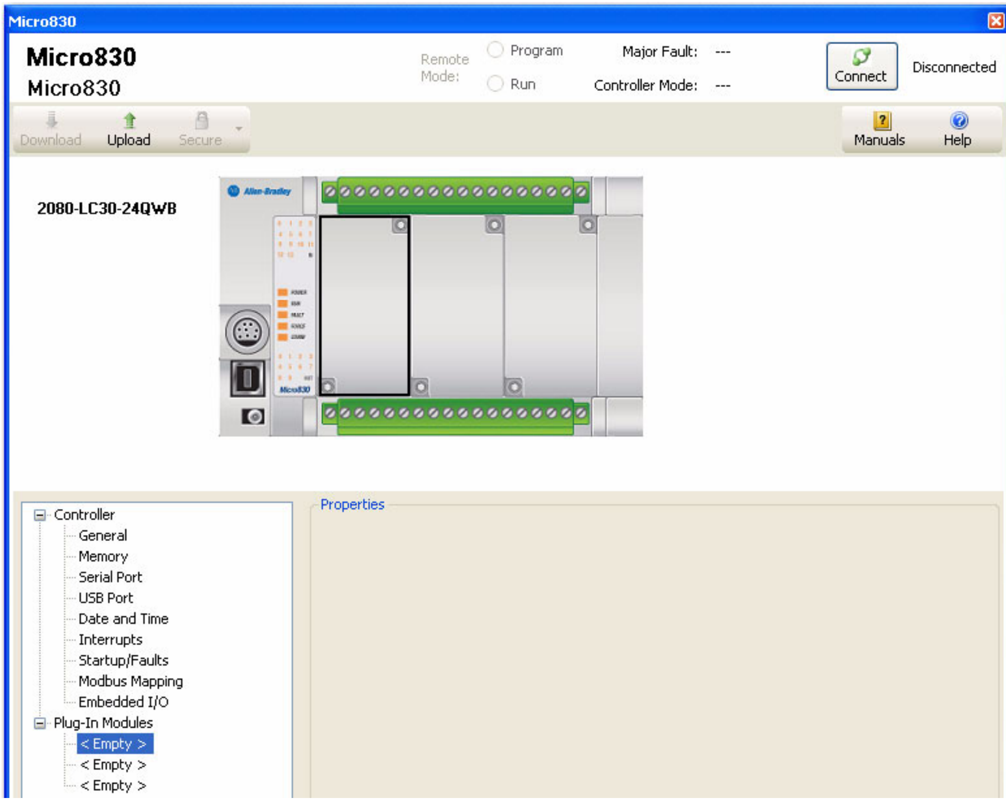
For more information about using Connected Components Workbench, you can check out the Connected Components Workbench Online Help (it comes with the software).

The following steps show a Micro830 24-point controller with three plug-in slots to illustrate the configuration process.

1. Launch the Connected Components Workbench software and open your Micro830 project. On the Project Organizer pane, right-click Micro830 and select Open.

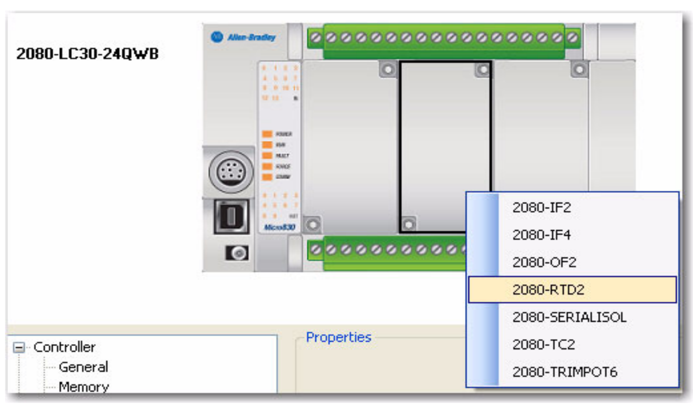


The Controller Properties page appears.

