GuardPLC Controller Systems

Allen-Bradley

Bulletin 1753, 1754, 1755

User Manual

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.

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

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

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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

Summary of Changes

The information below summarizes the changes to this manual since the last publication.

To help you find new and updated information in this release of the manual, we have included change bars as shown to the right of this paragraph.

For Information About	See
Configuring Communication Between the Controller and a PanelView PLUS Terminal	205
Updated GuardPLC 1800 specifications	286
Added service life specifications for 1753-OW8 module	294
Updated information on battery replacement	Appendix D
Various updates to style and format	throughout

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Who Should Use This Manual

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

Personnel responsible for installation, programming, operation, and troubleshooting of safety-related controllers must be familiar with relevant safety standards for programmable electronic systems (PES).

Purpose of This Manual

The manual only briefly describes the safety concept of the GuardPLC family of controllers. Its purpose is to provide information on installing and operating your controller system.

For detailed information on the safety policy regarding GuardPLC controllers, including information on the controller's central functions, input and output channels, operating system, application program safety and regulations for use, refer to the GuardPLC Controller Systems Safety Reference Manual, publication 1753-RM002.

For procedural information on programming and configuring GuardPLC Controller Systems with RSLogix Guard PLUS! programming software, refer to Using RSLogix Guard PLUS! Software with GuardPLC Controllers, publication 1753-PM001.

Additional Resources

The table on the following page lists documents that contain additional information concerning Rockwell Automation GuardPLC products.

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.

Resource	Description
Using RSLogix Guard PLUS! Software with GuardPLC Controllers Programming Manual, publication 1753-PM001	Provides procedural information for programming GuardPLC Controller Systems Using RSLogix Guard PLUS! Programming Software
GuardPLC Controller Systems Safety Reference Manual, publication 1753-RM002	Contains in-depth information on the safety concept of GuardPLC controller systems, including the DeviceNet Safety Scanner for GuardPLC Controller.
DeviceNet Safety Scanner for GuardPLC Controllers User Manual, publication 1753-UM002	Provides information on installing, configuring, and operating a DeviceNet Safety Scanner in a GuardPLC application
DeviceNet Safety I/O User Manual, publication 1791DS-UM001	Provides information on operating 1791DS DeviceNet Safety I/O Modules
GuardPLC Certified Function Blocks Safety Reference Manual, publication 1753-RM001	Provides information on using Certified Function Blocks in your GuardPLC safety application
EtherNet/IP Performance and Application Guide, publication ENET-AP001	Information on EtherNet/IP protocol
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	In-depth information on grounding and wiring Allen-Bradley programmable controllers
Application Considerations for Solid-State Controls, publication 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

Overview of Safety Controllers

Introduction

Safety Concept

GuardPLC controllers feature a fail-safe CPU according to IEC 61508 (SIL 3) and ISO 13849-1 (PLe/Cat. 4). Faults that cause loss of safety function are detected within the safety time you specify. Faults that cause loss of safety function only in combination with another fault, are detected at least within the multiple error occurrence time (24 hours).

This results in these requirements for the safety concept:

- You specify the safety time and the watchdog time. The multiple error occurrence time is preset to 24 hours.
- Even upon the detection of an error, the controller continues to react in a safety-related way.
- Faulty input signals (for example, incorrectly transmitted input values) do not affect the safe function of the controller. Faulted input signals have a 0 value.
- An error in a non-safety-related module does not affect the safety of the controller.
- The failure of the controller has no effect on the safety of other safety-related modules.

For more information on the safety concept, refer to the GuardPLC Controllers Safety Reference Manual, publication 1753-RM002.

Response to Faults

Type of I/O Error	Controller Behavior
Permanent	If an error occurs at an I/O point, only this I/O point is considered faulty and not the entire module. In case of faulty input points, '0' is assumed to be the safe value. Faulty output channels are de-energized. If it is not possible to de-energize a single point, the entire module is considered to be faulty, the entire module is de-energized, and the corresponding error status is set. The controller reports the error to the user program. If the entire module cannot be de-energized, the controller goes to Failure_Stop.
Transient	A transient error is an error that occurs in an I/O module and then disappears by itself. If a transient error occurs, the module performs a self test. If the test is successful, the status of the I/O module is set to 'good' and the module's normal function continues. In the process, the GuardPLC controller performs a statistical evaluation of the frequency of errors. The I/O module is permanently set to 'faulty' if the pre-set error frequency is exceeded. In this case, the module does not resume its normal function after the error has disappeared. To resume normal function, you must cycle power or change the controller to Stop and then Run. If an error persists for a period of time exceeding that of the multiple error occurrence time (24 hours), the I/O module is permanently set to 'faulty' and does not continue normal function after the disappearance of the error. The I/O module can only resume normal function after you cycle power or Stop/Start the controller. For faulty modules, the controller uses safe values (0, LOW).
Controller	Upon the detection of an error, the controller goes to Failure_Stop and all output channels are set to the safe state (value = 0). In some cases in which a Failure_Stop occurs, a power cycle will not enable normal operation. A manual reset from Stop to Run, using RSLogix Guard PLUS! software, is required. Cat. 4 faults typically require manual resets. An error in the user program is not considered an error of the controller.

The controller also monitors the timing and consistency of the:

- hardware self-tests and software self-tests of the controller.
- cycle of the user program.
- processing of the I/O signals including I/O tests.
- run cycle of the controller.
- transition from Run to Stop.

Safe States

Inputs

The safe state of an input is indicated by a 0 signal being passed to the user program logic. When a fault occurs, the inputs are switched off (0).

Outputs

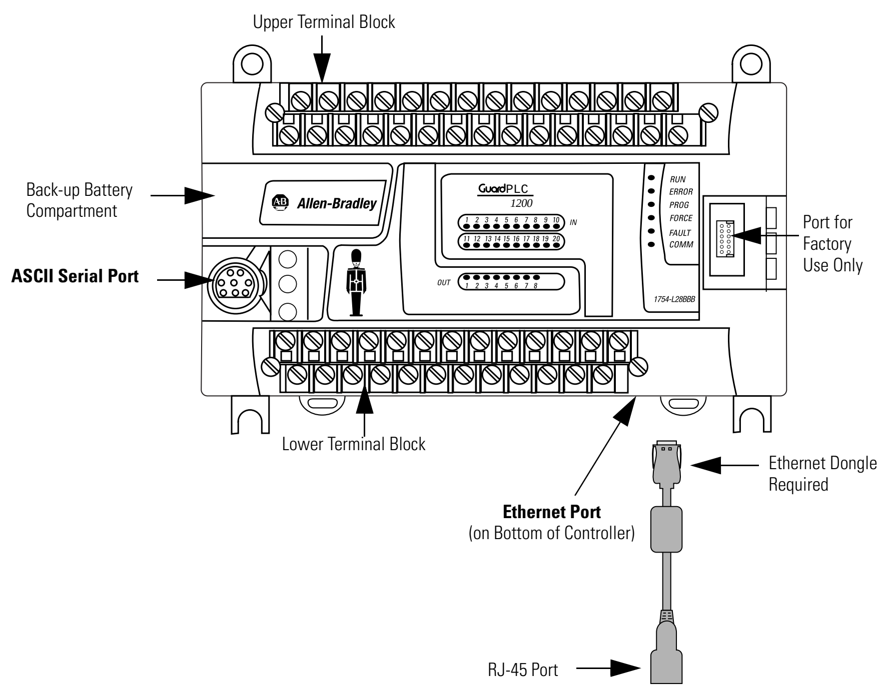
An output is in the safe state when it is de-energized. In the event of a fault, all outputs are switched off. This includes faults in Ethernet communication.

GuardPLC System Hardware

GuardPLC 1200 System

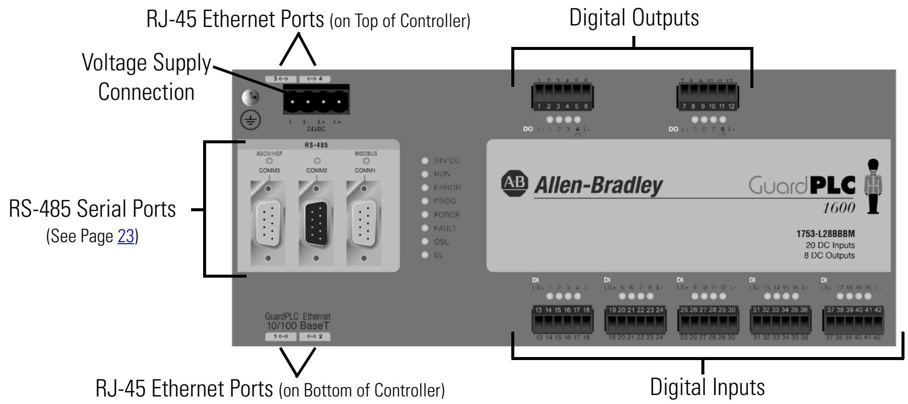
The GuardPLC 1200 controller is a compact system consisting of a CPU, watchdog, and on-board digital I/O. The GuardPLC 1200 controller features 20 digital inputs, 8 digital outputs, and 2 high-speed counters. An RS-232 serial port supports ASCII communication and an Ethernet port provides safety-related communication. A user-supplied 24V DC power supply is required. See page 45 for power supply connections.

GuardPLC 1200 Controller

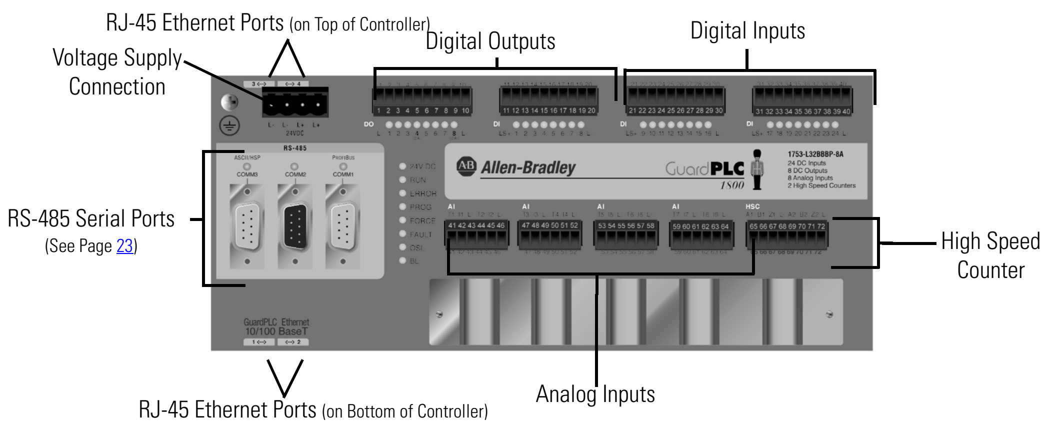


GuardPLC 1600 and GuardPLC 1800 System

GuardPLC 1600 Controller



GuardPLC 1800 Controller



The GuardPLC 1600 system features 20 digital inputs and 8 digital outputs with the addition of optional distributed Safety I/O. The GuardPLC 1800 system features 24 digital inputs, 8 digital outputs, 8 safety-related analog inputs, and 2 high-speed counters, as well as optional distributed Safety I/O. The status of inputs and outputs is indicated via status indicators. A user-supplied 24V DC power supply is required. See page 45 for information on power supply requirements.

Each controller features four 10/100BaseT, RJ-45 connectors to provide safety-related communication via the GuardPLC Ethernet network to distributed I/O and other GuardPLC controllers, OLE for Process Control (OPC) servers[1], and with RSLogix Guard PLUS! programming software. The four connectors and the controller are connected via an internal Ethernet switch.

(1) The OPC server is not suitable for safety-related communication.

Three ports are located on the front of the controller, providing these non-safety-related communication options.

Serial Port Designation	Function
COMM1 (RS-485)	Modbus RTU Slave (1753-L28BBBM or 1753-L32BBBM-8A) Profibus-DP-Slave (1753-L28BBBP or 1753-L32BBBP-8A) Read/Write
COMM2	not used
COMM3 (RS-485)	GuardPLC ASCII Protocol (Read-only)/High-Speed Safety Protocol (HSP)

The COMM3 (RS-485) also supports High-Speed Safety Protocol (HSP) for high-integrity communication with the 1753-DNSI DeviceNet Safety Scanner.

Refer to the DeviceNet Safety Scanner for GuardPLC Controllers User Manual, publication 1753-UM002, for more information.

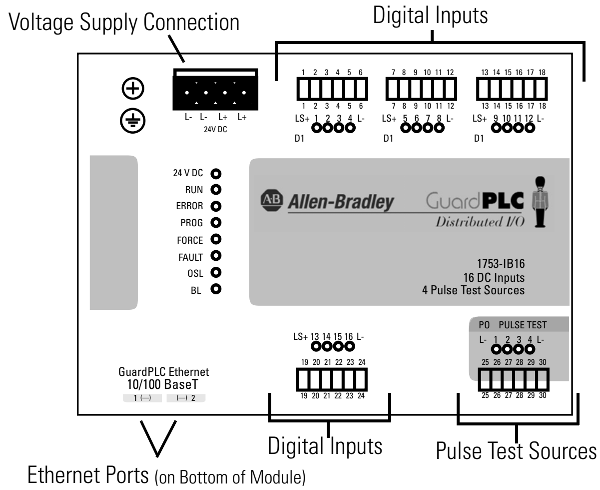
GuardPLC Distributed I/O

The following modules are available for use with the GuardPLC 1600 controllers, GuardPLC 1800 controllers, and series C GuardPLC 1200 controllers, and with series C GuardPLC 2000 CPUs. Module status is indicated via status indicators.

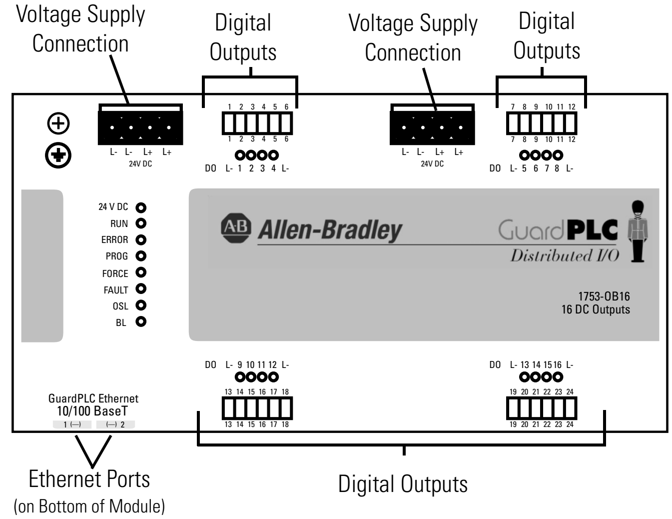
Cat. No.	Description	Inputs	Outputs
1753-IB16	Input Module	16 digital (not isolated) 4 pulse test sources	NA
1753-OB16	Output Module	NA	16 digital (not isolated)
1753-IB20XOB8	Input/Output Module	20 digital (not isolated)	8 digital (not isolated)
1753-IB8XOB8	Input/Output Module	8 digital (not isolated) 2 pulse test sources	8 positive-switching digital 2 negative-switching digital (not isolated)
1753-IB16XOB8	Input/Output Module	16 digital (not isolated) 2 pulse test sources	8 two-pole digital (not isolated)
1753-OW8	Relay Output Module	NA	8 relay
1753-IF8XOF4	Analog Input/Output Module	8 analog	4 standard analog

GuardPLC 1753 Digital I/O Modules

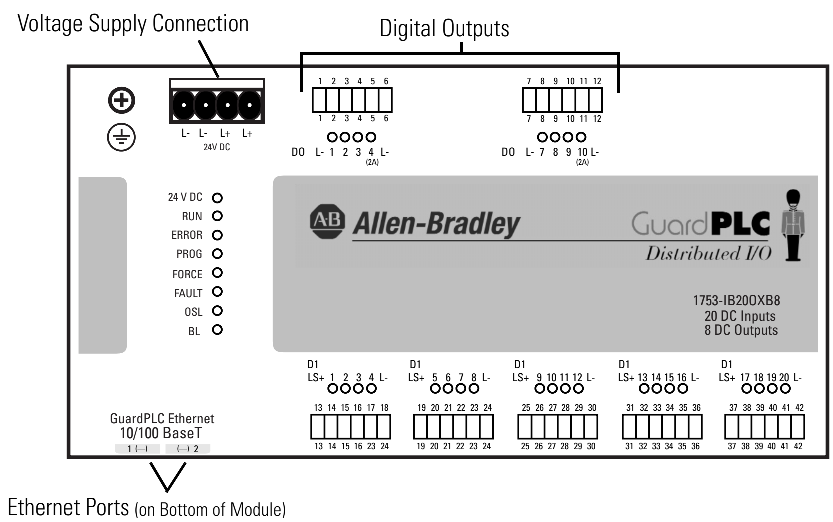
1753-IB16 Module



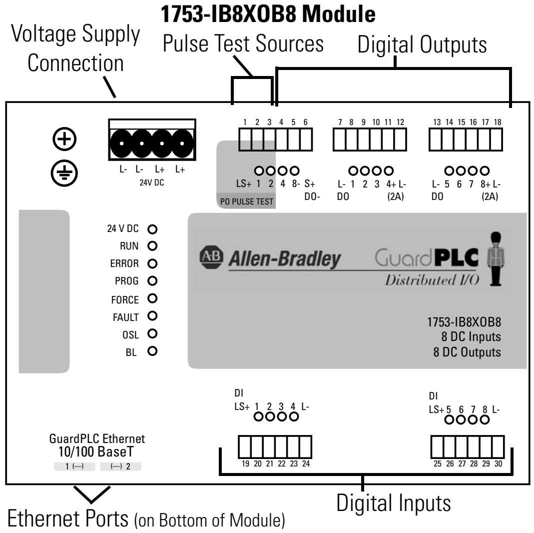
1753-OB16 Module



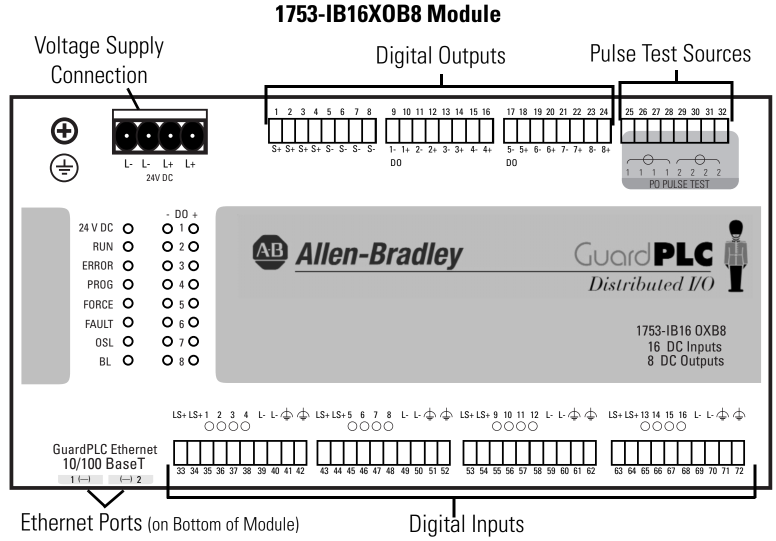
1753-IB20XOB8 Module



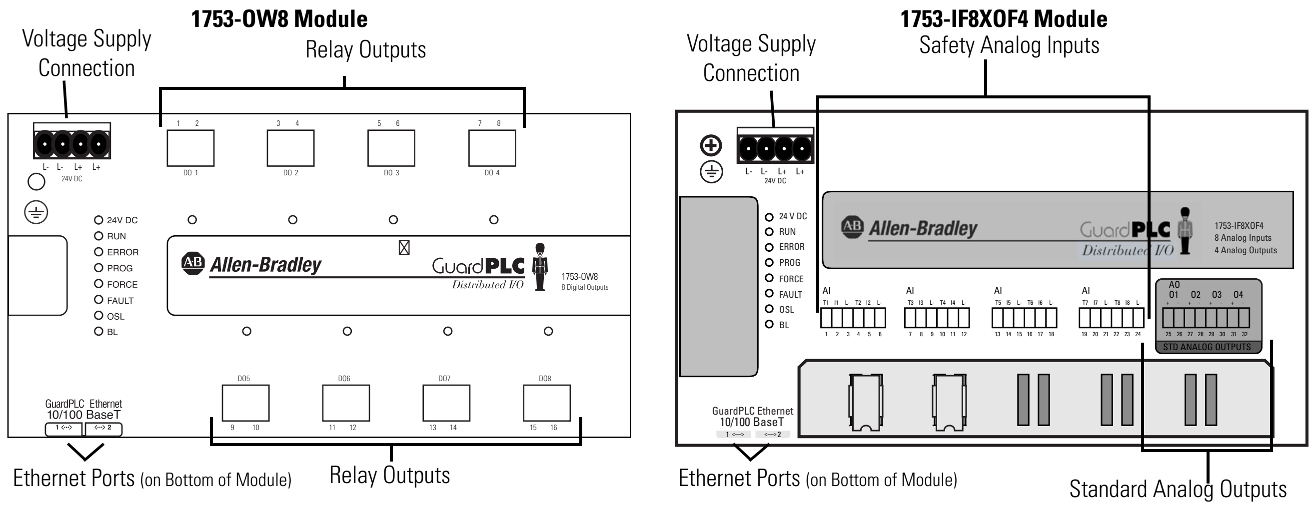
1753-IB8XOB8 Module



1753-IB16XOB8 Module



1753 Relay Output and Analog I/O Modules

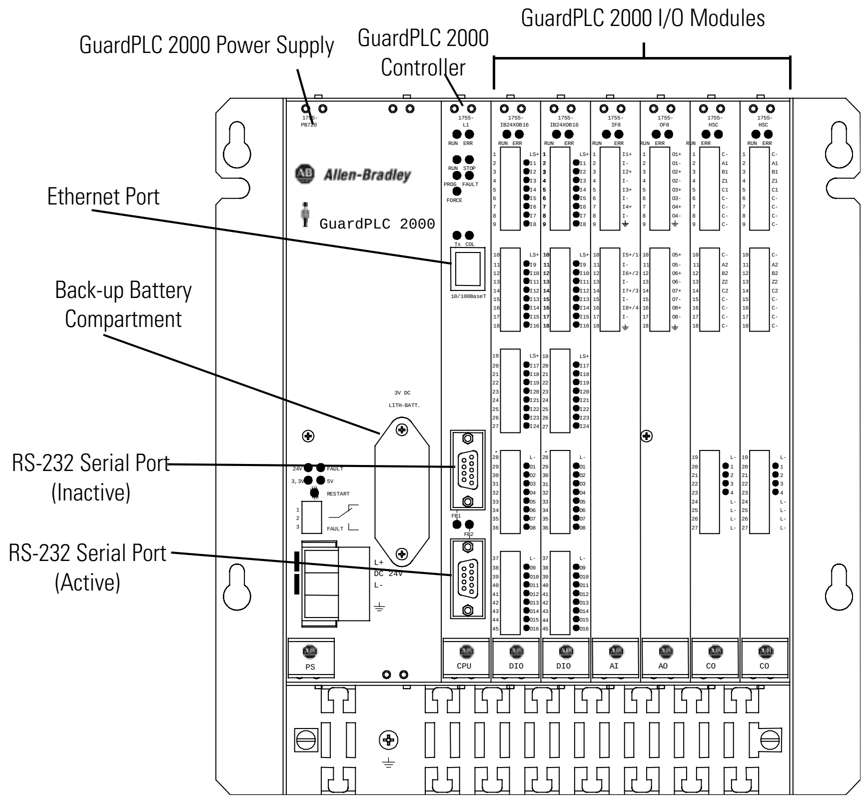


GuardPLC 2000 System

The GuardPLC 2000 controller is a modular system consisting of a controller (1755-L1), which provides central CPU and communication functions, and a separate power supply and I/O residing in a GuardPLC 1755-A6 chassis. A maximum of six I/O modules may be used in a single system.

The GuardPLC 2000 controller has one active RS-232 serial port for non-safety related communication. It also features an Ethernet port for configuration and safety-related communication. The lower DB9 port supports RS-232 ASCII (read-only) communication; the upper port is inactive.

GuardPLC 2000 Controller, Power Supply, and I/O Modules



GuardPLC 2000 Power Supply

The 1755-PB720 power supply module provides two voltages (3.3V DC and 5V DC) for the GuardPLC 2000 controller. They are electrically isolated from the supply voltage, 24V DC.

1755-IB24XOB16 I/O Module

The 1755-IB24XOB16 digital input/output module provides 24 digital inputs and 16 digital outputs. The status of each I/O signal is displayed with a status indicator located on the right side of the front plate connectors. Inputs and outputs are electrically isolated from the supply voltage, 24V DC.

1755-IF8 Analog Input Module

The 1755-IF8 analog input module has eight inputs. These inputs can be used as either eight single-ended inputs or four differential analog inputs that are electrically isolated from the logic side of the GuardPLC module. The measured input value can be either voltage or current. If you use the input module for current, you need a shunt resistor. The measured value is digitally transferred to the processor system as a value between 0 and 2000.

1755-OF8 Analog Output Module

The 1755-OF8 analog output module provides eight outputs, galvanically isolated in groups of 2 (that is, 2 outputs per power supply). They are electrically isolated from the processor system. Each analog output can operate as a current source or a voltage source.

1755-HSC High Speed Counter Module

The 1755-HSC counter module provides two counters and four digital outputs. They are electrically isolated from the processor system. The status of the four output signals is displayed with status indicators located at the right side of the front plate output connector.

Communication Capabilities

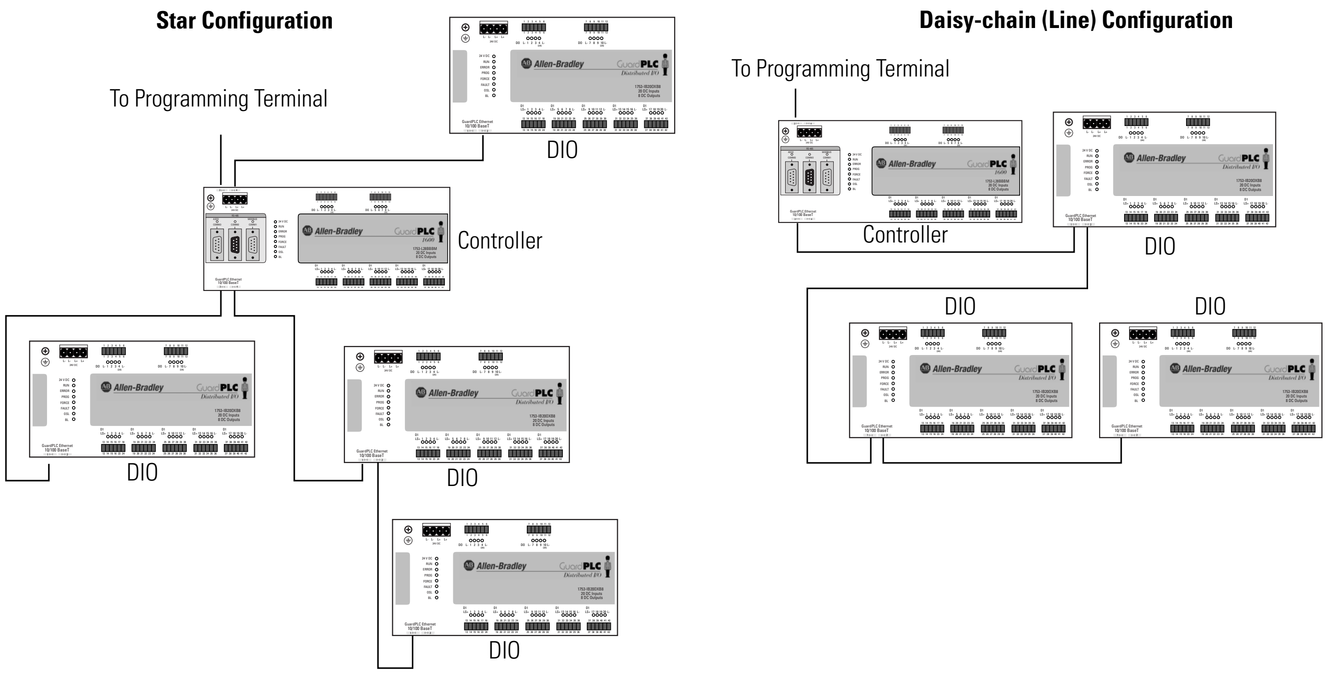
GuardPLC Ethernet Network

The GuardPLC Ethernet network provides safe communication via Ethernet protocol for distributed I/O and peer-to-peer communication for all GuardPLC controllers. It also provides non-safety-related communication with the OPC server. Programming and configuration of controllers is accomplished via the GuardPLC Ethernet network.

Various GuardPLC systems can be networked together on the GuardPLC Ethernet network, using star or daisy-chain configurations. A programming device running RSLogix Guard PLUS! software can also be connected wherever required.

IMPORTANT	Make sure that a network loop is not generated. Data packets must only be able to reach a node via a single path.

GuardPLC Ethernet Networking Example



EtherNet/IP

GuardPLC 1600 and GuardPLC 1800 controllers support EtherNet/IP communication. Able to run EtherNet/IP communication at the same time as safety-rated GuardPLC Ethernet network, the GuardPLC controller uses the EtherNet/IP network to communicate status about the safety control system to other standard devices such as PLCs (ControlLogix, FlexLogix, CompactLogix, SLC 500, or PLC-5 controllers), HMIs (PanelView, PanelView Plus, and VersaView terminals) and others. The GuardPLC controller can even control standard I/O, like FLEX I/O and POINT I/O modules, on an EtherNet/IP network.

ASCII

This read-only, non-safety-related protocol can be used to extract diagnostic and status information from the GuardPLC controllers. ASCII protocol is available over the RS-232 port on the GuardPLC 1200 and GuardPLC 2000 controllers and via the RS-485 Comm 3 port on GuardPLC 1600 and GuardPLC 1800 controllers.

See Chapter 21 for details on communication with ASCII devices.

High-speed Safety Protocol

GuardPLC 1600 and 1800 controllers support High-speed Safety Protocol (HSP), which allows them to connect to the DeviceNet safety network via the 1753-DNSI DeviceNet Safety Scanner.

Refer to the DeviceNet Safety Scanner for GuardPLC Controllers User Manual, publication 1753-UM002, for more information.

Modbus RTU Slave

Modbus is a standard industrial non-safety-related serial protocol in which the Modbus master can communicate with a maximum of 255 slave devices. The Modbus master initiates and controls all communication on the network.

Modbus RTU Slave protocol is available via the RS-485 Comm 1 port on GuardPLC 1600 and GuardPLC 1800 controllers with catalog numbers ending in 'M'.

Modbus RTU Slave protocol allows both the reading and writing of data.

For more information on the Modbus RTU Slave protocol, see the Modbus Protocol Specifications, available from www.modbus.org/specs.

PROFIBUS DP Slave

PROFIBUS DP protocol is a non-safety-related serial protocol, designed for high-speed data transmission between automation systems and distributed peripherals.

PROFIBUS DP slave protocol is available via the RS-485 Comm 1 port on GuardPLC 1600 and GuardPLC 1800 controllers with catalog numbers ending in 'P'.

PROFIBUS DP Slave protocol allows both the reading and writing of data.

OPC Server

The GuardPLC 1600, GuardPLC 1800, series C GuardPLC 1200, and series C GuardPLC 2000 controllers are OPC clients. An OPC server, catalog number 1753-OPC, is available from Rockwell Automation and lets personal computer applications read and write data to and from the GuardPLC controller (non-safety-related communication only).

Installation

Introduction

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General Safety

Open style devices must be provided with environmental and safety protection by proper mounting in enclosures designed for specific application conditions. See NEMA Standards 250 and IEC 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosure.

ATTENTION

Consider the following before installing your GuardPLC 1200/1600/1800 controller or distributed I/O.

These products are grounded through the DIN rail. Use zinc-plated yellow-chromate steel DIN rails to assure proper grounding. The use of other DIN rail materials (for example, aluminum and plastic) that can corrode, oxidize, or are poor conductors, can result in improper or intermittent grounding.

Mount the Equipment

GuardPLC 1200 Controller

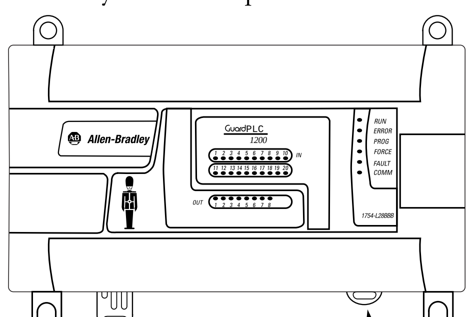
The GuardPLC 1200 controller can be either snapped onto a DIN rail or mounted to a back panel by using bolts. DIN rail mounting is the easiest way to attach the controller and should be used wherever possible.

IMPORTANT For cooling reasons:

- the GuardPLC 1200 controller must be mounted horizontally with the Ethernet socket facing down.
- a location where air flows freely or use an additional cooling fan.
- the minimum clearance around the GuardPLC 1200 controller must be at least 100 mm (3.94 in.).
- do not mount the GuardPLC 1200 controller over a heating device.

DIN Rail

1. Hook the two top latches, on the back of the GuardPLC 1200 controller, over the top of the DIN rail.
2. If the lower latches are extended (see figure below), push them up until they lock into place. If the lower latches are not extended, press the GuardPLC 1200 controller into the DIN rail until they lock into place.

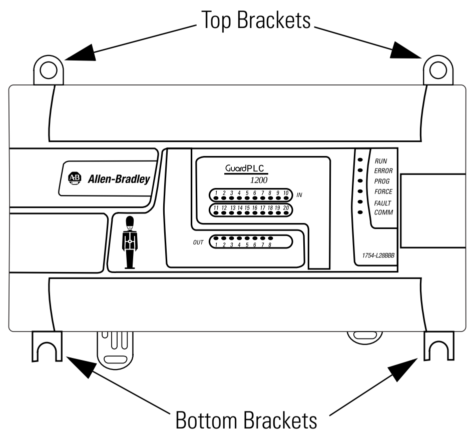


TIP If you need to remove the controller from the DIN rail, use a screwdriver to pull down the lower latches, then lift the controller toward you.

Back Panel

ATTENTION	Do not bend the controller. Bending the controller will damage it.

Use the four brackets on the GuardPLC 1200 controller to mount it onto a back panel.



Use the following to mount the controller.

Top Brackets	**Bottom Brackets**
M4 screws (2)	M5 screws (2)
lock washer	lock washer
washers	washers
nut	nut

If the mounting brackets are not flat before the nuts are tightened, use additional washers as shims, so the controller does not bend when you tighten the nuts.

GuardPLC 1600 and GuardPLC 1800 Controllers, and Distributed I/O

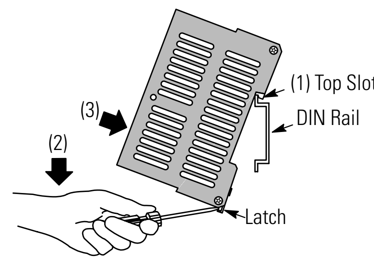
IMPORTANT

For effective cooling:

- mount the device horizontally.
- provide a gap of at least 100 mm (3.94 in.) above and below the device and at least 20 mm (0.79 in.) horizontally between devices.
- the wire duct can run in the 100 mm (3.94 in.) of free space above and below the controller if it is no deeper than 40 mm (1.58 in.). If the depth is greater than 40 mm (1.58 in.), the devices must be placed on stand-offs that match the depth of the duct. If stand-offs are not used, you must provide a gap of at least 80 mm (3.15 in.) between the device and the duct.
- select a location where air flows freely or use an additional fan.
- do not mount the controller or I/O module over a heating device.
- do not block the ventilation slots on the side of the device.

GuardPLC 1600 and GaurdPLC 1800 controllers and I/O cannot be panel-mounted. Mount these controllers and distributed I/O to a DIN rail by following the steps below.

1. Hook the top slot over the DIN rail.
2. Insert a flathead screwdriver into the gap between the housing and the latch and pull the latch downward.
3. Hold the latch down as you push the housing back onto the DIN rail.
4. Release the latch to lock the device onto the rail.



TIP To remove the device from the DIN rail, insert a flathead screwdriver into the gap between the housing and the latch and pull the latch downward as you lift the device off of the rail.

GuardPLC 2000 Chassis

The GuardPLC 2000 chassis provides two flanges with eyelets. Refer to the illustration below. Use bolts to mount the system to a back panel.

To mount the chassis flanges, you will need four M8-size bolts with lock washer, washer, and nut with 13 mm (0.51 in.) max head diameter. The bolts must be long enough to accept the chassis at its mounting place.

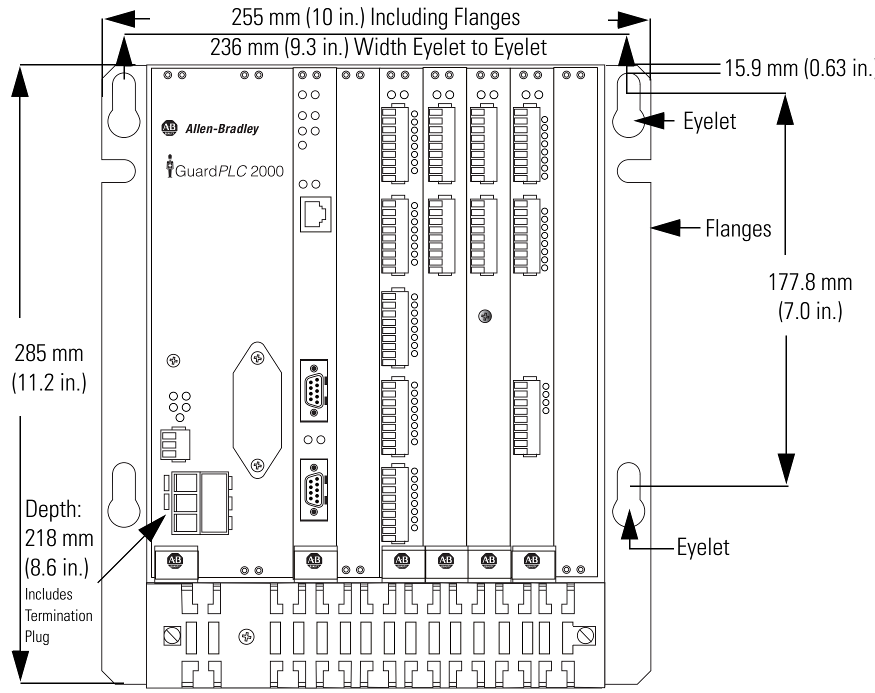
ATTENTION

- Do not bend the chassis. Bending will damage the chassis and/or the backplane inside the GuardPLC 2000 controller.
- If the rear side of the chassis does not lie flat before the nuts are tightened, use additional washers as shims so that the chassis does not bend when you tighten the nuts.

IMPORTANT

- The chassis must be installed without any modules inserted.
- Disconnect the supply voltage before mounting the chassis.
- The chassis must be vertically mounted with the cooling fans on the lower side.
- Do not obstruct ventilation openings.
- Provide a gap of at least 100 mm (3.94 in.) above and below the device and at least 20 mm (0.79 in.) horizontally between devices.

Modules are shown for illustration only. The chassis must be installed without any modules inserted.

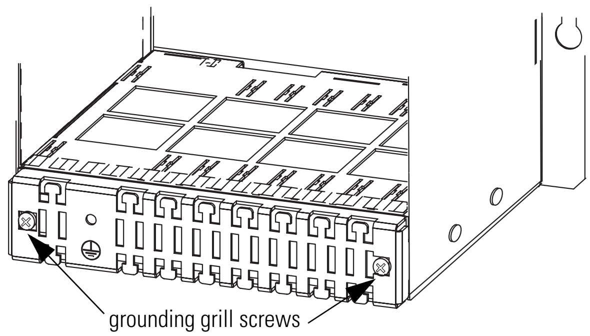


GuardPLC 2000 Controller, I/O, and Power Supply

Mount the GuardPLC 2000 chassis prior to installing the controller, I/O, and power supply.

IMPORTANT	Disconnect the power supply, 1755-PB720, from the 24V DC supply voltage before you insert any I/O modules.

1. Before you insert the device, you must detach the grounding grill. To do this, remove the grounding grill screws.



2. Remove the lower panel of the chassis and disconnect the fans.

3. Power Supply: Insert the power supply into the leftmost slot of the chassis.

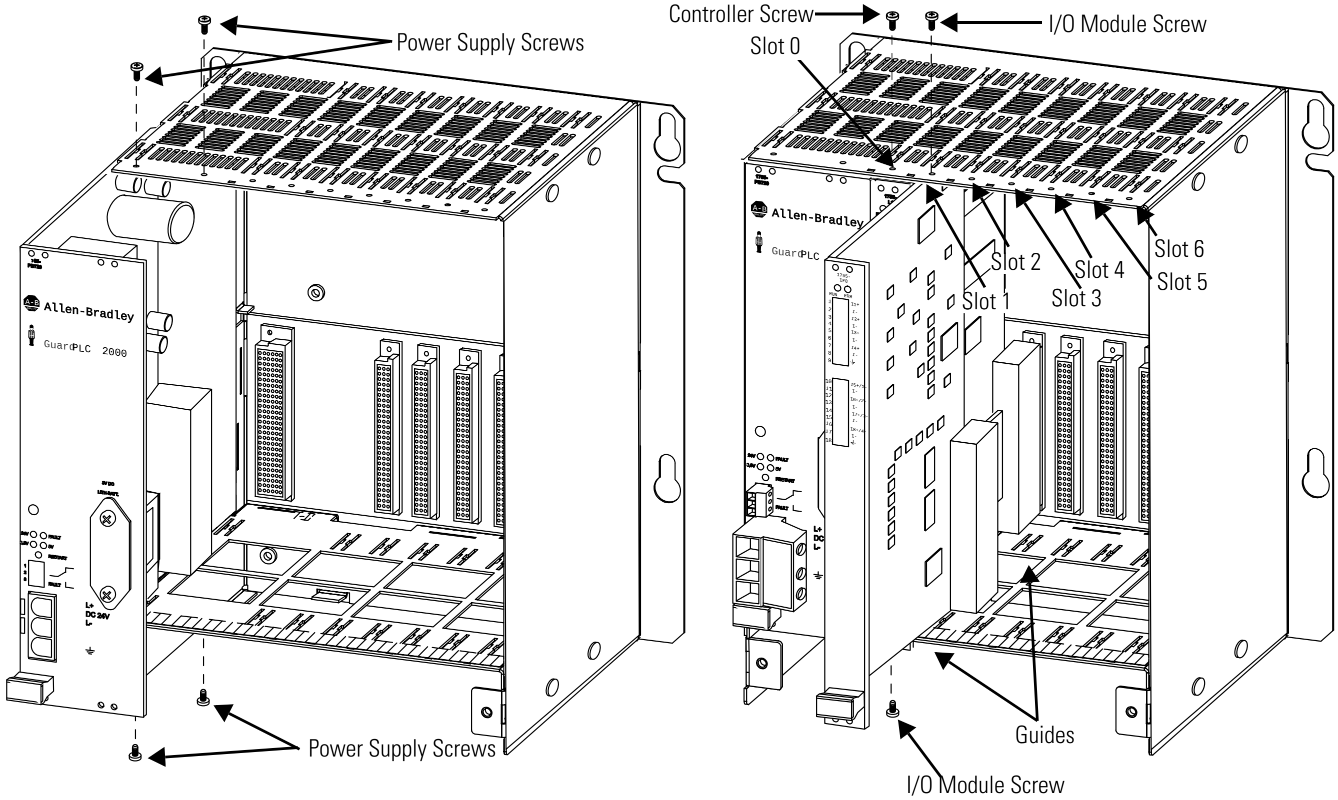
   Controller: Insert the controller into the slot directly to the right of the power supply module (slot 0).

   I/O Module: Insert the module into any unused slot from 1…6 (see the figure below). Keep the module in line with the guides so the module runs smoothly in the track.

4. Begin pushing the device into the chassis.
   a. If there is resistance when you push the device into the backplane, do not force the device because the pins will bend.
   b. Remove the device and start again at step 3.

5. Continue pushing the device into the chassis until the front of the device is flush with the other modules in the chassis.

6. Secure the device with the screws on the top and bottom of the device (see the figure below).



TIP	If you are installing other GuardPLC 2000 modules, follow their installation instructions up to this point before you complete the next 3 steps.

7. Reconnect the fans.

8. Replace the lower panel of the chassis, sliding it over the tabs on the sides of the chassis and under the tabs on the back of the chassis.