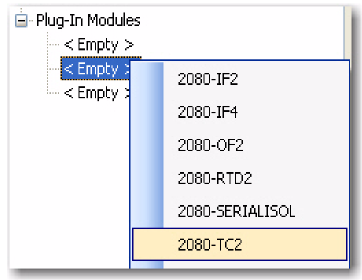


2. To add a Micro800 plug-in, you can do any of the following:

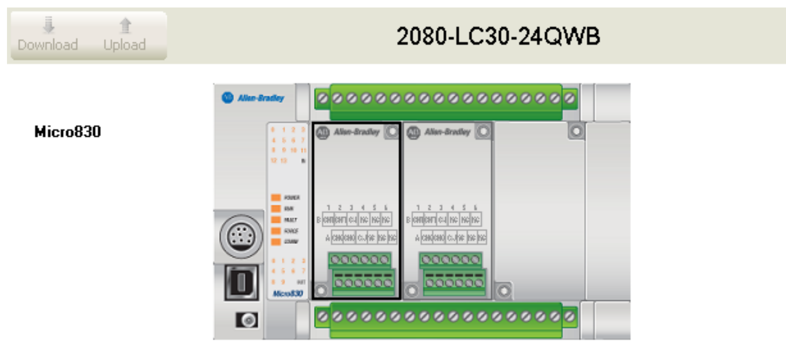
- Right-click the plug-in slot you would like to configure and choose the plug-in, as shown below.

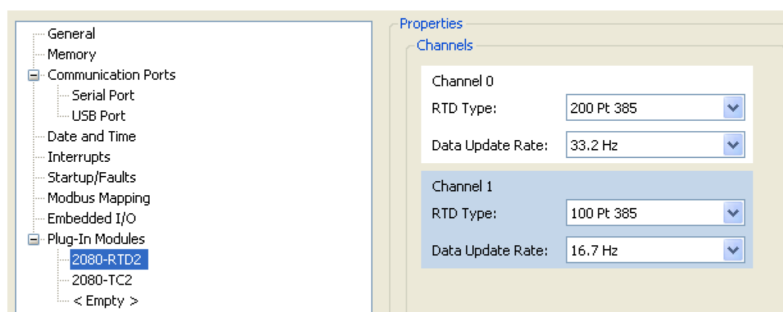


- Right-click the plug-in slot in the Controller Properties tree and choose the plug-in you would like to add.



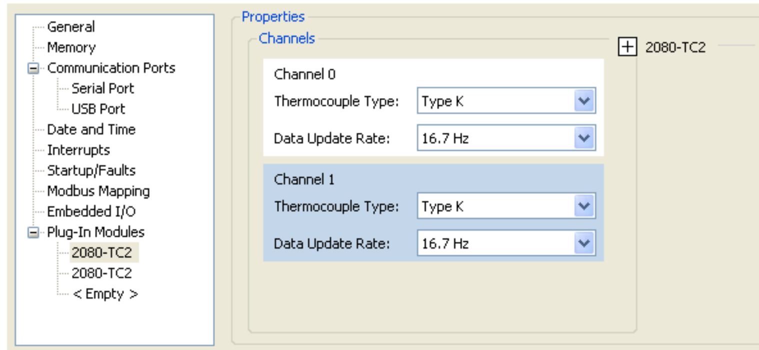
The device configuration window should show the added plug-in modules:





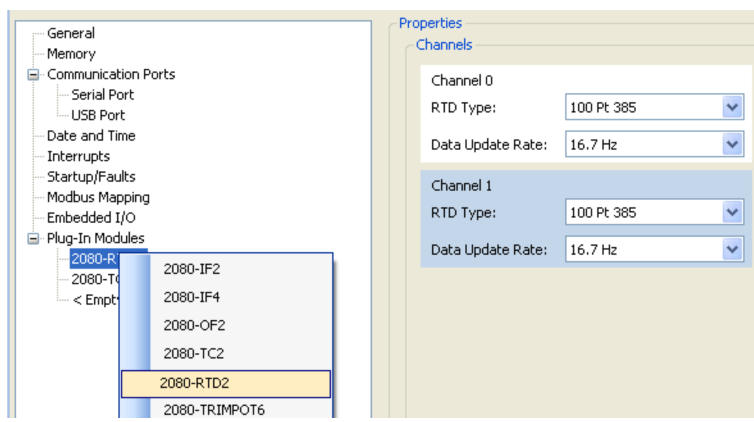
3. Click the 2080-RTD or 2080-TC2 plug-in module to set up the configuration properties.

a. For **2080-TC2**, specify Thermocouple Type and Update Rate for Channels 0 and 1. The default sensor type for TC is Type K and the default update rate is 16.7 Hz.