9. Use the grounding grill screws to attach the grounding grill.

Communication Connections

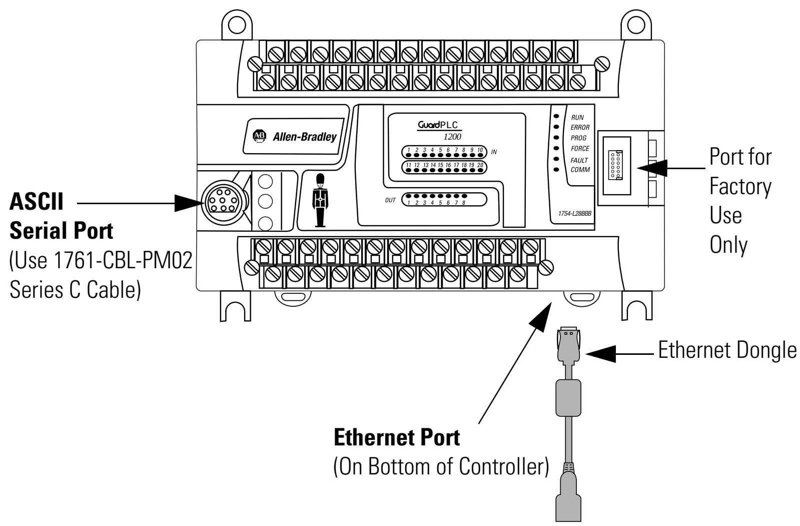
Connections for safety and non-safety related communication for GuardPLC controllers and distributed I/O modules are described in the following sections.

GuardPLC 1200 Controller

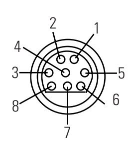
The GuardPLC 1200 controller has an ASCII serial port for non-safety-related communication and an Ethernet port for safety-related communication.

Connect the ASCII port to any RS-232 device that has the capability to send ASCII command strings to the controller. The controller replies with a data variable string. See Chapter 21 for more information on ASCII communication

Use this illustration to connect the ASCII and Ethernet ports.



The pin assignment of the ASCII Serial port is shown below.



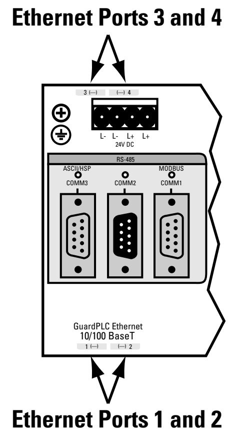
Pin	Function
1	24V DC
2	ground (GND)
3	request to send (RTS)
4	received data (RxD)
5	received line signal detector (DCD)
6	clear to send (CTS)
7	transmitted data (TxD)
8	ground (GND)
9	not applicable

GuardPLC 1600 and GuardPLC 1800 Controllers

Connections for safety- and non-safety-related communication are described in the following sections.

Connections for Safety-Related Communication

The controller has four 10/100BaseT, RJ-45 connectors to provide communication via the GuardPLC Ethernet network to other GuardPLC controllers, distributed I/O, and RSLogix Guard PLUS! software. These connectors also provide communication via an EtherNet/IP network to other Ethernet devices. Connectors 1 and 2 are located on the bottom side on the left. Connectors 3 and 4 are located on the top side on the left.



All four connectors and the GuardPLC controller are connected together by an internal Ethernet switch. In contrast to a hub, a switch is able to store data packets for a short period of time to establish a temporary connection between two communication partners for the transfer of data. In this way, collisions (typical of a hub) can be avoided and the load on the network is reduced.

The switch automatically switches between transfer rates of 10 and 100 Mbps and between full- and half-duplex connections. This makes the full bandwidth available (full-duplex operation) in both directions.

A switch enables several connections to be established at the same time and can address up to 1000 absolute MAC addresses.

Auto-crossing recognizes that cables with crossed wires have been connected and the switch adjusts accordingly. Therefore, either cross-over or straight-through Ethernet cabling can be used.

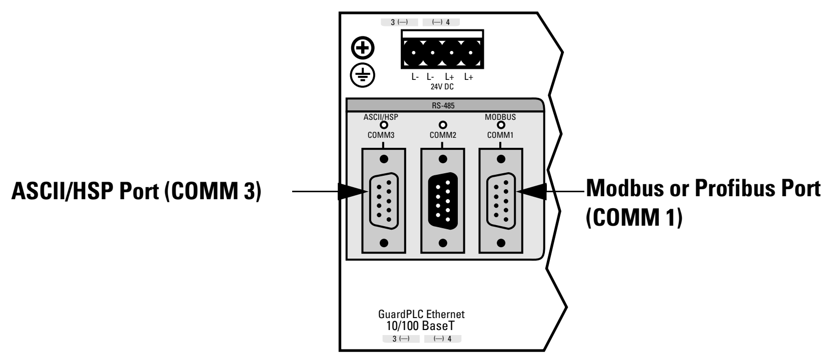
Star or line configurations are available. Make sure that a network loop is not generated. Data packets must only be able to reach a node via a single path.

See Chapter 16 for information on peer-to-peer communication or Chapter 18 for information on EtherNet/IP communication.

Connections for Non-Safety-Related communication

Three 9-pin Min-D connectors are located on the front of the controller, providing these communication options.

Designation	Function
COMM1 (RS-485)	Modbus RTU Slave (1753-L28BBBM or 1753-L32BBBM-8A) Profibus-DP-Slave 1753-L28BBBP or 1753-L32BBBP-8A)
COMM2	not used
COMM3	GuardPLC ASCII Protocol/HSP



IMPORTANT The three Min-D connectors are RS-485. You must use an electrical interface device to connect the controller to an RS-232 device.

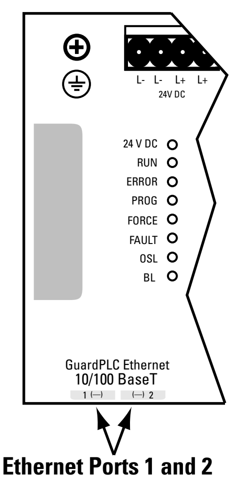
To use COMM3 for HSP, you must use a 1753-CBLDN cable, which ships with the 1753-DNSI DeviceNet Safety Scanner for GuardPLC Controllers.

The pin assignment of the Min-D connectors is shown in the table below.

Connection	Signal	Function
1	—	—
2	RP	5V, decoupled with diodes
3	RxD/TxD-A	Receive/Transmit data A
4	CNTR-A	Control Signal A
5	DGND	Data reference potential
6	VP	5V, positive pole of supply voltage
7	—	—
8	RxD/TxD-B	Receive/Transmit data B
9	CNTR-B	Control Signal B

GuardPLC Distributed I/O Modules

Each module has two 10/100BaseT, RJ-45 connectors to provide safety-related communication via the GuardPLC Ethernet network. These two connectors and the GuardPLC distributed I/O module are connected together by an internal Ethernet switch.

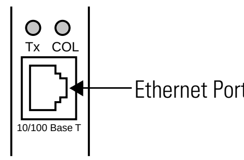


GuardPLC 2000 Controller

Connections for safety- and non-safety-related communication are described in the following sections.

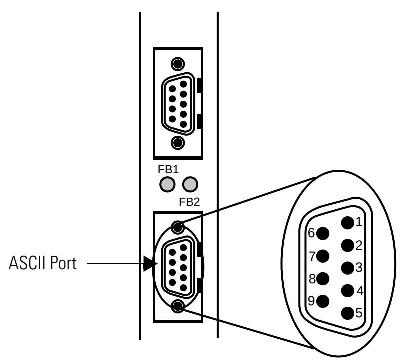
Connections for Safety-Related Communication

To configure/program the GuardPLC system, the controller must be connected on an Ethernet network to the RSLogix Guard PLUS! programming terminal. The GuardPLC Ethernet network also provides for peer-to-peer communication to distributed I/O and to other controllers.



Connections for Non-Safety-Related Communication

Connect the ASCII port (FB2) to any RS-232 device that has the capability to send ASCII command strings to the controller. The controller replies with a data variable string. See Chapter 21 for more information on ASCII communication.



pin	function
1	none
2	send data
3	receive data
4	none
5	ground
6	none
7	RTS
8	CTS
9	none

Reset Pushbutton

GuardPLC 1600 and 1800 controllers and distributed I/O are equipped with a reset pushbutton. Reset via the pushbutton is necessary if you:

- forget the password to go online via the programming software.
- are unable to determine the IP address and SRS of the controller.

The pushbutton is accessible through a small round hole at the top of the housing, approximately 4…5 cm (1.6…2.0 in.) from the left rim and recessed approximately 9.5 mm (0.375 in.).

IMPORTANT Activate the reset pushbutton by using an insulated pin to prevent short-circuits.

To reset, press and hold the pushbutton while restarting the controller by cycling power. Hold the reset pushbutton until the PROG status indicator stops flashing. Pressing the Reset pushbutton during operation has no affect.

After a reset, the IP address, SRS, and login accounts are temporarily reset to their default settings.

- IP = 192.168.0.99
- SRS = 60000.1
- Login Username = Administrator
- Login Password = [none]

At the next power cycle, these settings will be reset to the last values stored into Flash. This means that either:

- the settings prior to the reset will be restored.
- if any settings were changed after the reset, these new settings will still be in effect.

Notes:

General Wiring Considerations

Introduction

Prevent Electrostatic Discharge

ATTENTION

Electrostatic discharge can damage integrated circuits or semiconductors. Follow these guidelines when you handle the module.

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

Power Supply Considerations

The power supply must provide a voltage between 20.4 and 28.8V DC. You must supply enough power to drive the controller, inputs, and outputs because all GuardPLC controllers and distributed I/O modules source the current for the input channels and drive the output devices connected to them. No additional power supply is required to drive outputs. To operate, GuardPLC controllers typically draw less than 1 A at 24V DC. They require additional power to operate the inputs and outputs connected to the controller. Consider the power draw of the I/O when specifying the size of the power supply and required fusing.

The 24V DC voltage supply must feature galvanic isolation because inputs and outputs are not electrically isolated from the internal processor.[1] To comply with CE Low Voltage Directives (LVD), you must use either an NEC Class 2, a Safety Extra Low Voltage (SELV) or a Protective Extra Low Voltage (PELV) power supply to power the GuardPLC controller or I/O module. A SELV supply cannot exceed 30V rms, 42.4V peak or 60V DC under normal conditions and under single fault conditions. A PELV supply has the same rating and is connected to protective earth.

IMPORTANT	Protect the controller with a slow-blow fuse.

Ground the Equipment

You must provide an acceptable grounding path for each device in your application. For more information on proper grounding guidelines, refer to the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Considerations for Grounding All Controllers

- To improve EMC conditions, ground the controller.
- Run the ground connection from the ground screw of the controller to a good earth ground. Use a minimum of 2.5 mm^2 (14 AWG) wire.
- Keep the connection to earth ground as short as possible to minimize resistance.
- Grounding is required even if the control system does not have shielded cables.
- If you use shielded cables to connect the controller to the external 24V DC source, connect the shield to the grounding contact of the power supply.
- No protective grounding (against hazardous shock) is required.

GuardPLC 1200 Controller

Ground the GuardPLC 1200 controller by connecting the PA terminal, marked ⏚, to earth ground. See page 58 for GuardPLC 1200 terminal connections.

(1) The I/O and CPU are only isolated from one another on the GuardPLC 2000 controller.

GuardPLC 1600 and GuardPLC 1800 Controllers and Distributed I/O

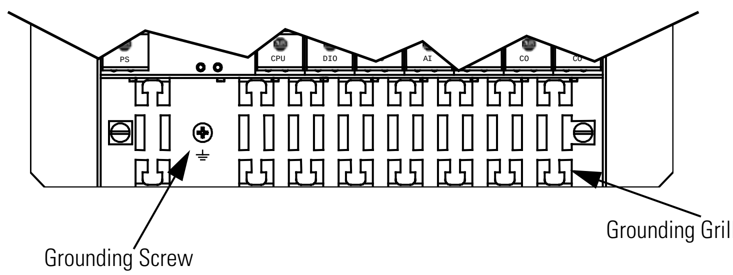
The I/O module is functionally grounded through its DIN rail connection. A protective earth ground connection is required and is provided by a separate grounding screw, located on the upper left of the housing and marked with the grounding symbol ⏚.

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 and plastic) that can corrode, oxidize, or are poor conductors, can result in improper or intermittent grounding.

GuardPLC 2000 Chassis

Ground the GuardPLC 2000 chassis and cables by using the grounding screw located on the left side of the grounding grill. Ground the chassis via the grounding grill.

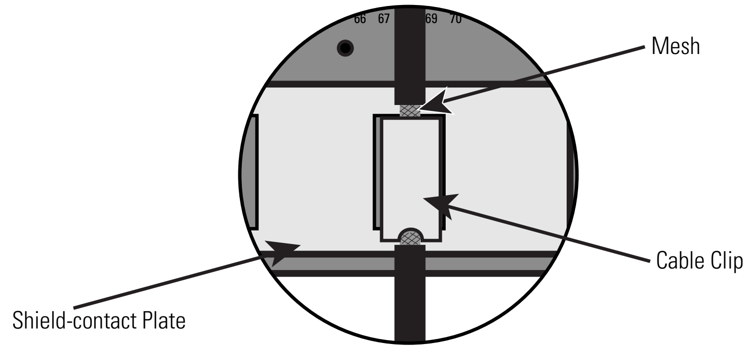


Terminal Connections

Terminals accommodate wire sizes up to 1.5 mm^2 (16 AWG) for input/output wiring and up to 2.5 mm^2 (14 AWG) for voltage supply connections.

Shield-contact Plate Connections

Shielded cabling is fed in from below so that the shielding can be connected to the shield-contact plate by using a clip. Remove about 2 cm (0.79 in.) of the outer cable insulation so that the mesh is exposed at the point where the cable is clipped to the plate. Position the clip over the uninsulated cable shielding and push it into the slots of the shield contact plate until it fits firmly in place, as shown below.



IMPORTANT Make sure that the mesh comes in direct contact with the shield-contact plate. If the mesh does not touch the plate, the cable is not grounded.

Detailed Wiring Information

For detailed wiring information by product, see the table below.

For	See
GuardPLC 1600, GuardPLC 1800 and GuardPLC 1200 Controllers	Chapter 4
GuardPLC 2000 Controller	Chapter 5
1753-IB16, 1753-OB16, 1753-IB20XOB8 Modules	Chapter 6
1753-IB8XOB8	Chapter 7
1753-IB16XOB8	Chapter 8
1753-IF8XOF4	Chapter 9
1753-OW8	Chapter 10
Wiring Examples	Appendix C

To be sure that GuardPLC controllers and I/O modules are used in a safety-related manner (SIL3 in accordance to IEC 61508), the whole system, including connected sensors and encoders, must satisfy the safety requirements described in the GuardPLC Controllers Safety Reference Manual, publication 1753-RM002.

Wire GuardPLC 1600, GuardPLC 1800, and GuardPLC 1200 Controllers

Introduction

Power Supply Connections

Power supply connections for GuardPLC 1600, GuardPLC 1800, and GuardPLC 1200 controllers are described in the following sections.

GuardPLC 1600 and GuardPLC 1800 Controllers

ATTENTION

Before connecting the power supply, check for correct polarity, value, and ripple.

Do not reverse the L+ and L- terminals or damage to the controller will result. There is no reverse polarity protection.

The supply voltage is connected via a 4-pin connector that accommodates wire sizes up to 2.5 mm^2 (14 AWG). You only need to connect one wire to L+ and one wire to L-. Both L+ and L- terminals are internally connected. The other terminal can be used to daisy-chain 24V DC to additional devices. The power supply connector is rated to 10 A.

GuardPLC 1200 Controller

Both L+ and L- terminals must be used in parallel to allow the maximum current of 8 A. (Each terminal maximum is 4 A so both are required for 8 A.)

If the power supply has only one (+) lead, a short bridge jumper must be installed between $L+_{(1)}$ and $L+_{(2)}$.

TIP The GuardPLC 1200 controller requires approximately 0.5 A to operate. The remaining 7.5 A is used to source power for inputs and outputs.

Safety-related Digital Inputs

The status of digital inputs is indicated via status indicators when the controller or module is in Run mode.

Follow the closed-circuit principle for external wiring when connecting sensors. To create a safe state in the event of a fault, the input signals revert to the de-energized state (0). The external line is not monitored, but a wire break is interpreted as a safe (0) signal.

The GuardPLC 1600 and GuardPLC 1800 controllers provide power to input devices through their LS+ terminals. However, input devices with their own dedicated power supply can also be connected instead of contacts. The reference pole (L-) of the power supply must then be connected to the reference pole (L-) of the appropriate GuardPLC input group. See the wiring diagrams in Appendix C for examples.

In general, the LS+ terminals, not L+ on the power supply connection, should be used to supply voltage for safety inputs. Each LS+ features individual short-circuit and EMC protection. Due to current limitations, use LS+ for only the safety inputs on the same terminal plug.

An EN 61000-4.5 surge impulse can be read as a short-duration HI signal in some modules. To avoid an error, either:

- install shielded input lines to prevent effects of surges in the system.
- implement software filtering in the user program. A signal must be present for at least two cycles before it is evaluated.

Safety-related Digital Outputs

The status of digital outputs is indicated via status indicators when the controller or module is in Run mode.

GuardPLC outputs are rated to either 0.5 A or 1.0 A at an ambient temperature of 60 °C (140 °F). At an ambient temperature of 50 °C (122 °F), outputs rated at 1.0 A increase to 2.0 A.

If an overload occurs, the affected outputs are turned off. When the overload is eliminated, the outputs are under the control of the controller and are energized based on the user program code.

An output is in the safe state when it is de-energized. Therefore, outputs are switched off when a fault that affects the safe control of those outputs occurs.

For connection of a load, the reference pole L- of the corresponding channel group must be used. Although L- poles are connected internally to L- on the power supply input, it is strictly recommended to connect the L- reference poles only to their corresponding output group. EMC testing was performed in this manner.

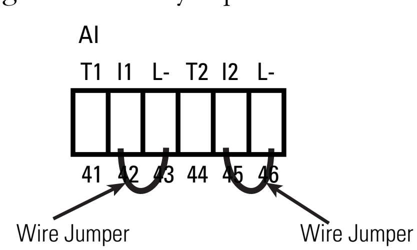
TIP	Inductive loads can be connected without a protection diode on the load, because there is a protection diode located within the GuardPLC device. However, Rockwell Automation strongly recommends that a protection diode be fitted directly to the load to suppress any interference voltage. A 1N4004 diode is recommended.

Safety-related Analog Inputs

GuardPLC 1800 controller analog inputs provide for the unipolar measurement of voltages from 0…10V, referenced to L-. A 10 KΩ shunt is used for single-ended voltage signals. With a 500 Ω shunt resistor, currents from 0…20 mA can also be measured.

Analog cabling should be no more than 300 m (984 ft) in length. Use shielded, twisted-pair cables, with the shields connected at one end, for each measurement input. See the instructions for connecting shielded cabling to the shield-contact plate on page 48.

Unused analog inputs must be short-circuited. Place wire jumpers to ground on any inputs that are not used.



High-speed Counters

The GuardPLC 1200 and 1800 controllers feature inputs for high-speed counting up to a maximum of 100 kHz. These counters are 24-bit, and are configurable for either 5V or 24V DC. The counters can be used as a counter or as a decoder for 3-bit Gray Code inputs. As a counter, input A is the counter input, input B is the counter direction input, and input Z is used for a reset.

The counter inputs must be connected by using shielded, twisted-pair cables for each measurement input. The shields must be connected at both ends. The input lines should be no more than 500 m (1640 ft) in length. All reference (L-, C-, or I- depending on the controller) connections are interconnected on the module in the form of common reference pole.

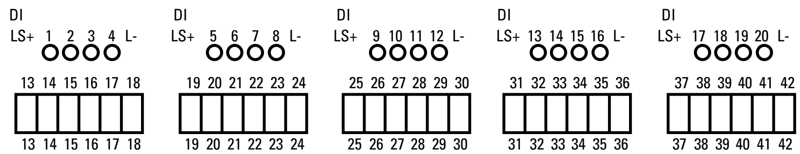
Cables are clipped to the shield contact plate when connecting counter inputs. See the instructions for connecting shielded cabling to the shield contact plate on page 48.

IMPORTANT Do not terminate unused high-speed counter inputs.

Wire the GuardPLC 1600 Controller

Input and output terminal connections for the GuardPLC 1600 controller are described below.

Safety-related Digital Input Terminals



Digital inputs are connected to these terminals.

Terminal Number	Designation	Function
13	LS+	Sensor supply for inputs 1…4
14	1	Digital input 1
15	2	Digital input 2
16	3	Digital input 3
17	4	Digital input 4
18	L-	Reference pole
19	LS+	Sensor supply for inputs 5…8
20	5	Digital input 5
21	6	Digital input 6
22	7	Digital input 7
23	8	Digital input 8
24	L-	Reference pole
25	LS+	Sensor supply for inputs 9…12
26	9	Digital input 9
27	10	Digital input 10
28	11	Digital input 11
29	12	Digital input 12
30	L-	Reference pole
31	LS+	Sensor supply for inputs 13 …16
32	13	Digital input13
33	14	Digital input 14
34	15	Digital input 15
35	16	Digital input 16
36	L-	Reference pole
37	LS+	Sensor supply for inputs 17…20
38	17	Digital input 17
39	18	Digital input 18
40	19	Digital input 19
41	20	Digital input 20
42	L-	Reference pole

Safety-related Digital Output Terminals

Digital outputs are connected to these terminals.

Terminal Number	Designation	Function	Current
1	L-	Reference pole	—
2	1	Digital output 1	0.5 A
3	2	Digital output 2	0.5 A
4	3	Digital output 3	0.5 A
5	4	Digital output 4 (for increased load)	2.0 A
6	L-	Reference pole	—
7	L-	Reference pole	—
8	5	Digital output 5	0.5 A
9	6	Digital output 6	0.5 A
10	7	Digital output 7	0.5 A
11	8	Digital output 8 (for increased load)	2.0 A
12	L-	Reference pole	—

Wire the GuardPLC 1800 Controller

The controller has 24 digital inputs whose status is indicated via status indicators when in Run mode. The digital inputs are actually analog inputs that provide the program with UINT values of 0…30V (0…3000), which are used to create limit values to calculate signals for the digital inputs. Default settings are:

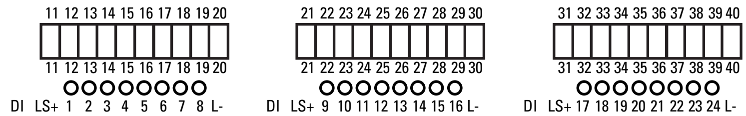
- <7V = 0 signal.
- >13V = 1 signal.

The limit values are set by using system variables. See page 328 for more information on configuring these inputs.

TIP	Because digital inputs are actually analog values, the .USED variable must be set HI in the output signal connections dialog box to activate the digital input.

The 24 digital inputs of the GuardPLC 18000 controller can be used as analog inputs by reading the DI[xx].Value Analog input signal. However, because these inputs are intended to be used as digital inputs, the accuracy of their analog values is not guaranteed to the be same as the published accuracy of the 8 actual analog inputs in the GuardPLC 1800 controller.

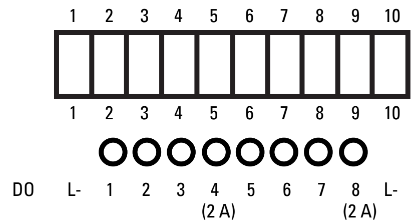
Safety-related Digital Input Terminals



Digital inputs are connected to these terminals.

Terminal Number	Designation	Function
11	LS+	Sensor supply for inputs 1…8
12	1	Digital input 1
13	2	Digital input 2
14	3	Digital input 3
15	4	Digital input 4
16	5	Digital input 5
17	6	Digital input 6
18	7	Digital input 7
19	8	Digital input 8
20	L-	reference pole
21	LS+	Sensor supply for inputs 9…16
22	9	Digital input 9
23	10	Digital input 10
24	11	Digital input 11
25	12	Digital input 12
26	13	Digital input 13
27	14	Digital input 14
28	15	Digital input 15
29	16	Digital input 16
30	L-	Reference pole
31	LS+	Sensor supply for inputs 17…24
32	17	Digital input 17
33	18	Digital input 18
34	19	Digital input 19
35	20	Digital input 20
36	21	Digital input 21
37	22	Digital input 22
38	23	Digital input 23
39	24	Digital input 24
40	L-	Reference pole

Safety-related Digital Output Terminals



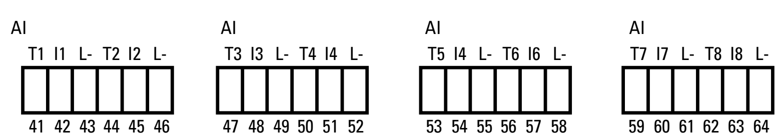
Digital outputs are connected to these terminals.

Terminal Number	Designation	Function	Current
1	L-	Reference pole	—
2	1	Digital output 1	0.5 A
3	2	Digital output 2	0.5 A
4	3	Digital output 3	0.5 A
5	4	Digital output 4 (for increased load)	2.0 A
6	5	Digital output 5	0.5 A
7	6	Digital output 6	0.5 A
8	7	Digital output 7	0.5 A
9	8	Digital output 8 (for increased load)	2.0 A
10	L-	Reference pole	—

Safety-related Analog Input Terminals

The GuardPLC 1800 controller features 8 single-ended analog inputs. Differential analog inputs cannot be used on the GuardPLC 1800 controller. Two- or four-wire transmitters can be used. These devices can be powered from the transmitter supply terminal of the GuardPLC 1800 controller or from an external power supply. See Appendix C for example wiring diagrams.

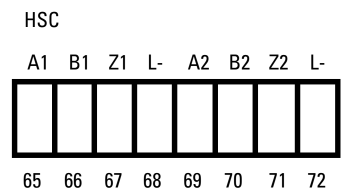
IMPORTANT Unused analog inputs must be short-circuited. See page 51.



The analog inputs are connected to these terminals.

Terminal Number	Designation	Function
41	T1	Transmitter supply 1
42	I1	Analog input 1
43	L-	Reference pole
44	T2	Transmitter supply 2
45	I2	Analog input 2
46	L-	Reference pole
47	T3	Transmitter supply 3
48	I3	Analog input 3
49	L-	Reference pole
50	T4	Transmitter supply 4
51	I4	Analog input 4
52	L-	Reference pole
53	T5	Transmitter supply 5
54	I5	Analog input 5
55	L-	Reference pole
56	T6	Transmitter supply 6
57	I6	Analog input 6
58	L-	Reference pole
59	T7	Transmitter supply 7
60	I7	Analog input 7
61	L-	Reference pole
62	T8	Transmitter supply 8
63	I8	Analog input 8
64	L-	Reference pole

Safety-related High-speed Counter Terminals



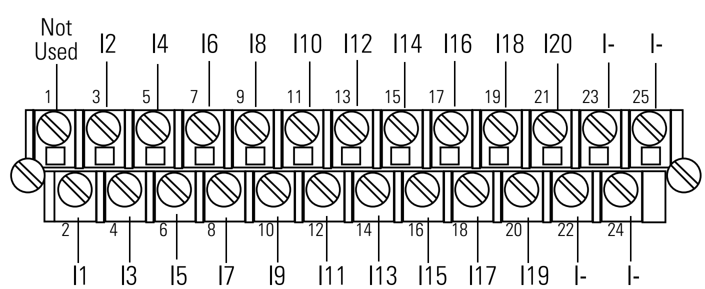
Counters are connected to these terminals.

Terminal Number	Designation	Counter Function	Gray Code Function
65	A1	Input A1	bit 0 (LSB)
66	B1	Input B1	bit 1
67	Z1	Input Z1	bit 2 (MSB)
68	L-	Common reference pole	
69	A2	Input A2	bit 0 (LSB)
70	B2	Input B2	bit 1
71	Z2	Input Z2	bit 2 (MSB)
72	L-	Common reference pole	

Wire the GuardPLC 1200 Controller

The GuardPLC 1200 controller has no LS+ terminal for a safety input voltage source. Use the L+ supply terminal as the source for safety input voltage. The four reference terminals, labeled I-, should be used for the safety input voltage reference. This is a common reference for all 20 inputs.

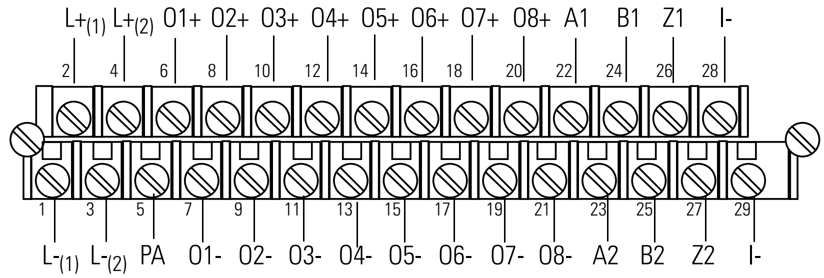
Lower Terminal Block



Terminal Number	Designation	Function
1	Not Used	None
2	I1	Digital input 1
3	I2	Digital input 2
4	I3	Digital input 3
5	I4	Digital input 4
6	I5	Digital input 5
7	I6	Digital input 6
8	I7	Digital input 7
9	I8	Digital input 8
10	I9	Digital input 9
11	I10	Digital input 10
12	I11	Digital input 11
13	I12	Digital input 12
14	I13	Digital input 13
15	I14	Digital input 14
16	I15	Digital input 15
17	I16	Digital input 16
18	I17	Digital input 17
19	I18	Digital input 18
20	I19	Digital input 19
21	I20	Digital input 20
22	I-	Reference pole
23	I-	Reference pole
24	I-	Reference pole
25	I-	Reference pole

Upper Terminal Block

All eight of the digital output zero-voltage reference terminals are common. Unlike the GuardPLC 1600 and GuardPLC 1800 controllers or distributed I/O, which have an earth ground screw, the GuardPLC 1200 controller's earth ground should be wired to the PA terminal, marked ⏚ .



Terminal Number	Designation	Function
1	L-	24V DC return path
2	L+	24V DC power input
3	L-	24V DC return path
4	L+	24V DC power input
5	PA	Functional ground
6	O1+	Digital output 1
7	O1-	Voltage reference for digital output 1
8	O2+	Digital output 2
9	O2-	Voltage reference for digital output 2
10	O3+	Digital output 3
11	O3-	Voltage reference for digital output 3
12	O4+	Digital output 4
13	O4-	Voltage reference for digital output 4
14	O5+	Digital output 5
15	O5-	Voltage reference for digital output 5
16	O6+	Digital output 6
17	O6-	Voltage reference for digital output 6
18	O7+	Digital output 7
19	O7-	Voltage reference for digital output 7
20	O8+	Digital output 8
21	O8-	Voltage reference for digital output 8
22	A1	Universal signal input for counter 1
23	A2	Universal signal input for counter 2
24	B1	Signal input for counting direction for counter 1
25	B2	Signal input for counting direction for counter 2
26	Z1	Reset for counter 1
27	Z2	Reset for counter 2
28	I-	Signal ground for counters 1 and 2
29	I-	Signal ground for counters 1 and 2

Wire the GuardPLC 2000 Controller and I/O

Introduction

Safety-related Digital Inputs

The status of digital inputs is indicated via status indicators when the controller or module is in Run mode.

Follow the closed-circuit principle for external wiring when connecting sensors. To create a safe state in the event of a fault, the input signals revert to the de-energized state (0). The external line is not monitored, but a wire break is interpreted as a safe (0) signal.

Input devices with their own dedicated power supply can also be connected instead of contacts. The reference pole (L-) of the power supply must then be connected to the reference pole of the input (L-). See the wiring diagrams in Appendix C for examples.

In general, the LS+ terminals, not L+ on the power supply connection, should be used to supply voltage for safety inputs. Each LS+ features individual short-circuit and EMC protection. Due to current limitations, use LS+ for only the safety inputs on the same terminal plug.

An EN 61000-4.5 surge impulse can be read as a short-duration HI signal in some modules. To avoid an error, either:

- install shielded input lines to prevent effects of surges in the system.
- implement software filtering in the user program. A signal must be present for at least two cycles before it is evaluated.

Safety-related Digital Outputs

The status of digital outputs is indicated via status indicators when the controller or module is in Run mode.

GuardPLC 2000 controller outputs are rated at 2 A per point, but the total load of all 16 outputs on a single module must not exceed 8 A.

If an overload occurs, the affected outputs are turned off. When the overload is eliminated, the outputs are under the control of the controller and are energized based on the user program code.

An output is in the safe state when it is de-energized. Therefore, outputs are switched off when a fault that affects the safe control of those outputs occurs.

For connection of a load, the reference pole L- of the corresponding channel group must be used. Although L- poles are connected internally to L- on the power supply input, it is strictly recommended to connect the L- reference poles only to their corresponding output group. EMC testing was performed in this manner.

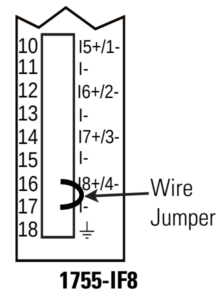
TIP	Inductive loads can be connected without a protection diode on the load, because there is a protection diode located within the GuardPLC device. However, Rockwell Automation strongly recommends that a protection diode be fitted directly to the load to suppress any interference voltage. A 1N4004 diode is recommended.

Safety-Related Analog Inputs (1755-IF8)

GuardPLC analog inputs provide for the unipolar measurement of voltages from 0…10V, referenced to L-. A 10 kΩ shunt is used for single-ended voltage signals. With a 500 Ω shunt resistor, currents from 0…20 mA can also be measured.

The feeder lines should be no more than 300 m (984 ft.) in length. Use shielded, twisted-pair cables, with the shields connected at one end, for each measurement input. See the instructions for connecting shielded cabling to the shield contact plate on page 48.

Unused analog inputs must be short-circuited. Place wire jumpers to ground on any inputs that are not used.



High-speed Counter Module (1755-HSC)

The 1755-HSC module features inputs for high-speed counting up to 1 MHz. These counters are 24-bit, and are configurable for either 5V or 24V DC. The counters can be used as a counter or as a decoder for 3-bit Gray Code inputs. As a counter, input A is the counter input, input B is the counter direction input, and input Z is used for a reset.

The counter inputs must be connected by using shielded, twisted-pair cables for each measurement input. The shields must be connected at both ends. The input lines should be no more than 500 m (1640 ft) in length. All reference (L-, C-, or I- depending on the controller) connections are interconnected on the module in the form of common reference pole.

Cables are clipped to the shield-contact plate when connecting counter inputs. See the instructions for connecting shielded cabling to the shield contact plate on page 48

IMPORTANT	Do not terminate unused high-speed counter inputs.

To be sure that counters are used in a safety-related manner (SIL3 in accordance to IEC 61508), the whole system, including connected sensors and encoders, must satisfy these safety requirements. Refer to the GuardPLC Controllers Safety Reference Manual, publication 1753-RM002, for more detailed information.

Safety-related Analog Output Module (1755-OF8)

The 1755-OF8 module uses analog outputs to transfer analog values from the user program into outputs ranging from ±10V DC and 0…20 mA. The relationship between the value in the user program and the output value is linear and is displayed in this table.

Logic Value	Output Voltage	Output Current
0	0.00V	0.0 mA
1000	10.00V	20.0 mA
-1000	-10.00V	na

Current Draw

The GuardPLC 2000 controller features several different modules. These modules and their backplane current draw specifications are listed in this table.

Cat. No.	Current Draw at 3.3V DC	Current Draw at 24V DC
1755-IB24XO16	0.3 A	0.5 A
1755-IF8	0.15 A	0.4 A
1755-OF8	0.15 A	0.4 A
1755-HSC	0.8 A	0.1 A
1755-L1	1.5 A	1.0 A

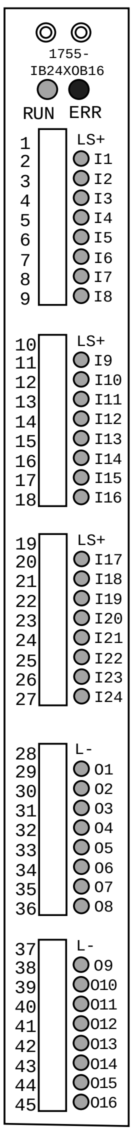
TIP The GuardPLC 2000 controller can draw up to 30 A. The majority of this 30 A is used to source inputs and outputs. Only 1 A is required to operate the CPU module.

Connect the power supply, 1755-PB720, to the 24V DC supply voltage. Refer to the GuardPLC 2000 Power Supply Installation Instructions, publication 1755-IN007, for detailed instructions.

Wire the 1755-IB24XOB16 Digital I/O Module

This module is a combination I/O module featuring 24 safety-related digital inputs and 16 safety-related digital outputs.

- Inputs: The sockets with pins 2…9, 11…18, and 20…27 provide the 24 digital inputs I1…I24. Pins 1, 10, and 19 are the common positive poles (LS+). Each group of 8 inputs has current limits of 100 mA.
- Outputs: The sockets with pins 29…36 and 38…45 provide the 16 digital outputs O1…O16. Pins 28 and 37 are the common negative poles (L-) for the output loads.
- Each output channel can be loaded with 2 A, but the total load of all 16 outputs must not exceed 8 A.



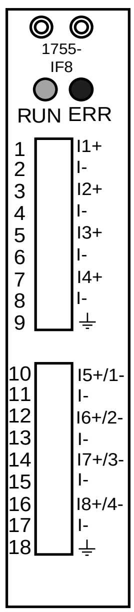
Terminal Number	Designation	Function	Terminal Number	Designation	Function
1	LS+	Digital input supply for inputs 1…8	24	I21	Digital input 21
2	I1	Digital input 1	25	I22	Digital input 22
3	I2	Digital input 2	26	I23	Digital input 23
4	I3	Digital input 3	27	I24	Digital input 24
5	I4	Digital input 4	28	L-	Reference pole for outputs 1…8
6	I5	Digital input 5	29	O1	Digital output 1
7	I6	Digital input 6	30	O2	Digital output 2
8	I7	Digital input 7	31	O3	Digital output 3
9	I8	Digital input 8	32	O4	Digital output 4
10	LS+	Digital input supply for inputs 9…16	33	O5	Digital output 5
11	I9	Digital input 9	34	O6	Digital output 6
12	I10	Digital input 10	35	O7	Digital output 7
13	I11	Digital input 11	36	O8	Digital output 8
14	I12	Digital input 12	37	L-	Reference pole for outputs 9 …16
15	I13	Digital input 13	38	O9	Digital output 9
16	I14	Digital input 14	39	O10	Digital output 10
17	I15	Digital input 15	40	O11	Digital output 11
18	I16	Digital input 16	41	O12	Digital output 12
19	LS+	Digital input supply for inputs 17…24	42	O13	Digital output 13
20	I17	Digital input 17	43	O14	Digital output 14
21	I18	Digital input 18	44	O15	Digital output 15
22	I19	Digital input 19	45	O16	Digital output 16
23	I20	Digital input 20			

Wire the 1755-IF8 Analog Input Module

This module features 8 single-ended analog inputs or 4 differential analog inputs. Two-wire or four-wire transmitters can be used. The devices cannot be powered from the GuardPLC module. An external power supply is required for all analog transmitters. Single-ended transmitters connect between the Ix+ and I- terminals. For example: pins 1 and 2, 3 and 4, 5 and 6. Differential transmitters connect between Ix+ and x- terminals. For example, pins 1 and 10, 3 and 12, 5 and 14.

IMPORTANT Unused channels must be short-circuited. See page 63.

All reference poles (I-) are internally connected.



Terminal Number	Designation	Function
1	I1+	Analog input 1
2	I-	Reference pole for input 1
3	I2+	Analog input 2
4	I-	Reference pole for input 2
5	I3+	Analog input 3
6	I-	Reference pole for input 3
7	I4+	Analog input 4
8	I-	Reference pole for input 4
9	shield connection	signal ground
10	I5+/1-	Analog input 5
11	I-	Reference pole for input 5
12	I6/2-	Analog input 6
13	I-	Reference pole for input 6
14	I7+/3-	Analog input 7
15	I-	Reference pole for input 7
16	I8+/4-	Analog input 8
17	I-	Reference pole for input 8
18	shield connection	signal ground

Wire the 1755-OF8 Analog Output Module

This module features 8 analog outputs. Devices cannot be powered from the 1755-OF8 module. An external power supply is required for all analog output devices.

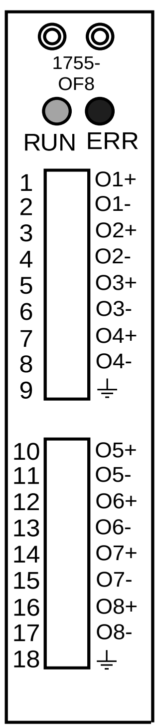
There are 4 reference poles for the 8 outputs. A pair of outputs share a reference pole as shown below.

These outputs	Share these Reference Poles
1 and 2	O1- and O2-
3 and 4	O3- and O4-
5 and 6	O5- and O6-
7 and 8	O7- and O8-

Each group of 2 outputs is electrically isolated from the others.

IMPORTANT If an unused channel is defined as a current output (software configuration set to current output), the output channel has to be short-circuited. Place jumpers into these outputs and tighten the screws.

IMPORTANT If an unused channel is defined as a voltage output (software configuration set to voltage output), the unused outputs must be left open. Short-circuiting a unused voltage output may cause damage to the output.



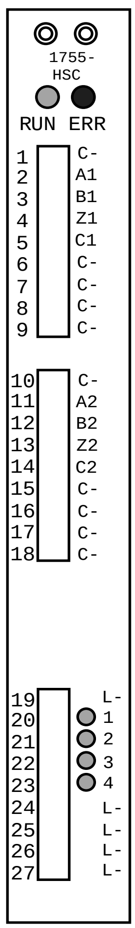
Terminal Number	Designation	Function
1	O1+	Analog output 1
2	O1-	Group 1 reference pole
3	O2+	Analog output 2
4	O2-	Group 1 reference pole
5	O3+	Analog output 3
6	O3-	Group 2 reference pole
7	O4+	Analog output 4
8	O4-	Group 2 reference pole
9	shield connection	signal ground
10	O5+	Analog output 5
11	O5-	Group 3 reference pole
12	O6+	Analog output 6
13	O6-	Group 3 reference pole
14	O7+	Analog output 7
15	O7-	Group 4 reference pole
16	O8+	Analog output 8
17	O8-	Group 4 reference pole
18	shield connection	signal ground

Wire the 1755-HSC Counter Modules

This module contains 2 high-speed counters and 4 digital outputs. Although the 4 digital outputs are located on the 1755-HSC module, they cannot be driven by counter presets. The 4 digital outputs are driven by software, just as on the 1755-IB24XOB16 module.

The nominal current per output is limited to ≤ 0.5 A. Currents > 0.5 A are regarded as overload. The overload is limited to ≤ 11 A per output, or ≤ 2 A if all four outputs are overloaded at the same time. With an overload of 2 A, the output voltage drops to 18V.

All counter common reference poles, C-, share the same path. All digital output common reference poles, L-, share the same path, but are electrically isolated from the C- pins.



Terminal Number	Designation	Function
1	C-	Common reference pole
2	A1	Signal input for counter 1
3	B1	Counting direction input for counter 1
4	Z1	Reset input for counter 1
5	C1	no function
6	C-	Common reference pole
7	C-	Common reference pole
8	C-	Common reference pole
9	C-	Common reference pole
10	C-	Common reference pole
11	A2	Signal input for counter 2
12	B2	Counting direction input for counter 2
13	Z2	Reset input for counter 2
14	C2	no function
15	C-	Common reference pole
16	C-	Common reference pole
17	C-	Common reference pole
18	C-	Common reference pole
19	L-	Reference pole for digital outputs
20	1	Digital output 1
21	2	Digital output 2
22	3	Digital output 3
23	4	Digital output 4
24	L-	Reference pole for digital outputs
25	L-	Reference pole for digital outputs
26	L-	Reference pole for digital outputs
27	L-	Reference pole for digital outputs

Wire 1753-IB16, 1753-OB16, and 1753-IB20XOB8 Modules

Introduction

Safety-related Digital Inputs

The status of digital inputs is indicated via status indicators when the module is in Run mode.

Follow the closed-circuit principle for external wiring when connecting sensors. To create a safe state in the event of a fault, the input signals revert to the de-energized state (0). The external line is not monitored, but a wire break is interpreted as a safe (0) signal.

The GuardPLC 1600 and GuardPLC 1800 controllers provide power to input devices through their LS+ terminals. However, input devices with their own dedicated power supply can also be connected instead of contacts. The reference pole (L-) of the power supply must then be connected to the reference pole (L-) of the appropriate GuardPLC input group. See the wiring diagrams in Appendix C for examples.

In general, the LS+ terminals, not L+ on the power supply connection, should be used to supply voltage for safety inputs. Each LS+ features individual short-circuit and EMC protection. Due to current limitations, use LS+ for only the safety inputs on the same terminal plug.