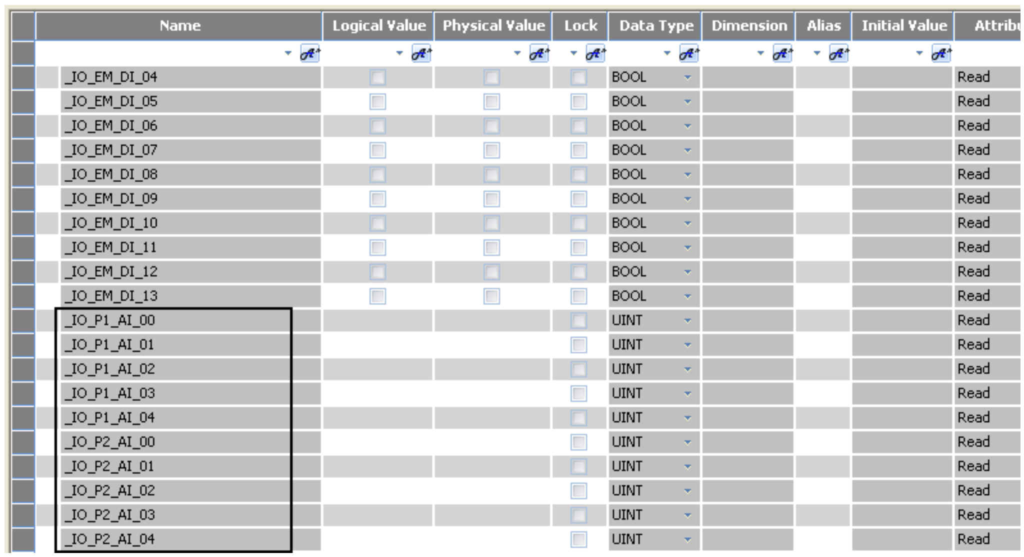
To determine available Thermocouple Types, corresponding temperature ranges, accuracy, and available update rates, refer to Thermocouple Sensor Types and Temperature Ranges on page 318.

b. For **2080-RTD2**, specify RTD Type and Update Rate. The default sensor type for RTD is 100 Pt 385 and the default update rate is 16.7 Hz.



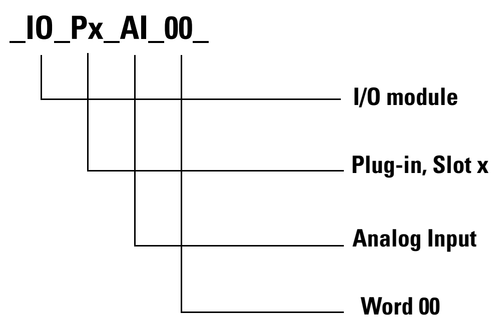
To determine available RTD Types, corresponding temperature ranges, accuracy, and available update rates, refer to RTD Sensor Types and Temperature Ranges on page 320.

When the module is in RUN mode and sensors are connected to the plug-in, the global variable fields _IO_Px_AI_00, _IO_Px_AI_01 show temperature data as per measured value.



Name	Logical Value	Physical Value	Lock	Data Type	Dimension	Alias	Initial Value	Attribu
_IO_EM_DI_04				BOOL				Read
_IO_EM_DI_05				BOOL				Read
_IO_EM_DI_06				BOOL				Read
_IO_EM_DI_07				BOOL				Read
_IO_EM_DI_08				BOOL				Read
_IO_EM_DI_09				BOOL				Read
_IO_EM_DI_10				BOOL				Read
_IO_EM_DI_11				BOOL				Read
_IO_EM_DI_12				BOOL				Read
_IO_EM_DI_13				BOOL				Read
_IO_P1_AI_00				UINT				Read
_IO_P1_AI_01				UINT				Read
_IO_P1_AI_02				UINT				Read
_IO_P1_AI_03				UINT				Read
_IO_P1_AI_04				UINT				Read
_IO_P2_AI_00				UINT				Read
_IO_P2_AI_01				UINT				Read
_IO_P2_AI_02				UINT				Read
_IO_P2_AI_03				UINT				Read
_IO_P2_AI_04				UINT				Read

The variable name string stands for the following:



For more information on bit word descriptions, go to Connected Components Workbench Global Variables Data Maps on page 320.