An EN 61000-4.5 surge impulse can be read as a short-duration HI signal in some modules. To avoid an error, either:

- install shielded input lines to prevent effects of surges in the system.
- implement software filtering in the user program. A signal must be present for at least two cycles before it is evaluated.

Safety-related Digital Outputs

The status of digital outputs is indicated via status indicators when the module is in RUN mode.

GuardPLC outputs are rated to either 0.5 A or 1.0 A at an ambient temperature of 60 °C (140 °F). At an ambient temperature of 50 °C (122 °F), outputs rated at 1.0 A increase to 2.0 A.

If an overload occurs, the affected outputs are turned off. When the overload is eliminated, the outputs are under the control of the controller and are energized based on the user program code.

An output is in the safe state when it is de-energized. Therefore, outputs are switched off when a fault that affects the safe control of those outputs occurs.

For connection of a load, the reference pole L- of the corresponding channel group must be used. Although L- poles are connected internally to L- on the power supply input, it is strictly recommended to connect the L- reference poles only to their corresponding output group. EMC testing was performed in this manner.

TIP Inductive loads can be connected without a protection diode on the load, because there is a protection diode located within the GuardPLC device. However, Rockwell Automation strongly recommends that a protection diode be fitted directly to the load to suppress any interference voltage. A 1N4004 diode is recommended.

Power Supply Connections

ATTENTION Before connecting the power supply, check for correct polarity, value and ripple.

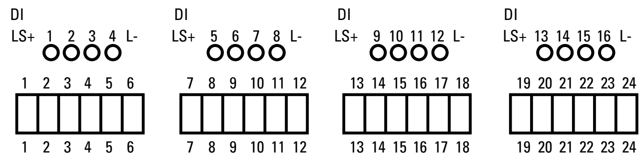
Do not reverse the L+ and L- terminals or damage to the controller will result. There is no reverse polarity protection.

The supply voltage is connected via a 4-pin connector that accommodates wire sizes up to 2.5 mm^2 (14 AWG). You only need to connect one wire to L+ and one wire to L-. Both L+ and L- terminals are internally connected. The other terminal can be used to daisy-chain 24V DC to additional devices. The power supply connector is rated to 10 A.

Wire the 1753-IB16 Input Module

The 1753-IB16 input module features 16 digital inputs and 4 pulse test sources.

Safety-related Digital Inputs



Digital inputs are connected to these terminals.

Terminal Number	Designation	Function
1	LS+	Sensor supply for inputs 1…4
2	1	Digital input 1
3	2	Digital input 2
4	3	Digital input 3
5	4	Digital input 4
6	L-	Reference pole
7	LS+	Sensor supply for inputs 5…8
8	5	Digital input 5
9	6	Digital input 6
10	7	Digital input 7
11	8	Digital input 8
12	L-	Reference pole
13	LS+	Sensor supply for inputs 9…12
14	9	Digital input 9
15	10	Digital input 10
16	11	Digital input 11
17	12	Digital input 12
18	L-	Reference pole
19	LS+	Sensor supply for inputs 13 …16
20	13	Digital input 13
21	14	Digital input 14
22	15	Digital input 15
23	16	Digital input 16
24	L-	Reference pole

Pulse Test Sources

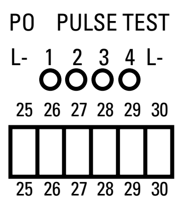
The 1753-IB16 input module is equipped with four pulse test sources that can be software-configured for pulse testing of safety inputs, if required. Due to minimal current capacity, these pulse test sources cannot be used as outputs if they are not configured as pulse test sources.

ATTENTION

Pulse test sources must not be used as safety-related outputs.

For information on configuring pulse test sources for line control, see Chapter 11. See Appendix C for example wiring diagrams.

Pulse test sources are connected to these terminals.



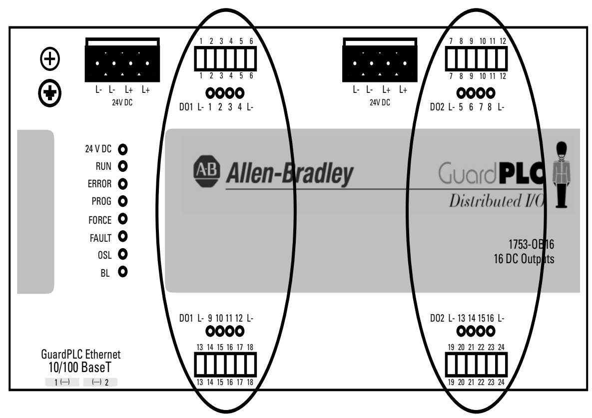
Terminal Number	Designation	Function
25	L-	Reference pole
26	1	Pulse test source 1
27	2	Pulse test source 2
28	3	Pulse test source 3
29	4	Pulse test source 4
30	L-	Reference pole

Wire the 1753-OB16 Output Module

Operating Voltage Considerations

The 1753-OB16 output module has a total current capacity (16 A) higher than the terminal block current limitation (10 A). Therefore, it features two separate operating voltage supply connections if more than 10 A is used by the module. The two output groups are shown below. Each group has a current capacity of 8 A.

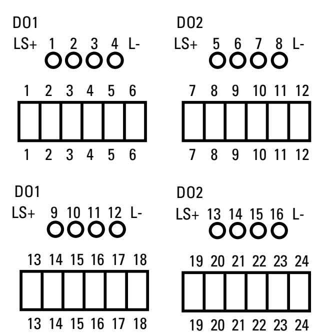
Group 1 **Group 2**



Group	Outputs
1	1, 2, 3, 4, and 9, 10, 11,12
2	5, 6, 7, 8 and 13, 14, 15, 16

Safety-related Digital Outputs

The module has 16 digital outputs (DO1 to DO16) whose status is indicated via status indicators.



Each output is rated for up to 1 A at 60 °C (140 °F) or 2 A at 40 °C (104 °F). However, each group of 8 outputs may not exceed 8 A total. For heat dissipation, intersperse high-current and low-current outputs so that all the high-current outputs are not next to each other.

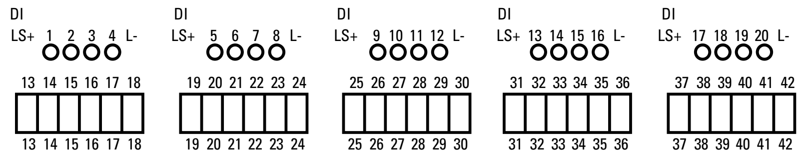
The digital outputs are connected to these terminals.

Terminal Number	Designation	Function
1	L-	Reference pole
2	1	Digital output 1
3	2	Digital output 2
4	3	Digital output 3
5	4	Digital output 4
6	L-	Reference pole
7	L-	Reference pole
8	5	Digital output 5
9	6	Digital output 6
10	7	Digital output 7
11	8	Digital output 8
12	L-	Reference pole
13	L-	Reference pole
14	9	Digital output 9
15	10	Digital output 10
16	11	Digital output 11
17	12	Digital output 12
18	L-	Reference pole
19	L-	Reference pole
20	13	Digital output 13
21	14	Digital output 14
22	15	Digital output 15
23	16	Digital output 16
24	L-	Reference pole

Wire the 1753-IB20XOB8 Combination Module

The remote I/O module features 20 digital inputs and 8 digital outputs whose status is indicate via status indicators.

Safety-related Digital Inputs



The digital inputs are connected to these terminals.

Terminal Number	Designation	Function
13	LS+	Sensor supply for inputs 1…4
14	1	Digital input 1
15	2	Digital input 2
16	3	Digital input 3
17	4	Digital input 4
18	L-	Reference pole
19	LS+	Sensor supply for inputs 5…8
20	5	Digital input 5
21	6	Digital input 6
22	7	Digital input 7
23	8	Digital input 8
24	L-	Reference pole
25	LS+	Sensor supply for inputs 9…12
26	9	Digital input 9
27	10	Digital input 10
28	11	Digital input 11
29	12	Digital input 12
30	L-	Reference pole
31	LS+	Sensor supply for inputs 13…16
32	13	Digital input 13
33	14	Digital input 14
34	15	Digital input 15
35	16	Digital input 16
36	L-	Reference pole
37	LS+	Sensor supply for inputs 17…20
38	17	Digital input 17
39	18	Digital input 18
40	19	Digital input 19
41	20	Digital input 20
42	L-	Reference pole

Safety-related Digital Outputs

The digital outputs are connected to these terminals.

Terminal Number	Designation	Function	Current
1	L-	Reference pole	—
2	1	Digital output 1	0.5 A
3	2	Digital output 2	0.5 A
4	3	Digital output 3	0.5 A
5	4	Digital output 4 (for increased load)	2.0 A
6	L-	Reference pole	—
7	L-	Reference pole	—
8	5	Digital output 5	0.5 A
9	6	Digital output 6	0.5 A
10	7	Digital output 7	0.5 A
11	8	Digital output 8 (for increased load)	2.0 A
12	L-	Reference pole	—

Wire and Configure the 1753-IB8XOB8 Module

Introduction

The module features 8 digital inputs, 8 positive-switching digital outputs, 2 negative-switching digital outputs, and 2 pulsed outputs.

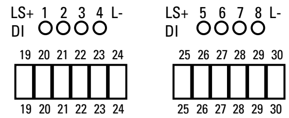
Safety-related Digital Inputs

The status of the module's 8 digital inputs is indicated via status indicators when the controller or module is in Run mode.

LS+ is a voltage source that provides 24V DC for a group of four inputs. There are two groups on the module. If devices require 24V DC to operate and use the same power source as the GuardPLC module, wire the outputs of the device directly to inputs on the GuardPLC module. Devices with their own dedicated power supply can also be connected instead of contacts. Connect the reference pole of the signal source to the L- reference pole of the input. See the wiring diagrams in Appendix C for examples.

Follow the closed-circuit principle for external wiring when connecting sensors. To create a safety state in the event of a fault, the input signals revert to the de-energized state (0). The external line is not monitored, but a wire break is interpreted as a safe (0) signal.

Terminal Connections



See the wire size and terminal torques specifications on page 290. Digital inputs are connected to these terminals.

Terminal Number	Designation	Function
19	LS+	Sensor supply for inputs 1… 4
20	1	Digital input 1
21	2	Digital input 2
22	3	Digital input 3
23	4	Digital input 4
24	L-	Reference pole
25	LS+	Sensor supply for inputs 5 …8
26	5	Digital input 5
27	6	Digital input 6
28	7	Digital input 7
29	8	Digital input 8
30	L-	Reference pole

Surge on Digital Inputs

An EN 61000-4.5 surge impulse can be read as a short-duration HI signal in some modules. To avoid an error, either:

- install shielded input lines to prevent effects of surges in the system.
- implement software filtering in the user program. A signal must be present for at least two cycles before it is evaluated.

Safety-related Digital Outputs

The module has 8 positive-switching digital outputs that switch +24V DC and two negative-switching digital outputs that switch 24V COM. Their status is indicated via status indicators.

The positive and negative-switching digital outputs can be connected in a one-pole or two-pole manner.

If configured for one-pole operation, use the reference pole L- for the positive-switching outputs and reference pole S+ for the negative-switching outputs. The total output current of the module is limited to 8 A and is generated from the 24V of the system.

If configured for two-pole operation, the positive-switching output DO4 operates with the negative-switching output DO4- and the positive-switching output DO8 operates with the negative-switching output DO8-. Line control is carried out for detection of an external short-circuit between positive and negative-switching outputs. A switch-on delay is necessary for inductive or capacitive load or lamp load because the inrush of these loads may be mistakenly detected as a short-circuit. This delay is set in the RSLogix Guard PLUS! Hardware Management via the **Switch-o n delay** signal at the negative-switching output variables. The delay can be set from 0…30 ms, in 1 ms increments. An external line break will not be detected.

An output is in a safety state when it is de-energized. When a fault occurs, all outputs are switched off.

Outputs 1…3 and 5…7 can have a load of 0.5 A. Outputs 4 and 8 can each have a load of 1 A at the maximum ambient temperature 60 °C (140 °F), 2 A at an ambient temperature of 40 °C (104 °F).

The negative-switching outputs DO4- and DO8- can supply up to 1 A at the maximum ambient temperature of 60 °C (140 ° F), 2 A at an ambient temperature of 40 °C (104 °F).

With an overload, one or all of the outputs are turned off. When the overload is eliminated, the outputs are activated again.

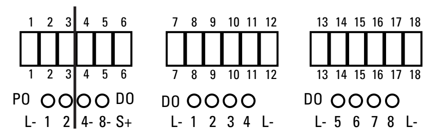
Signals for Output Configuration

Set up these signals for 1753-IB8XOB8 modules by using the Outputs tab of the digital outputs Signal Connections dialog box in RSLogix Guard PLUS! software.

L+ Switching	L-Switching	Description	Notes
DO1[xx].Value (outputs 1 to 8)	DO2[xx].Value (outputs 4- and 8-)	Output value for digital output channels	1 = output is set 0 = output is not set; no current
—	DO2[xx].2-pole	Configures the channel for 2-pole operation	1 = channel DO2[01] (4-) is used for 2-pole operation with channel DO1[04] or channel DO2[02] (8-)is used for 2-pole operation with channel DO1[08] 0 = channel DO2[xx] is not used for 2-pole operation.
—	Switch-on delay	Sets switch-on delay for 2-pole tests, due to lamp load, inductive and capacitive load	

See Appendix B for a complete list of 1753-IB8XOB8 variables.

Terminal Connections

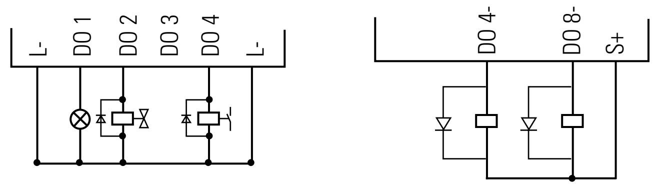


See the wire size and terminal torques specifications on page 290. Digital outputs are connected to these terminals.

Terminal Number	Designation	Function
4	4-	Negative switching digital output 4 (for increased load or bi-polar output)
5	8-	Negative switching digital output 8 (for increased load or bi-polar output)
6	S+	Reference pole for negative switching outputs (short-circuit protection)
7	L-	Reference pole for positive-switching outputs
8	1	Digital output 1
9	2	Digital output 2
10	3	Digital output 3
11	4	Digital output 4 (for increased load or bi-polar output)
12	L-	Reference pole for positive-switching outputs
13	L-	Reference pole for positive-switching outputs
14	5	Digital output 5
15	6	Digital output 6
16	7	Digital output 7
17	8	Digital output 8 (for increased load or bi-polar output)
18	L-	Reference pole for positive-switching outputs

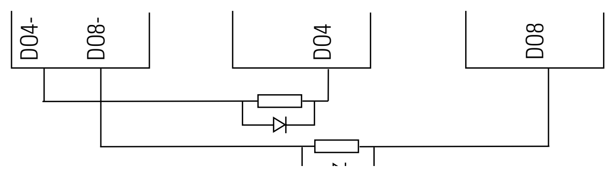
For connection of a load, the reference pole L- of the channel group must be used. Although L- at terminals 7 and 12 and at terminals 13 and 18 are connected internally to L- on the power supply input, it is strictly recommended to use 7 and 12 for outputs 1…4 only and 13 and 18 for outputs 5…8 only. EMC testing was performed in this manner.

1-pole Connection Examples



TIP	Inductive loads can be connected without a protection diode on the load. However, Rockwell Automation strongly recommends that a protection diode be fitted directly to the load to suppress any interference voltage.

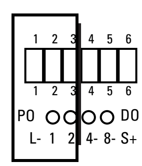
2-pole Connection Example



Pulse Test Sources

There are two digital pulse test sources (PO) used for line control monitoring of digital inputs. For information on configuring pulse test sources for line control, see Chapter 11.

Pulse test sources are connected to these terminals.



Terminal Number	Designation	Function
1	L-	Reference pole
2	1	Pulsed output 1
3	2	Pulsed output 2

ATTENTION	Pulse test sources must not be used as safety-related outputs.

Notes:

Wire and Configure the 1753-IB16XOB8 Module

Introduction

The module features 16 digital inputs, 8 two-pole (8 positive-switching and 8 negative-switching) digital outputs, and 2 pulsed outputs.

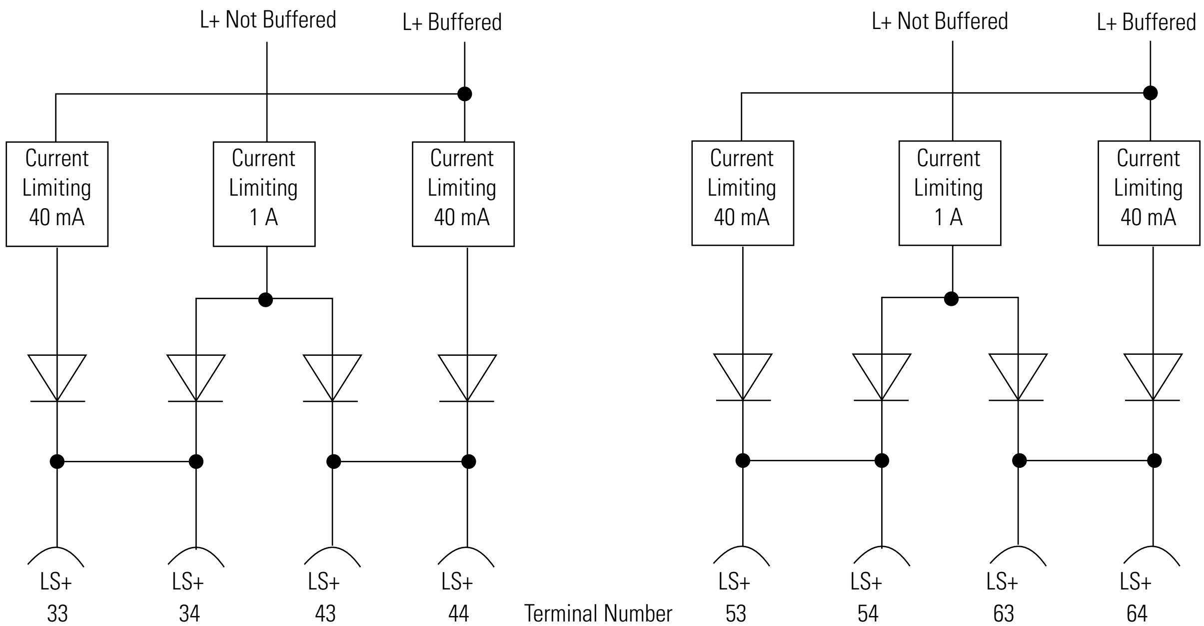
Safety-related Digital Inputs

The status of digital inputs is indicated via status indicators when the module is in Run mode.

LS+ is a voltage source that provides 24V DC for a group of four inputs. There are four groups on the module. If devices require 24V DC to operate and use the same power source as the GuardPLC module, wire the outputs of the device directly to inputs on the GuardPLC module. Devices with their own dedicated power supply can also be connected instead of contacts. Connect the reference pole of the signal source to the L- reference pole of the input. See the wiring diagrams in Appendix C for examples.

The safety state of an input is indicated by a 0 signal being passed to the user program logic. If the test routines detect a fault in the digital inputs, a 0-signal is processed in the user program for the defective channel. When a fault occurs, the inputs are switched off (0) and the fault status indicator is activated.

The sensor supplies, LS+, supply a default current of 40 mA that is buffered for 20 ms in case of a power failure. If a higher current is needed, two unbuffered supplies of 1 A can be switched on by using the **DI Supply [xx]** system signal in the application program. This supply feeds the neighboring input channel group. The status of this supply is read and the supply is switched off if an overcurrent condition occurs. This supply is protected by a current limiting device.

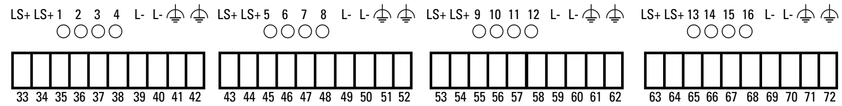


Follow the closed-circuit principle for external wiring when connecting sensors. To create a safe state in the event of a fault, the input signals revert to the de-energized state (0). Although the external line is not monitored, a wire break is interpreted as a safe 0-signal. Unused inputs must not be terminated.

An EN 61000-4.5 surge impulse can be read as a short-duration HI signal in some modules. To avoid an error, either:

- install shielded input lines to prevent effects of surges in the system.
- implement software filtering in the user program. A signal must be present for at least two cycles before it is evaluated.

Terminal Connections



See the wire size and terminal torques specifications on page 290. Digital inputs are connected to these terminals.

Terminal Number	Designation	Function
33	LS+	Sensor supply for inputs 1… 4 40 mA buffered/1 A unbuffered
34	LS+	Sensor supply for inputs 1…4 40 mA buffered/1 A unbuffered
35	1	Digital input 1
36	2	Digital input 2
37	3	Digital input 3
38	4	Digital input 4
39	L-	Reference pole
40	L-	Reference pole
41	Ground	Shield
42	Ground	Shield
43	LS+	Sensor supply for inputs 5…8 40 mA buffered/1 A unbuffered
44	LS+	Sensor supply for inputs 5…8 40 mA buffered/1 A unbuffered
45	5	Digital input 5
46	6	Digital input 6
47	7	Digital input 7
48	8	Digital input 8
49	L-	Reference pole
50	L-	Reference pole
51	Ground	Shield
52	Ground	Shield
53	LS+	Sensor supply for inputs 9…12 40 mA buffered/1 A unbuffered
54	LS+	Sensor supply for inputs 9…12 40 mA buffered/1 A unbuffered
55	9	Digital input 9
56	10	Digital input 10
57	11	Digital input 11
58	12	Digital input 12
59	L-	Reference pole
60	L-	Reference pole
61	Ground	Shield
62	Ground	Shield

Terminal Number	Designation	Function
63	LS+	Sensor supply for inputs 13…16 40 mA buffered/1 A unbuffered
64	LS+	Sensor supply for inputs 13…16 40 mA buffered/1 A unbuffered
65	13	Digital input 13
66	14	Digital input 14
67	15	Digital input 15
68	16	Digital input 16
69	L-	Reference pole
70	L-	Reference pole
71	Ground	Shield
72	Ground	Shield

Safety-related Digital Outputs

The module has 8 digital output pairs, each with a positive- and negative-switching output. The digital outputs are not electrically isolated.