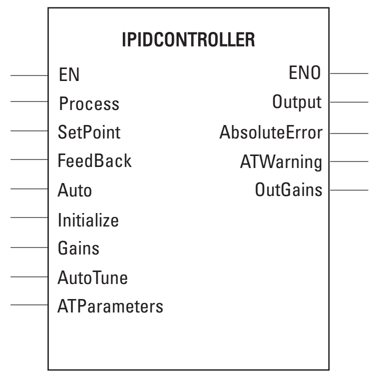
Recommended Cable Specifications

All cabling used for 2080-TC2 and 2080-RTD2 modules have to be shielded twisted cores with the shield wire shorted to chassis ground at controller end. It is advisable to use 22AWG wires to connect the sensors to the module. Use sensors dipped in oil-filled thermowells for stable and uniform readings. Recommended cable type: Alpha wire P/N 5471C.

Appendix H

IPID 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 When EN = TRUE, execute function. When EN = FALSE, do not execute function. Only applicable to LD, EN is not required in FBD Programming
Process	Input	REAL	Process value, measured from the output of controlled process.
SetPoint	Input	REAL	Set point value for desired process.
Feedback	Input	REAL	Feedback signal is the value of the control variable applied to the process, such as the IPIDCONTROLLER output.
Auto	Input	BOOL	Operating modes of PID controller: • TRUE —controller runs in normal mode • FALSE — the derivative term is ignored. This will force the controller output to track the feedback within controller limits, and allow the controller to switch back to auto without bumping the output.
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.

IPIDCONTROLLER Arguments

Parameter	Parameter Type	Data Type	Description
Gains	Input	GAIN_PID	Gains for IPIDCONTROLLER See GAIN_PID Data type
AutoTune	Input	BOOL	Start AutoTune sequence
ATParameters	Input	AT_Param	Auto tune parameters See AT_Param Data Type
Output	Output	Real	Output value from the controller
AbsoluteError	Output	Real	AbsoluteError is the difference between Process value and set point value
ATWarnings	Output	DINT	Warning for the Auto Tune sequence. Possible value are: • 0 — No auto tune done • 1 — Auto tuning in progress • 2 — Auto tuning done • -1 — Error 1: Controller input “Auto” is TRUE, please set it to False • -2 — Error 2: Auto tune error, the ATDynaSet time expired
OutGains	Output	GAIN_PID	Gains calculated from AutoTune Sequences. See GAIN PID Data type
ENO	Output	BOOL	Enable out. Only applicable to LD. “ENO” is not required in FBD Programming

GAIN_PID Data Type

Parameter	Type	Description
DirectActing	BOOL	Types of acting: • TRUE – Direct acting • FALSE – Reverse acting
ProportionalGain	REAL	Proportional gain for PID ($\geq$ 0.0001)
TimeIntegral	REAL	Time integral value for PID ($\geq$ 0.0001)
TimeDerivative	REAL	Time derivative value for PID ($\geq$ 0.0)
DerivativeGain	REAL	Derivative gain for PID ($\geq$ 0.0)

AT_Param Data Type

Parameter	Type	Description
Load	REAL	Initial controller value for Auto tuning process.
Deviation	REAL	Deviation for auto tuning. This is the standard deviation used to evaluate the noise band needed for AutoTune (noise band = 3* Deviation)(1)
Step	REAL	Step value for AutoTune. Must be greater than noise band and less than ½ load.
ATDynamSet	REAL	Auto Tune time. Set the time to wait for stabilization after the step test (in seconds). Auto Tune process will be stopped when ATDynamSet time expires.
ATReset	BOOL	Determines whether the output value is reset to zero after an AutoTune sequence: • True – Reset IPIDCONTROLLER output to zero after Auto tune process. • 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 continue, be sure that:

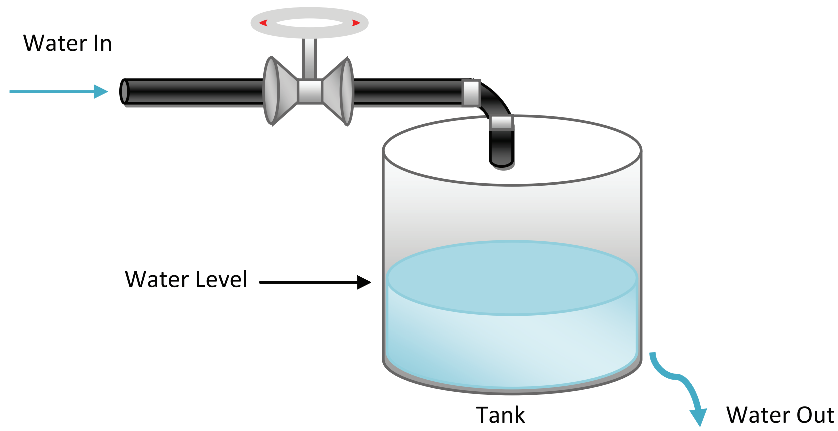
- the system is stable
- the "Auto" input to the IPIDCONTROLLER is set to false
- AT_Param is set. The input Gain and DirectActing must be set according to the process and DerivativeGain set, typically, to 0.1.

To auto tune, 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 go to steady state.
4. Change the "Initialize" input to "FALSE".
5. Wait until the "ATWarning" output value changes to"2".
6. Get the tuned value from "OutGains".

IMPORTANT	To finalize the tuning, some fine tuning may be needed depending on the processes and needs. Autotune will provide suboptimal value of tuning. It may be necessary to do fine tuning with the values, in close loop, to achieve the user goal. If ATWarning goes to -2 to indicate Auto Tune unsuccessful, you may need to adjust the AT_Param or/and scan time.

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 measureable rate.

IPID Autotuning for First and Second Order Systems

Autotune of IPID can only work on first and second order systems.

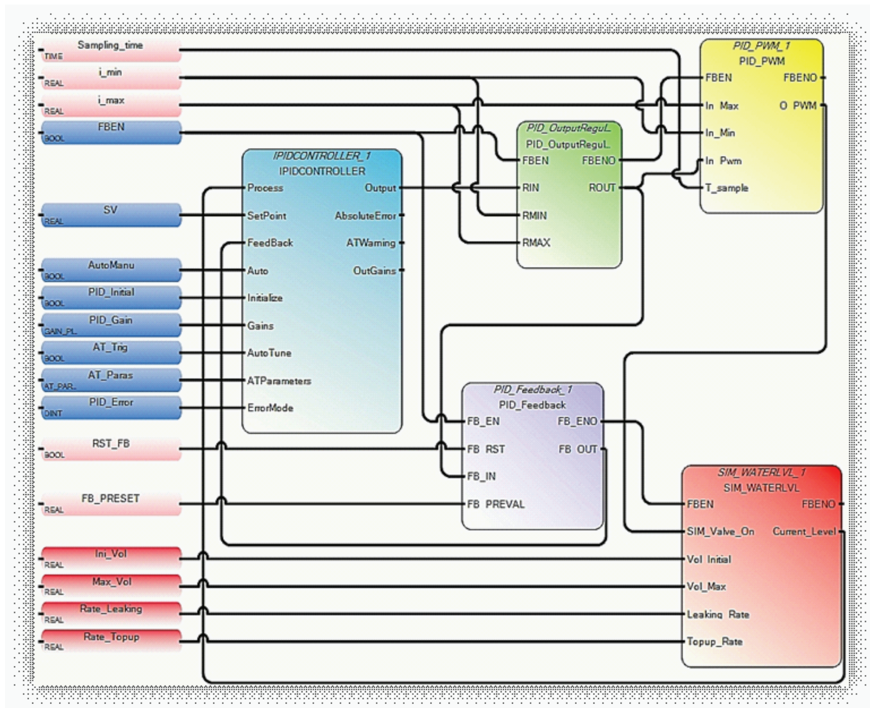
A first order system can be described by a single independent energy storage element. Examples of first order systems are the cooling of a fluid tank, the flow of fluid from a tank, a motor with constant torque driving a disk flywheel or an electric RC lead network. The energy storage element for these systems are heat energy, potential energy, rotational kinetic energy and capacitive storage energy, respectively.

This may be written in a standard form such as $f(t) = \tau\, dy/dt + y(t)$, where τ 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 ≤ RIN ≤ 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.

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