An output is in the safe state when it is de-energized. Therefore, outputs are switched off when a fault that affects the safety control of those outputs occurs.

If an overload occurs, the affected output is switched off. If the total current exceeds 9 A, all eight outputs are switched off. When the overload is eliminated, the outputs are activated again according to their current software-driven state.

Configuration

The digital outputs can be configured three ways.

- 1-pole switch (no line monitoring)
- 2-pole switch (with or without line monitoring)
- 3-pole switch (2-pole with common reference)

1-Pole Connection

For 1-pole applications, all 8 positive-switching and all 8 negative-switching outputs are available, for a total of 16 outputs. If you are using a positive-switching output, connect the other side of the output to S-. If you are using a negative-switching output, connect the other side of the output to S+.

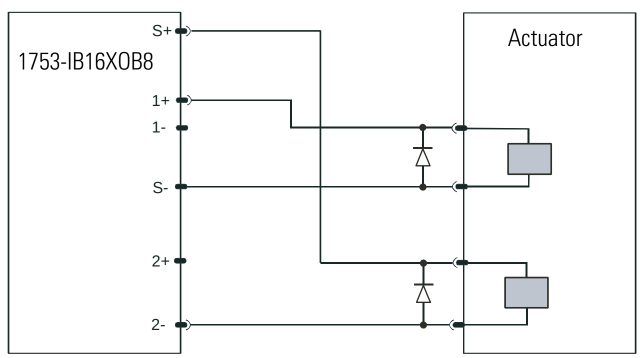
Line monitoring with a 1-pole connection is not possible.

ATTENTION

You must not connect the positive-switching output directly to an external L- load or connect the negative-switching output directly to an external L+ load. You must use the S+ and S- terminals.

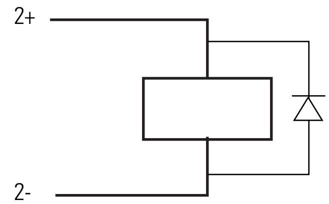
For 1-pole connections, inductive loads can be connected without a protection diode on the load, because there is a protection diode located within the GuardPLC module. However, Rockwell Automation strongly recommends that a protection diode be fitted directly to the load to suppress any interference voltage. A 1N4004 diode is recommended.

1-pole Configuration



2-Pole Connection

If the outputs are configured for 2-pole operation, 8 outputs are available. Each of the 8 outputs switch both L+ and L-. 2-pole outputs (without line monitoring) are wired to both the positive-switch and negative-switch of a single channel, 2+ and 2- for example.

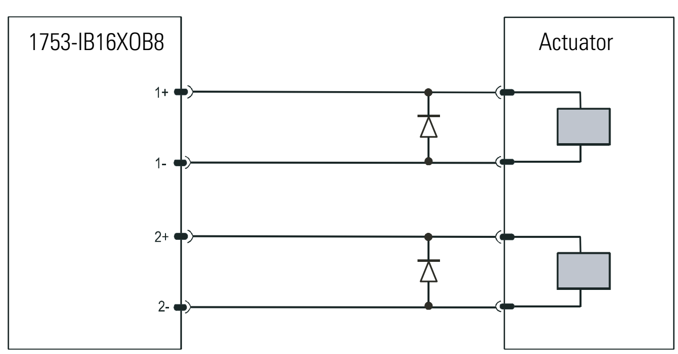


IMPORTANT	The corresponding channels for 2-pole connections must be configured for 2-pole operation by using the system variable DO[xx].2-pole. See Appendix B for more information on system variables.

ATTENTION	The positive-switching output must be wired to an output along with the corresponding negative-switching output of the same channel. Negative- or positive-switching outputs must not span different channels unless they are connected in pairs (see 3-pole Connection With Line Monitoring on page 89).

ATTENTION	Inductive loads must be connected with a protection diode on the load in 2-pole operation.

2-pole Configuration



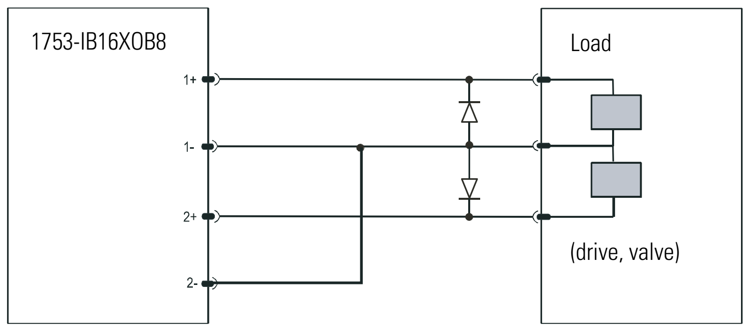
3-pole Connection With Line Monitoring

Two 2-pole channels can support dual-channel devices with only a single reference connection. If line monitoring is required, the channels must be configured in pairs, using the system parameter DO[xx][xx].in pairs. There are four pairs allowed: channels 1 and 2, channels 3 and 4, channels 5 and 6, and channels 7 and 8.

Line monitoring is accomplished by switching off one channel while the second channel is tested for wiring faults.

A detected line fault is reported by the module's error codes. See Appendix B for error code information.

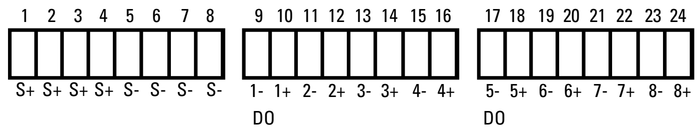
3-pole Configuration



IMPORTANT	Inductive loads must be connected with a protection diode on the load for 3-pole connections.

Terminal Connections

See the wire size and terminal torques specifications on page 290.
Digital outputs are connected to these terminals.



Terminal Number	Designation	Function
1	S+	Reference pole for negative-switching digital outputs
2	S+	Reference pole for negative-switching digital outputs
3	S+	Reference pole for negative-switching digital outputs
4	S+	Reference pole for negative-switching digital outputs
5	S-	Reference pole for positive-switching digital outputs
6	S-	Reference pole for positive-switching digital outputs
7	S-	Reference pole for positive-switching digital outputs
8	S-	Reference pole for positive-switching digital outputs
9	1-	Digital output 1, negative-switching
10	1+	Digital output 1, positive-switching
11	2-	Digital output 2, negative-switching
12	2+	Digital output 2, positive-switching
13	3-	Digital output 3, negative-switching
14	3+	Digital output 3, positive-switching
15	4-	Digital output 4, negative-switching
16	4+	Digital output 4, positive-switching
17	5-	Digital output 5, negative-switching
18	5+	Digital output 5, positive-switching
19	6-	Digital output 6, negative-switching
20	6+	Digital output 6, positive-switching
21	7-	Digital output 7, negative-switching
22	7+	Digital output 7, positive-switching
23	8-	Digital output 8, negative-switching
24	8+	Digital output 8, positive-switching

Monitor for Line Short Line Break

The Line Short Line Break (LSLB) monitoring measures the impedance of a load and allows the modules to detect the following faults, when LSLB monitoring is configured by using the system variable DO[xx].LSLB:

- Short-circuit between DO+ and DO-
- Short-circuit DO+ and external L+
- Short-circuit between DO+ and external L-
- Short-circuit between DO- and external L+
- Short-circuit between DO- and external L-
- Line break between DO+ and DO-

Line monitoring of the digital outputs is possible only when outputs are configured for 2-pole operation and both poles DO[xx]- and DO[xx]+ are wired to a load. A detected line fault is reported in the system signal DO[xx].+Error Code or DO[xx].-Error Code. See Appendix B for information on system signals.

There are two kinds of line monitoring.

- Line monitoring for lamp loads and inductive loads
- Line monitoring for resistive, capacitive loads

For both types, you must configure a period and time for line monitoring by using the system signal variables described on page 93.

Line Monitoring for Lamp and Inductive Loads

For short-circuit detection, a 24V impulse with a duration of 500 µs is switched in the output circuit. Afterwards, a 10V signal is set for the duration of the monitoring time to detect a line break.

To configure this type of line monitoring:

- set a DO.LSLB period and DO.LSLB time.
- set the output DO[xx].2-pole signal to 1 (TRUE).
- set the output DO[xx].LSLB monitoring signal to 1 (TRUE).
- set the output DO[xx].LS monitoring with reduced voltage signal to 0 (FALSE).

See Required Signals for Line Monitoring on page 93.

Line Monitoring with Reduced Voltage for Resistive, Capacitive Loads

For line monitoring, a 10V signal is switched on in the output circuit for the duration of the monitoring time. This kind of line monitoring is designed for resistive or resistive-capacitive loads. There is no short-circuit detection for these types of loads.

To configure this type of line monitoring:

- set a DO.LSLB period and DO.LSLB time.
- set the output DO[xx].2-pole signal to 1 (TRUE).
- set the output DO[xx].LSLB monitoring signal to 1 (TRUE).
- set the output DO[xx].LS monitoring with reduced voltage signal to 1 (TRUE).

See Required Signals for Line Monitoring on page 93.

ATTENTION

During the 10V test to detect a line break, DO+ is at 24V and DO- is at 14V. If DO- is shorted to 0V DC, then there is 24V at the output for the duration of the monitoring time, which could turn on the actuator.

During line monitoring time, a 10V signal is impressed at the load (relay, actuator). This reduced voltage level (10V) of line monitoring, is normally not enough to switch the load.

Period and Monitoring Times

You must set a period and monitoring time for line control. These configured times affect all channels that are set for line monitoring.

During monitoring time, readbacks occur at intervals of 1 ms. If no errors occur, the output is set per the application program.

ATTENTION

The duration of monitoring time adds to the cycle time.

TIP

There are 4 tests during the LSLB test period (DO.LSLBperiod). In principle, this means that there will be a test every 1/4 of the period. So if the period is 1 second, there will be a test every 250 ms. If the LSLB time duration (DO.LSLB time) is 20 ms, there will be 230 ms between 20 ms tests.

Required Signals for Line Monitoring

Line monitoring must be configured by using these system signals for 1753-IB16XOB8 modules on the Outputs tab of the digital outputs Signal Connections dialog box in RSLogix Guard PLUS! software.

Name	Description	Setting
DO.LSLB period	The time between steps in Line Short Line Break (LSLB) monitoring	Values in one second increments from 1…100.
DO.LSLB time	The duration of LSLB monitoring	Values in one millisecond increments from 0…50 ms. The default is 0 ms.
DO[xx].2-pole	Configures the module for 2-pole operation	1 = 2-pole operation. 0 = 1-pole operation.
DO[xx].+Value	Output value for DO channels (DO+)	1-pole (Value: 0 or 1). 2-pole, identical to DO- (Value: 0 or 1).
DO[xx].-Value	Output value for DO channels (DO-)	1-pole (Value: 0 or 1). 2-pole, identical to DO+ (Value: 0 or 1).
DO[xx].LSLB monitoring	Configures line control	1 = set for LSLB (line control) 0 = no LSLB (line control)
DO[xx].LS monitoring with reduced voltage	Configures line control with reduced voltage	1 = reduced signal voltage level 0 = normal signal voltage level
DO[xx][xx].in pairs	Configures line control with channel pairs	Pair 1 = channel 1 [01] and channel 2 [02] Pair 2 = channel 3 [03] and channel 4 [04] Pair 3 = channel 5 [05] and channel 6 [06] Pair 4 = channel 7 [07] and channel 8 [08]

See Appendix B for a complete list of 1753-IB16XOB8 module variables.

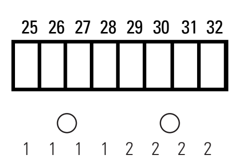
Pulse Test Sources

The two digital pulse test sources (PO) can be used for short-circuit or line break monitoring of digital inputs. For information on configuring pulse test sources for line control, see Chapter 11.

ATTENTION

Pulse test sources must not be used as safety-related outputs.

Each output has four terminals for wiring connections.



Pulse test sources are connected to these terminals.

Terminal Number	Designation	Function
25	1	Pulse test source 1
26	1	Pulse test source 1
27	1	Pulse test source 1
28	1	Pulse test source 1
29	2	Pulse test source 2
30	2	Pulse test source 2
31	2	Pulse test source 2
32	2	Pulse test source 2

All PO1 terminals are internally connected and all PO2 terminals are internally connected. Therefore, all PO1 and all PO2 terminals pulse together.

Wire the 1753-IF8XOF4 Analog I/O Module

Introduction

The 1753-IF8XOF4 module features 8 safety analog inputs and 4 standard analog outputs.

Safety-related Analog Inputs

These input values are available.

Input Channels	Polarity	Current or Voltage	Range	Safety Accuracy
8	unipolar	0…+10V	0…2000	2%
		0…20 mA / 4…20 mA	0…1000(1) 0…2000(2)	

(1) With external 250 Ω shunt.
(2) With external 500 Ω shunt.

Voltage Measurement

If an open-circuit fault occurs during voltage measurement, unpredictable input signals are received on the high resistance inputs. Values resulting from this fluctuating input voltage are not reliable. Because the module does not feature circuit monitoring, you must terminate input channels with a 10 kΩ resistor when measuring voltage. Consider the internal resistance of the source as well.

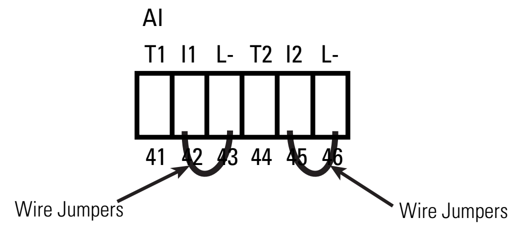
Current Measurement

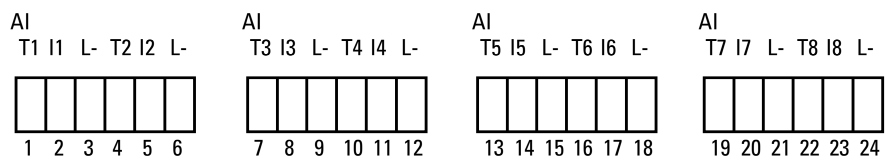
To measure current, connect a 500 Ω external shunt in parallel to the input. Accuracy of the shunt must be included in accuracy calculations of the input signal. Terminating resistors are not required for current measurement with the external shunt connected in parallel.

Terminal Connections

Analog cabling should be no more than 300 m (984 ft) in length and must be shielded, twisted-pair cables for each measurement input. The shields must be connected at one end.

IMPORTANT Short-circuit unused input channels to the reference pole by connecting wire jumpers.





See the wire size and terminal torques specifications on page 292. Analog inputs (AI) are connected to these terminals.

Terminal Number	Designation	Function
1	T1	Sensor supply 1
2	I1	Analog input 1
3	L-	Reference pole input 1
4	T2	Sensor supply 2
5	I2	Analog input 2
6	L-	Reference pole input 2
7	T3	Sensor supply 3
8	I3	Analog input 3
9	L-	Reference pole input 3
10	T4	Sensor supply 4
11	I4	Analog input 4
12	L-	Reference pole input 4
13	T5	Sensor supply 5
14	I5	Analog input 5
15	L-	Reference pole input 5
16	T6	Sensor supply 6
17	I6	Analog input 6
18	L-	Reference pole input 6

Terminal Number	Designation	Function
19	T7	Sensor supply 7
20	I7	Analog input 7
21	L-	Reference pole input 7
22	T8	Sensor supply 8
23	I8	Analog input 8
24	L-	Reference pole input 8

Standard Analog Outputs

The module has 4 analog outputs, which are not safety-rated outputs. However, in the event of an internal error, they can be shut down safely through configuration via the user program.

ATTENTION

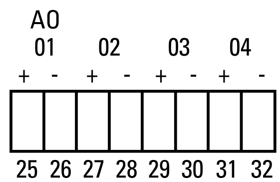
To achieve SIL 3, the output values must be read back via safety analog inputs and evaluated in the RSLogix Guard PLUS! user program. Appropriate reactions to incorrect output values must be applied. Otherwise, they may not be used as safety outputs.

When you are not using the analog outputs, use RSLogix Guard PLUS! programming software to set the 4 analog output (USED) system signals to FALSE. When set to FALSE, no output signals are transmitted when the safety switches are opened. Alternatively, you can set the analog outputs to zero by using the Emergency Off system variable.

These are the analog output resolution options.

Value Range in the Application	Output Current
0	0 mA
2000	20 mA

Terminal Connections



See the wire size and terminal torques specifications on page 292. Analog outputs (AO) are connected to these terminals.

Terminal Number	Designation		Function
25	01	+	Analog output 1
26		-	Reference pole output 1
27	02	+	Analog output 2
28		-	Reference pole output 2
29	03	+	Analog output 3
30		-	Reference pole output 3
31	04	+	Analog output 4
32		-	Reference pole output 4

Wire the 1753-OW8 Relay Output Module

Introduction

Safety-related Relay Outputs

The module has 8 isolated relay outputs whose status is indicated via status indicators.

An output is in a safety state when it is de-energized. When a fault occurs, all outputs are switched off. Errors in one or more channels are indicated by the FAULT status indicator. In addition, the system status can be evaluated in the user program.

If the 1753-OW8 module faults, all 8 outputs are switched off. This is indicated by the FAULT status indicator.

Each output has 2 safety relays with positively guided contacts and one MSR type relay. Internal, non-replaceable fuses are used to limit the switching current of the output contacts to 60% (3.15 A) of the maximum admissible AC switching current. For DC switching, the relay contact circuits must be additionally equipped with an external fuse rated no higher than the maximum admissible DC switching capacity.

Terminal Connections

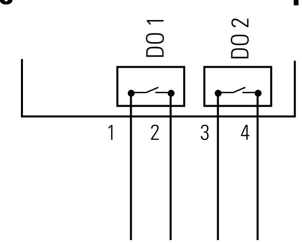
See the wire size and terminal torques specifications on page 294. Relay outputs are connected to these terminals.

Terminal Number	Designation	Relay Output
1	DO1	Contact 1, terminal A
2		Contact 1, terminal B
3	DO2	Contact 2, terminal A
4		Contact 2, terminal B
5	DO3	Contact 3, terminal A
6		Contact 3, terminal B

Terminal Number	Designation	Relay Output
7	DO4	Contact 4, terminal A
8		Contact 4, terminal B
9	DO5	Contact 5, terminal A
10		Contact 5, terminal B
11	DO6	Contact 6, terminal A
12		Contact 6, terminal B
13	DO7	Contact 7, terminal A
14		Contact 7, terminal B
15	DO8	Contact 8, terminal A
16		Contact 8, terminal B

The output contacts are connected in pairs via terminal connectors (numbered terminals). The terminal pins on the front plate of the module have the same numbering sequence to help prevent miswiring.

Example: Connecting Actuators to the Outputs



Voltage Supply Considerations

For the connection of higher voltages (110/220V AC) besides SELV and PELV (24V DC), suitable cables must be used with double or reinforced insulation.

Pulse Testing

Introduction

Pulse testing is a high-frequency diagnostic test that can detect wiring faults on input devices before demand is placed on the safety system. There are two ways to generate a pulse test in the GuardPLC family of products.

- By using Redundant Pulse Test Output (RPTO) and Single Pulse Test Output (SPTO) certified function blocks in the application program
- By using the services built into the GuardPLC 1600 and GuardPLC 2000 controllers' operating systems

This table lists the pulse test methods available for your product.

Controller	RPTO/SPTO Function Blocks	OS Configurable
GuardPLC 1200	yes	no
GuardPLC 1600	yes	yes
GuardPLC 1800	yes	no
GuardPLC 2000	yes	yes

Pulse testing cannot be configured on the GuardPLC 1200 and GuardPLC 1800 controllers, or on the 1753-OB16 output-only module. The GuardPLC 1800 controller is excluded because it features digital inputs that are actually analog inputs with 1-bit resolution.

You can choose between the two methods for pulse testing the GuardPLC 1600 controller and distributed I/O modules (catalog numbers 1753-IB16, 1753-IB8XOB8, 1753-IB16XOB8, and 1753-IB20XOB8) controlled by the GuardPLC 1600 controller. You also have the choice of methods for the GuardPLC 2000 controller and 1755-IB24XOB16 module.

Consider the following when choosing a method of pulse testing:

- The certified function block lets the pulse test source (output) and safety input to be on different physical nodes. The OS configured pulse test assumes that the source and input are local to the same physical controller or I/O module.
- The certified function block has a pulse test fault output that can be used for status inside the user program. The OS configured pulse test has an error code that can be monitored for pulse test status.
- The OS configured pulse test occurs each cycle. The pulse test certified function blocks allow you to configure the pulse test interval.
- The duration of the pulse test is configurable when using the certified function blocks.
- The pulse test can be disabled if necessary when using the certified function blocks.
- The response to RPTO/SPTO pulse test faults is user configurable.

See the Certified Function Block Safety Reference Manual, publication 1753-RM001, for more information on the Single Pulse Test Output (SPTO) and Redundant Pulse Test Output (RPTO) certified function blocks.

Response to OS Configurable Faults

When the following occurs, the faulted inputs are set to 0, a fault code is generated, and the FAULT status indicator is on:

- Short-circuit occurs between two parallel connections.
- Two connections are reversed.
- Earth fault occurs on one of the lines (only with earthed reference pole).
- Line break or opening of the contacts (for example, when one of the E-stop off switches is pressed in the example above), the FAULT status indicator is on and the fault code is generated.

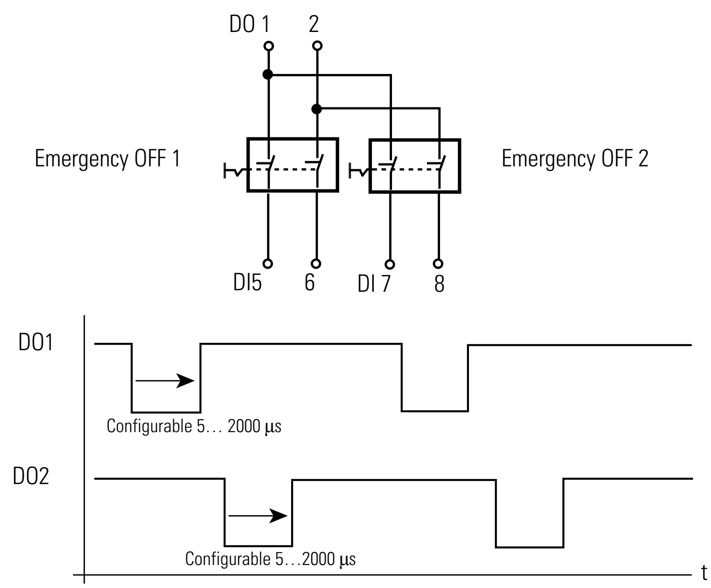
TIP	If multiple errors exist at the same time, the error code is the sum of the individual error codes. See Appendix B for error code information.

Wire for OS Configurable Line Control

GuardPLC 1600 Controller and 1753-IB20XOB8 Module

Up to 8 digital outputs (DO1 to DO8) can be configured as pulsed outputs. The example below shows 2 outputs, configured as pulse test outputs, connected to the digital inputs (DI) of the same system. As a result, the connections to the digital inputs (DI) are monitored.

The pulse outputs must begin at DO[01] and must be sequential. For example, if two pulse outputs are required, they must be DO[01] and DO[02].

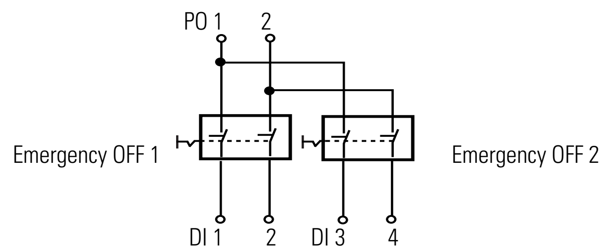


The digital outputs DO1 and DO2 are pulsed (briefly set to low) so that the connections to the digital inputs are monitored. The duration of the test can be configured in the range of 5…2000 µs with a default value of 400 µs.

1753-IB16, 1753-IB8XOB8, and 1753-IB16XOB8 Modules

The 1753-IB16 module has four digital pulse test sources (PO). The 1753-IB8XOB8 and 1753-IB16XOB8 modules have two digital pulse test sources.

The example below shows 2 pulse test sources connected to the digital inputs (DI) of the same system. As a result, the connections to the digital inputs (DI) are monitored..



ATTENTION

Do not use pulsed outputs as safety-related outputs for control of safety-related actuators.

Input Configuration for Pulse Testing

Set up these signals by using the Outputs tab of the digital inputs Signal Connections dialogbox in RSLogix Guard PLUS! software.

Name	Description	Type	Initial Value	Notes
Number of Pulse Channels	Number of pulse outputs being used	USINT	1 to 8	1…4 for 1753-IB16 1…8 for GuardPLC 1600/2000 controllers 1…8 for 1753-IB20XOB8 1…2 for 1753-IB8XOB8 and 1753-IB16XOB8
Pulse Slot	Slot occupied by the module with the pulsed outputs	UDINT	—	2 for GuardPLC 1600 controllers 2 for 1753-IB20XOB8 1 for 1753-IB16 3 for 1753-IB8XOB8 3 for 1753-IB16XOB8 1…6 for GuardPLC 2000 controllers (wherever 1755-IB24XOB16 is located)
Pulse Delay	Pulse delay is both the low pulse width and pulse test duration.	UINT	400 (default)	Values in µs from 5…2000.
Error Code	Error code for each switch	BYTE	N/A	See Appendix B for error code descriptions.
Value	Value for each switch	BOOL		
DI[xx].PulseChannel	Indicates which pulse output is sourcing the input channel	USINT	1 to 8	1…4 for 1753-IB16 1…8 for GuardPLC 1600/2000 controllers 1…8 for 1753-IB20XOB8 1…2 for 1753-IB8XOB8 and 1753-IB16XOB8
DO[xx].Value	Initialization value for the pulse outputs	BOOL	TRUE	Each pulse output must be activated.

Notes:

High-Speed Counters

Introduction

This chapter covers using counters in these systems:

- GuardPLC 1200 controllers
- GuardPLC 1800 controllers
- GuardPLC 2000 controllers using a 1755-HSC module

Counter/Decoder Modes

The counters can be used in these operating modes:

- Counter mode
- Decoder mode

The two counters can be used in different modes at the same time.

Counter Mode

Counter mode is used for counting pulses at speeds up to 1 MHz on the GuardPLC 2000 controllers and 100 kHz on the GuardPLC 1200 and 1800 controllers.

Follow these guidelines when using counters in a GuardPLC system:

- The 5V signal must be between 4.5V and 5.5V, while the 24V signal must be between 13V and 26.4V.
- The steepness of the falling edge must be at least 1V per µs.
- The low and high signal times must be at least 5 µs for the GuardPLC 1200 controller (duty cycle 50% at 100 kHz) and 0.5 µs for the GuardPLC 2000 controller (duty cycle 50% at 1 MHz).
- Shield the cable against noise.

Counter Mode Inputs

Pins	Functions
A1, A2	counting input for pulses (high-signals) with falling edge of the pulses
B1, B2	counting direction input, incrementing the counter with low-signal, decrementing the counter with high-signal
Z1, Z2	resets inputs Resets can be made with a short high-signal. A continuous high-signal blocks the counter. Resets can also be made by the controller program.
C1, C2	has no function (GuardPLC 2000 controller - 1755-HSC only)
C-	GuardPLC 2000 controller common reference pole, all pins have electrical continuity
L-	GuardPLC 1800 controller common reference pole, all pins have electrical continuity
I-	GuardPLC 1200 controller common reference pole, all pins have electrical continuity

Decoder Mode

Decoder mode is used for safety supervising the inputs by Gray code, but in the application, the bit structure is handled as a normal binary code value. To use this value, it must be converted in the application. The counter inputs can be connected to an incremental encoder with 4-bit binary code to recognize rotation and the direction of rotation.

Decoder Mode Inputs

Pins	Functions
A1, A2	bit 1 (LSB)
B1, B2	bit 2
Z1, Z2	bit 3
C1, C2	bit 4 (GuardPLC 2000 controllers only)

Understand Counter Module Configuration

The high-speed counters can be configured for three counting modes: Counter mode with manual direction, Counter mode with direction and reset, and Decoder mode (Gray codes).

Counter Mode/Manual Direction

The simplest mode of operation is pulse counting with manual direction. It can be used, for example, in connection with a light barrier where counting events are to be recorded. The direction of counting is determined by the routine.

The count begins at 0 and is incremented or decremented by 1 at each negative transition of the counting pulse. The resolution of the counter is 24 bits. This results in a value range from 0…16,777,215.

The counting pulse must be bounce free and must not exceed the maximum frequency of 1 MHz for a GuardPLC 2000 controller or 100 kHz for a GuardPLC 1200 or 1800 controller. The counter input can be set to a voltage of 5V or 24V via the software.

To be sure that the counter functions correctly, configure these parameters.

Parameter	Setting
Cnt[0x].5/24V Mode	true for 24V or false for 5V You must configure this parameter with a constant.
Cnt[0x].Auto Advance Sense	(optional according to routine) false to count only up or only down based upon the direction bit
Cnt[0x].Direction	(optional according to routine) true to decrement (counts from 16,777,215 downward) or false to increment
Cnt[0x].Gray Code	(optional according to routine) false
Cnt[0x].Reset	(optional according to routine) true If this parameter is set to false, the counter value is reset to 0.

Counter Mode/Direction and Reset

In pulse counting with direction and reset, the state of input B is evaluated in addition to counter input A.

When the B input has a low signal while the counter recognizes a negative pulse edge at its A input, the value of the counter is incremented by 1. When there is a high signal at the B input, the counter is decremented by 1.

The counter is released or reset via the Z input. The counter is released when there is a constant LOW signal at the Z input. A constant HIGH signal halts the counter and a short-time HIGH signal resets the counter value to 0.

To enable the counter to function correctly, configure these parameters in the routine.

Parameter	Setting
Cnt[0x].5/24V Mode	true for 24V or false for 5V The adjusted level also applies to inputs B and Z. You must configure this parameter with a constant.
Cnt[0x].Auto Advance Sense	true to count up and down simultaneously
Cnt[0x].Direction	true to decrement (counts from 16,777,215 downward) or false to increment (standard setting)
Cnt[0x].Gray Code	false
Cnt[0x].Reset	true If this parameter is set to false, the counter value is reset to 0.

Decoder Mode/Gray Codes

The Gray code is a binary code where the code differs by only one bit with two neighboring numbers. Gray codes are useful in mechanical encoders, because a slight change in location affects only one bit. The controller uses a Gray code (4 bits for a GuardPLC 2000 controller or 3 bits for GuardPLC 1200 and 1800 controllers) that has this structure.

Step	Gray Code (GuardPLC 2000)	Gray Code (GuardPLC 1200, 1600, and 1800)	Cnt[0x].Value
0	0000	000	0
1	0001	001	1
2	0011	011	3
3	0010	010	2
4	0110	110	6
5	0111	111	7
6	0101	101	5
7	0100	100	4
8	1100		12
9	1101		13
10	1111		15
11	1110		14
12	1010		10
13	1011		11
14	1001		9
15	1000		8

Each counter input is fed to three internal counters. When a count is accomplished, the values of the three internal counters are compared, and if the three values differ by more than one bit, the measuring result is rejected and Cnt[0x].State indicates an error.

If the measuring result is valid, the system variable Cnt[0x].Value contains the associated value (see the above table).

To enable the Gray code decoder to work correctly, configure these parameters in the routine.

Parameter	Setting
Cnt[0x].5/24V Mode	true for 24V or false for 5V The adjusted level also applies to inputs B and Z. You must configure this parameter with a constant.
Cnt[0x].Auto Advance Sense	this setting has no function on the gray code (set to false)
Cnt[0x].Direction	this setting has no function on the gray code (set to false)
Cnt[0x].Gray Code	true
Cnt[0x].Reset	this setting has no function on the gray code (set to true)

Controller Configuration and Modes of Operation

Introduction

The GuardPLC operating system is stored permanently in the memory of the controller. The operating system is designed to make sure that all tasks of the controller are performed in a safety-related way.

You have access to the controller via the RSLogix Guard PLUS! software so that you can define the functionality of the controller.

Controller Modes

The controller can operate in various modes. These modes depend on the results of the tests of the hardware, software, and the system configuration.

After you apply power to the controller or restart the controller, the controller first performs a system test of the data and address lines and the flash and RAM memories. Then the controller checks the operating system in the flash memory. During this time, the controller is in the Init mode.

If all these initialization checks are OK, the operating system is started and the controller changes to the Stop mode.

If any hardware or software errors are detected, the controller goes to the Failure_Stop mode. If the check of the operating system detected errors, the emergency loader starts. The emergency loader loads an operating system from the programming terminal.

If the controller has a valid configuration and a routine downloaded to the controller, the controller goes to the Stop mode.

To put the controller in Run mode:

- set the Autostart switch of the both controller and the routine.
- manually choose Run mode from the programming software.

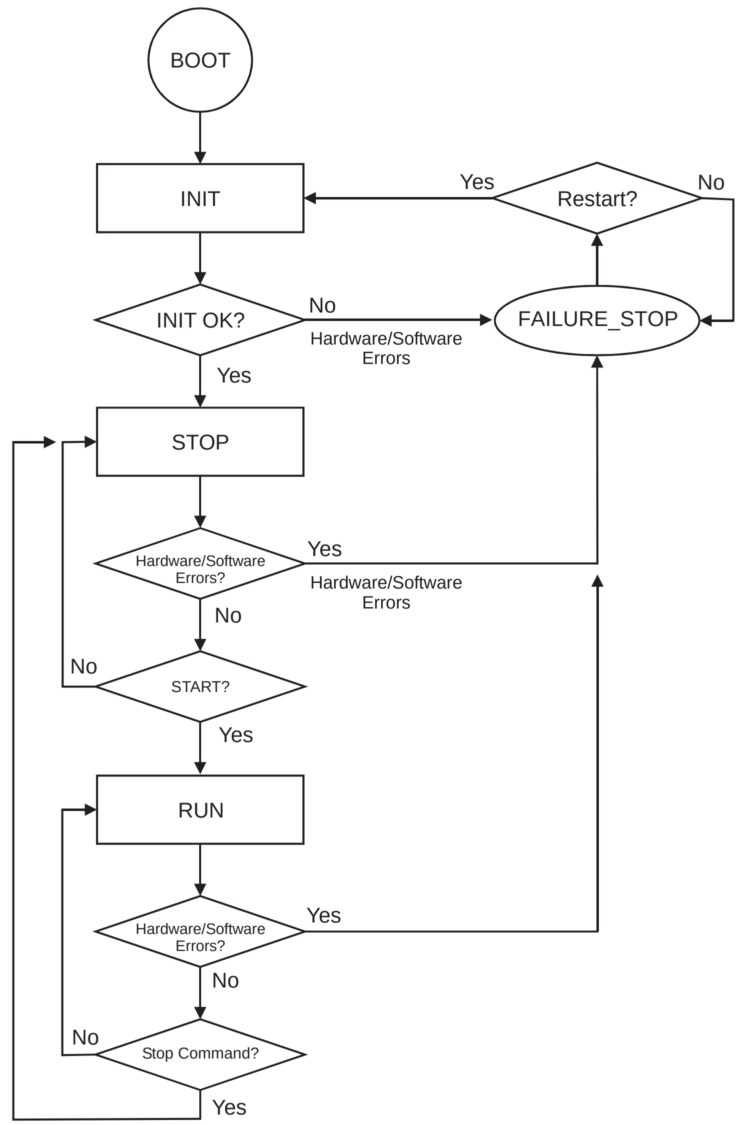
If you stop the controller, it transitions from Run to Stop and interrupts the execution of the routine. The outputs of the routine and the I/O modules are reset to safe values.

You can use the Emergency Stop system variable to put the controller in Stop mode by programming this variable in your logic or forcing it when necessary.

The following table and flowchart summarize the controller modes.

Mode	Description
INIT	Safe state of the controller during initialization and the hardware tests after booting. • The controller is performing hardware and software tests.
STOP	Safe state of the controller without execution of a routine. • A loaded routine is in the Stop mode. • The outputs of the controller have been reset (LOW). • The controller is performing hardware and software tests.
RUN	The CPU is active. • The routine is being executed. • I/O signals are being processed. • The controller performs non-safety-related communication. • The controller performs software tests, hardware tests, and I/O module tests.
FAILURE_STOP	Safe state of the controller after a system fault. • A loaded routine is in Stop or Failure_Stop mode. • The outputs of the controller are being reset (LOW). • The controller is not performing software or hardware tests. • The controller is being held in the safe state. • The hardware watchdog is not triggered. • To recover from Failure_Stop, a restart of the controller is necessary. A restart can be initiated only via RSLogix Guard PLUS! software. See Recover From a Failure_Stop on page 116.

Controller Modes

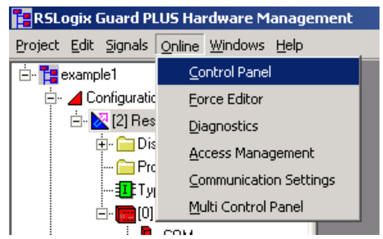


Recover From a Failure_Stop

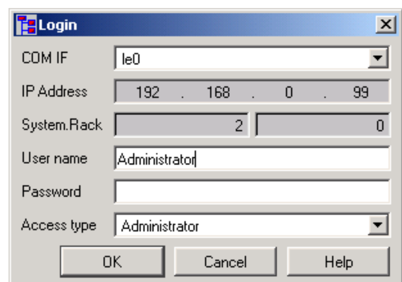
If the controller is in Failure_Stop, you must restart the controller, following the steps below.

1. If the controller is not online, you must go online first.

   a. In the Hardware Management window, from the Online menu, choose Control Panel .

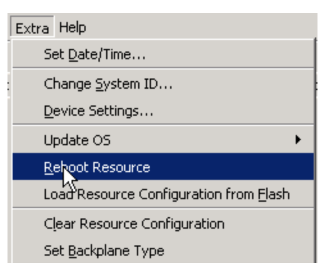


   b. Type the Administrator username and password on the login dialog box.



TIP You can use the [Ctrl]+[A] shortcut to enter the default username (Administrator) and password.

2. Once online, from the Control Panel Extra menu, choose Reboot Resource as shown below.



TIP A Reboot Resource can be initiated only when the controller is in Failure_Stop mode. If you attempt a restart while the controller is in any other mode, an error message appears.

If a routine has already been loaded in the controller when Failure_Stop occurs, the controller goes to Stop/Valid_Configuration after booting. If Autostart Enable is activated, the routine starts up automatically.

If a routine has not been loaded in the controller when Failure_Stop occurs, the controller goes to Stop/Invalid_Configuration after booting.

TIP If the GuardPLC controller is in Stop/Invalid_Configuration after booting, you need to update the SRS. From the Extra menu, choose Change System ID (SRS). Enter the SRS and click OK.

TIP A brand-new GuardPLC 1200 or 2000 controller, into which a back-up battery has not yet been installed, is always in Failure_Stop and must be restarted before you can download a routine.

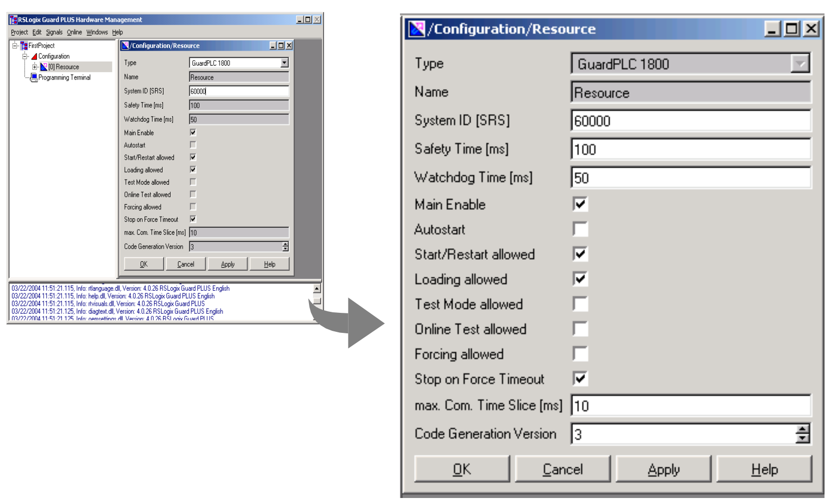
Controller Configuration

To enable the controller to perform its tasks, you have to configure the controller. The parameters you specify are stored in the nonvolatile RAM and in the flash file system of the communication section of the controller.

To configure a controller, follow these steps.

1. In the Hardware Management Window, expand the Configuration module.

2. Right-click Resource and choose Properties.



3. From the Type pull-down menu, choose your controller.

4. Set the controller parameters based on the information the table below.

IMPORTANT The safety time you specify must meet the needs of the controlled process. See the GuardPLC Controller Systems Safety Reference Manual, publication 1753-RM002.

For this parameter	Specify
System ID (SRS)	the system ID of the controller. The system ID is a component of the SRS (System, Rack, Slot), and can be in the range of 2…65535. The programming terminal uses the system ID to communicate with the controller. The purpose of the SRS is to match a routine to a specific resource and guarantee that only a routine with a matching SRS can be downloaded to a resource. The system ID of the controller should not be set at 1 because 1 is the default system ID for the programming terminal. IMPORTANT: The SRS set in the configuration is compiled in the routine.EXE file and must match the SRS of the GuardPLC controller for a routine to be correctly downloaded to the GuardPLC controller. A different system ID results in an Invalid_Configuration error during download. IMPORTANT: The default SRS of a new controller is 60000. You must use this to establish communication with the controller the first time. Once you establish communication, you can change the SRS.
Safety Time (ms)	the safety time (in milliseconds) for the controller. The safety time is the time: • the controller must react to an input signal with an output signal. • within which the controller must react to an error. The default safety time is 2 times the default watchdog time. You can specify any time from 20…50000 ms.
Watchdog Time (ms)	the maximum amount of time (in milliseconds) that the controller can take to execute one cycle. The watchdog time must be: • ≥ 10 ms. • ≤0.5 x Safety Time (Worst case, two cycles must occur within the Safety Time. Therefore, Safety Time ÷ 2 is the maximum watchdog time.). • no more than 5000 ms. The default watchdog time is: • 500 ms for GuardPLC 1200 and GuardPLC 2000 controllers. • 50 ms for GuardPLC 1600 and GuardPLC 1800 controllers. • 10 ms for 1753-IB16, 1753-IB20XOB8, 1753-OB16 modules. If the controller exceeds the watchdog time, the controller goes into Failure_Stop.

You can set these switches.

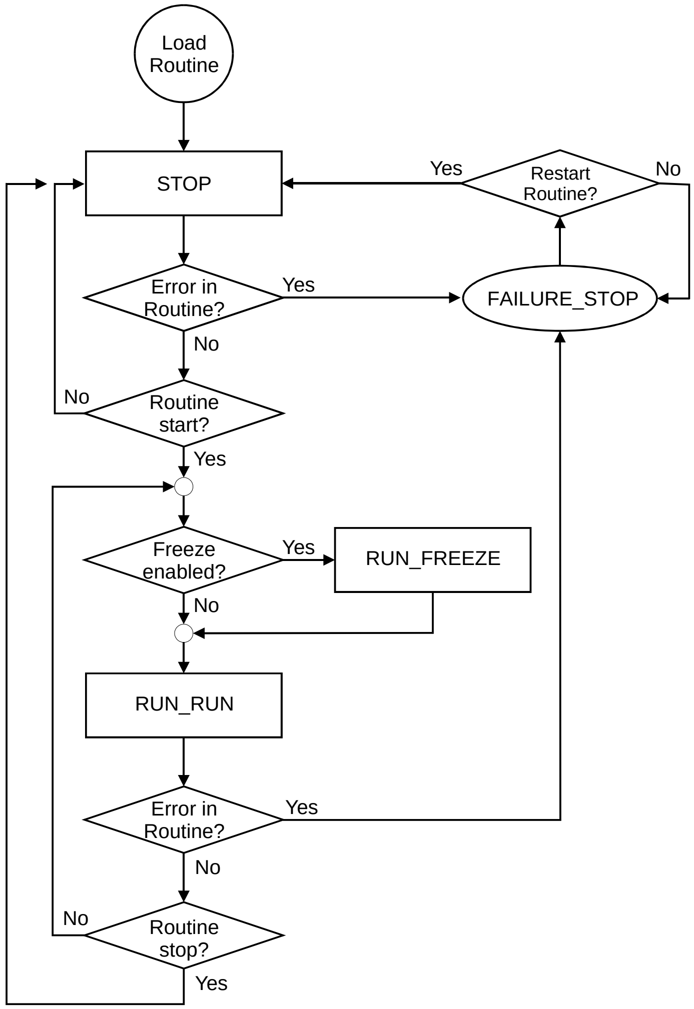
This switch	Specifies	Default
Main Enable	whether CPU switches can be changed while the controller is executing. If Main Enable is disabled, you cannot change the settings of the other 7 switches (described below) while the controller is in operation (routine in Run).	On/Enabled
Autostart	whether the controller automatically starts up after restarting the controller or applying power to the controller. If Autostart Enable is enabled, the routine automatically starts up after a restart or applying power to the controller.	Off/Disabled
Start/Restart allowed	whether you can start a routine manually. If Start/Restart allowed is enabled, you can start a routine manually via the Routine menu of the Control Panel. Choose either Coldstart or Warmstart. Coldstart is the recommended setting. If Start/Restart allowed is disabled, you cannot start a routine manually. You can only start a routine by restarting the controller or applying power to the controller.	On/Enabled
Loading allowed	whether you can load new configuration information to the controller. If Loading allowed is disabled, no (new) configuration can be loaded into the controller. This prevents a user from overwriting the current routine.	On/Enabled
Test Mode allowed	whether you can freeze the routine. If Test Mode allowed is enabled, the routine currently running on the controller can be frozen. This allows the Test Mode with Single Cycle function. You are not allowed to freeze a routine in standard operation (this would be non-safe operation).	Off/Disabled
Online Test allowed	whether you can monitor the Function Block code online.	Off/Disabled
Forcing allowed	whether you can force signals. If Forcing allowed is enabled, you can force the signals in the controller. If Forcing allowed is disabled, you can still display the force editor, but the forcing functions are locked.	Off/Disabled
Stop on Force Timeout	whether to stop forcing when the force time expires. If Stop on Force Timeout is enabled, the controller terminates execution of the routine after the user-set force time expires. All outputs go to LOW. If Stop on Force Timeout is disabled, the controller continues executing the routine with the process values when the force time expires.	On/Enabled
Max Communication Time Slice	the time in milliseconds reserved for a controller to carry out and complete all communication tasks in one CPU cycle. This setting is required for Peer-to-Peer networking.	10 ms

Routine Modes

The controller runs only one routine. The following table and flowchart summarize the routine modes.

Mode	Description
Run_Run	The controller is in the Run mode. • The routine is executed cyclically by the controller. • Input data are processed in the routine. • Output data of the routine are operated.
Run_Freeze	The controller is in the Run mode. • The routine is not executed. • No input data are processed. • No output data of the routine are operated.
Stop	The controller is in the Stop mode. • The routine is no longer being executed. • All outputs have been reset.
Failure_Stop	The controller is in the Stop mode. • The routine was stopped due an error. • All outputs are reset. • The hardware watchdog is not triggered. • To recover from Failure_Stop, a restart of the controller is necessary. A restart can be initiated only via RSLogix Guard PLUS! software. See Recover From a Failure_Stop on page 116.
Test Mode (single step)	The controller is in Run mode. • The routine is triggered manually. • I/O data are processed. IMPORTANT: Test Mode is not permitted for safe operation.

Routine Modes



Load a Configuration and Routine (in Stop Mode only)

You can load a controller configuration and routine when:

- the controller is in Stop mode.
- the controller Loading Allowed switch is set.

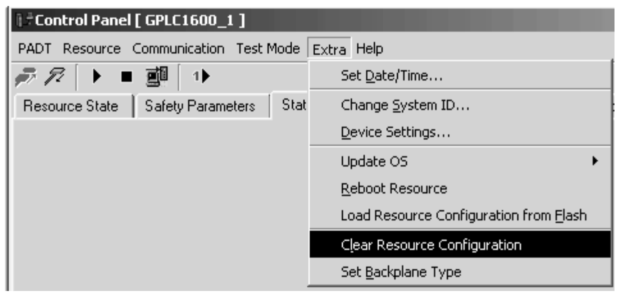
The controller Stop mode is subdivided into these categories.

STOP Mode Category	Description
Stop_Valid_Config	The configuration is correctly loaded. The controller can be set to Run via a command from the programming software. This initiates a loaded user routine.
Stop_Invalid_Config	No configuration loaded or the loaded configuration is faulty. The controller cannot go to Run mode.
Stop_Load_Config	loading configuration in process

The configuration and the routine are loaded together into the controller. Loading a new configuration and a new routine automatically deletes all previously loaded objects, even if the new objects are faulty.

IMPORTANT	Configuration changes take effect only if you re-generate code before downloading to the controller.

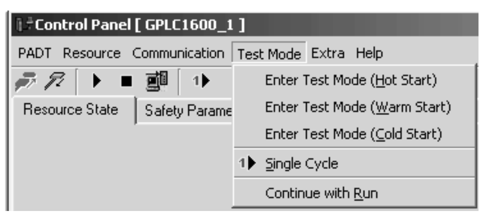
If the controller is in Stop mode, the controller configuration and routine can also be deleted by using the programming software's Clear resource configuration command. The controller goes into the Stop_Invalid Configuration mode.



Test Mode of the Routine

To execute a single-step operation (cycle step), the controller must be in Run mode. The Test Mode Allowed switch must be set to ON.

To enter Test Mode, choose the Test Mode menu from the control panel. Then choose from Hot Start, Warm Start, or Cold Start.



The controller state changes to Freeze, and you can now single cycle the routine by using the Single Cycle option on the Test Mode menu. To return to normal operation, choose Continue with Run.

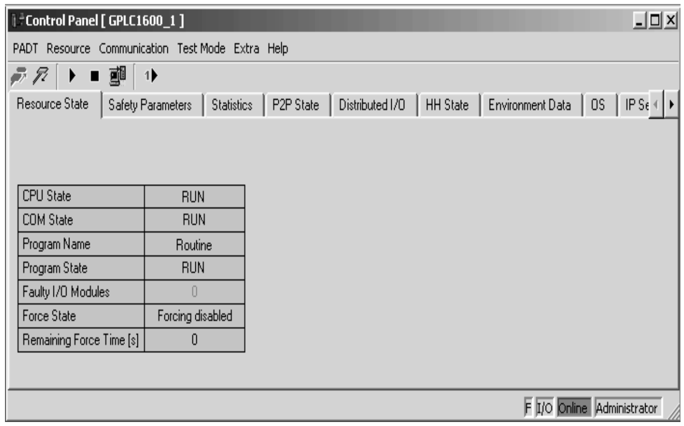
For more information on Test mode options, refer to the Using RSLogix Guard PLUS! Software with GuardPLC Controllers Programming Manual, publication 1753-PM001.

Use the Control Panel to Monitor Status

Introduction

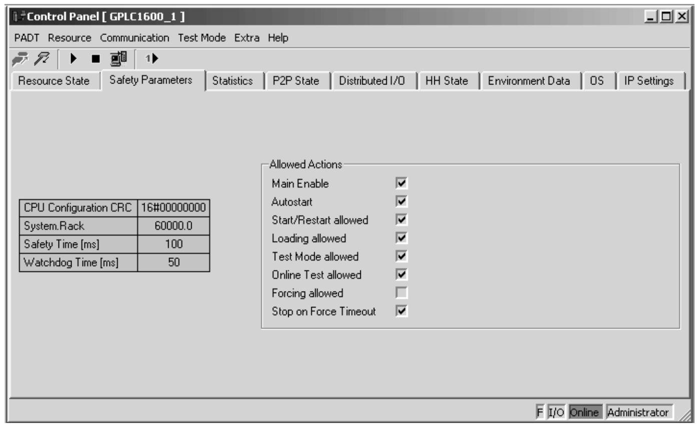
The Control Panel is your window into the online functionality of the controller. Use the tabs to modify or monitor controller status.

Resource State Tab



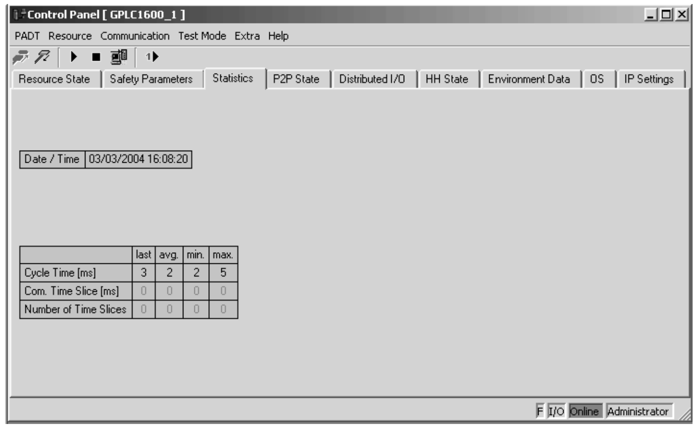
This field	Displays
CPU State	The current state of the controller. Possible states are Init, Run, Stop/Valid_Configuration, Stop/Invalid_Configuration, and Failure_Stop. See Controller Modes on page 113.
COM State	State of the communication portion of the controller. Possible states are Run, Stop, and OS_Loading.
Program Name	The routine name. The name assigned by the user to the routine. The default name is 'Routine.'
Program State	The current state of the routine. Possible states are Run, Stop, Freeze, and Failure_Stop. SeeRoutine Modes on page 120.
Faulty I/O Modules	The number of faulty I/O modules, when the controller is in Run.
Force State	The force status. 0 – forcing is disabled 1 – ready for forcing (the controller is in stop but is set for forcing) 2 – forcing is active
Remaining Force Time [s]	The remaining force time in seconds.

Safety Parameters Tab



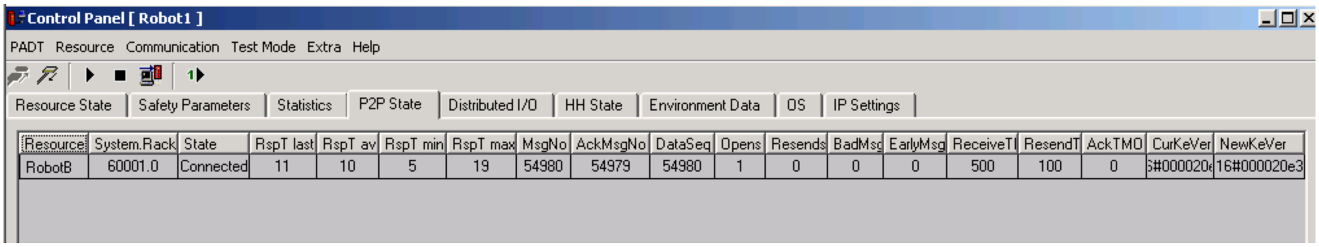
This field	Displays
CPU configuration CRC	Cyclic redundancy check (CRC) option for the configuration in the CPU (in hexadecimal notation). This identifies the configuration loaded in the controller.
System ID	The system ID.
Safety Time [ms]	The safety time in milliseconds.
Watchdog Time [ms]	The watchdog time in milliseconds.
Main Enable	Whether controller switches can be changed while the controller is executing.
Autostart	Whether the controller automatically starts up after restarting the controller or applying power to the controller.
Start/Restart allowed	Whether you can start a controller manually.
Loading allowed	Whether you can load new configuration information to the controller.
Test Mode allowed	Whether you can freeze the routine.
Forcing allowed	Whether you can force tags.
Stop on Force Timeout	Whether to stop executing the routine when the force time expires.

Statistics Tab



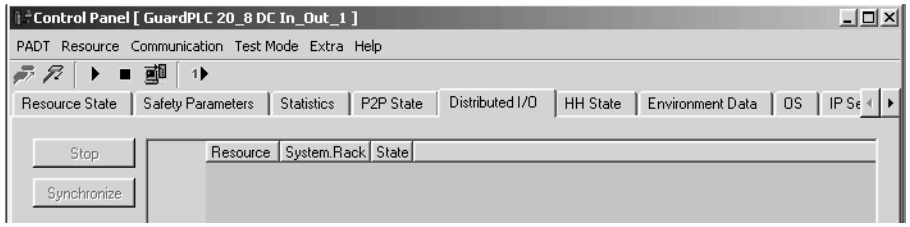
This field	Displays
Cycle Time [ms] average	The average cycle time (in milliseconds) of the last 50 cycles.
Cycle Time [ms] last	The cycle time (in milliseconds) of the last cycle.
Cycle Time [ms] min	The fastest cycle time (in milliseconds).
Cycle Time [ms] max	The slowest cycle time (in milliseconds). If this value exceeds the Watchdog Time, the controller goes to Failure_Stop.
Com. Time Slice [ms]	The time required to process all Peer-to-Peer communication tasks within a CPU cycle.
Number of Time Slices	The number of time slices required to process all communication tasks. This value should always be 1 to avoid having multiple CPU cycles to complete all communication tasks.
Date/Time	The date and time in the controller.

P2P (Peer-to-Peer) State Tab



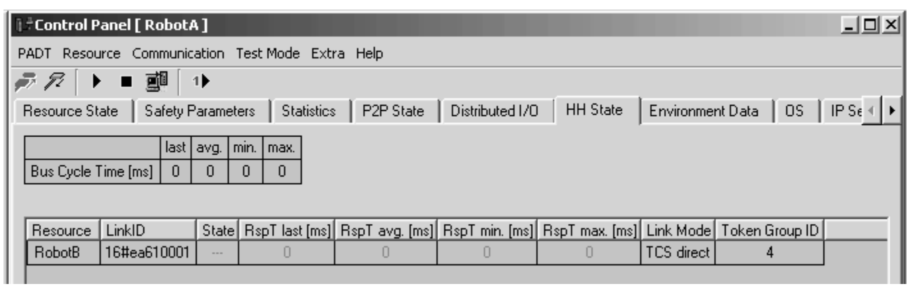
This field	Displays
Resource	The name of the controller.
System ID	The network ID of the controller.
State	The status of the communication.
RspT (last, avg, min, max)	The Measured ResponseTime for a message from $PES_1 \rightarrow PES_2 \rightarrow PES_1$, based on the network hardware, CPU cycle time, and Peer-to-Peer profile. This parameter will be optimized later.
MsgNr	The Counter (32-bit resolution) for all messages sent to a controller.
AckMsgNr	The number of the received message that the controller has to acknowledge.
DataSeq	The Counter (16-bit resolution) for sent messages, which contain process data.
Opens	The number of successful connects to a controller. A figure higher than 1 indicates that a controller dropped out and has been reconnected.
Resends	The Counter (32-bit resolution) for messages that have been resent due to an elapsed ResendTMO.
BadMsgs	The Counter (32-bit resolution) for received messages that are corrupted, or are not expected at that instant. A corrupt message, for example, is a message with a wrong sender or with a faulty CRC. An unexpected message, for example, is an 'Open' command, when the controllers are already connected.
EarlyMsgs	The Counter (32-bit resolution) for received messages that are not in the correct sequence. If a message drops out and is lost at the addressee, there is a gap in the received messages, and the next message comes early.
Receive Tmo	Receive Timeout as entered by the user.
ResendTMO	Resend Timeout as set by the profile.
AckTmo	Acknowledge Timeout as set by the profile.
CurKeVer	CRC for the Peer-to-Peer configuration. Identical to the Peer-to-Peer system signal.
NewKeVer	Reserved for future use.

Distributed I/O Tab



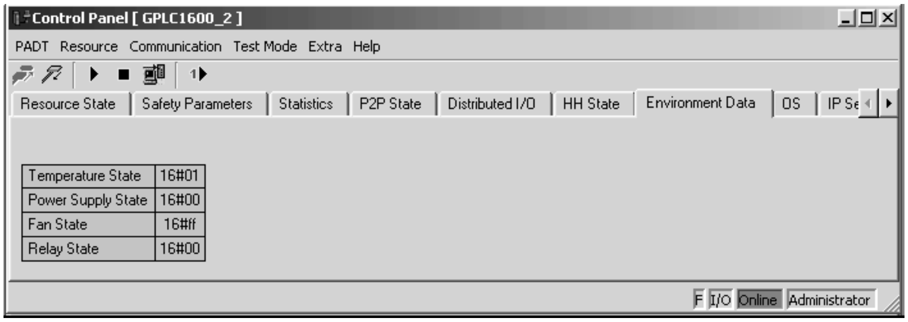
This field	Displays	
Resource	The name of the module.	
System.Rack	The System.Rack ID of the module.	
State	The status of the I/O module: • Run • Stop/Valid_Configuration • Stop/Invalid_Configuration	• Error_Stop • not connected

HH (High-level High-speed) State Tab



This field	Displays
Bus Cycle Time	The time in milliseconds for a Token cycle. The value is 0, if Token Passing is off (any Cleanroom profile).
Resource	The name of the controller.
LinkID	The controller network ID.
State	The status of communication.
RspT	• If Link Mode is TCS direct (Token Passing OFF), RspT is the ResponseTime of the HH profile for a message from $PES_1 \rightarrow PES_2 \rightarrow PES_1$, based on the network hardware and topology. This parameter cannot be changed by the user. • If Link Mode is TCS TOKCYC (Token Passing ON), RspT is part of the Bus Cycle Time.
Link Mode	• TCS direct when Token Passing is OFF. • TCS TOKCYC when Token Passing is ON.
Token Group ID	The ID of the Token Group.

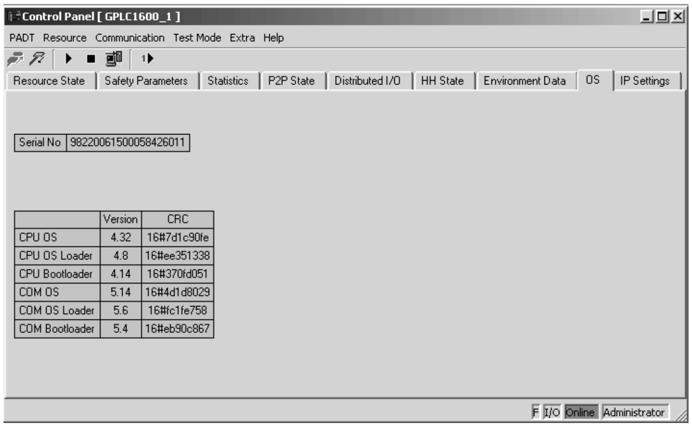
Environment Data Tab



This tab displays status messages in hexadecimal form for Temperature State, Power Supply State, Fan State, and Relay State.

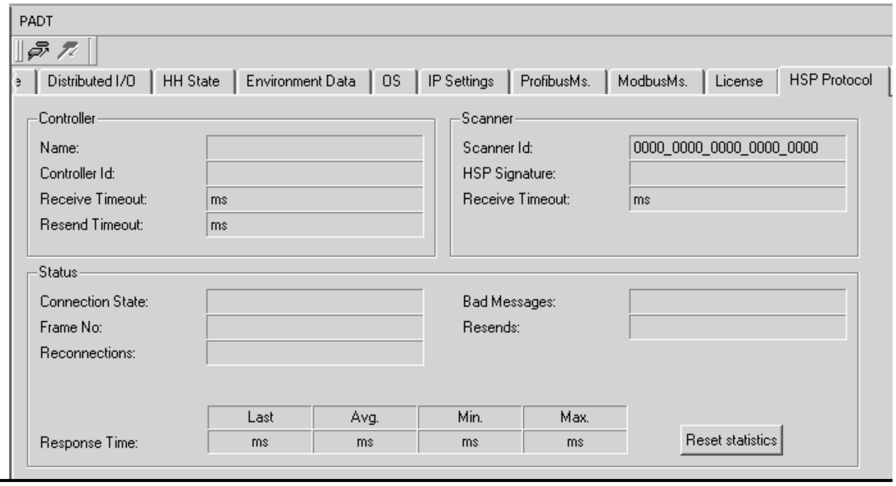
See Programming Controller Data on page 305 for an explanation of the error bits.

OS Tab



This field	Displays
Serial Number	The serial number of the communication module of the controller.
CPU OS	The version of the operating system and the cyclic redundancy check of the operating system (in hexadecimal). (Version 2.4 or later is required for Peer-to-Peer communication.)
CPU Loader	The version of the operating system loader and the cyclic redundancy check of the operating system loader (in hexadecimal).
CPU BootLoader	The version of the boot loader and the cyclic redundancy check of the boot loader (in hexadecimal).
COM OS	The version of the communication operating system and the cyclic redundancy check of the communication operating system (in hexadecimal). (Version 2.4 or later is required for Peer-to-Peer communication.)
COM OS Loader	The version of the communication operating system loader and the cyclic redundancy check of the communication operating system loader (in hexadecimal).
COM BootLoader	The version of the communication boot loader and the cyclic redundancy check of the communication boot loader (in hexadecimal).

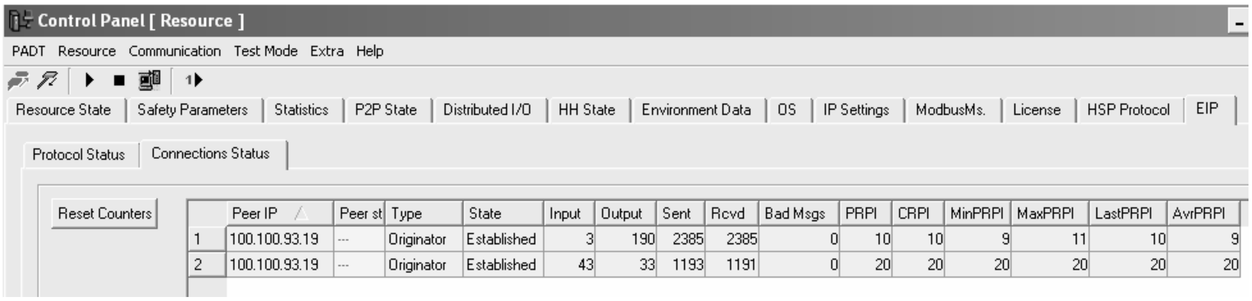
HSP Protocol Tab



This field	Displays
Name	The Name of the controller
Controller Id	The SRS of the controller
Controller Receive Timeout	The time limit, within which a message from the scanner must be answered
Controller Resend Timeout	The length of time the controller waits for an acknowledgement of a message before it resend the message
Scanner Id	
HSP Signature	A unique number that ensures that the controller's configuration data matches the scanner's configuration data
Scanner Receive Timeout	The time limit, within which the scanner must receive a message from the controller
Connection State	The state of the connection. • 0 = closed. • 1 = try open. The active endpoint is attempting to open the connection. • 2 = connected. The connection is established. Normal data transfer, time monitoring, and other functions are occurring.
Frame No.	The number of the last frame sent
Reconnections	The number of connections since the last statistics reset
Bad Messages	The number of discarded messages since the last statistics reset
Resends	The number of repeated messages since the last statistics reset
Last Scanner Response Time	The last scanner response time
Average Scanner Response Time	The average scanner response time since the last statistics reset
Minimum Scanner Response Time	The smallest scanner response time since the last statistics reset
Maximum Scanner Response Time	The greatest scanner response time since the last statistics reset

Click Reset Statistics to reset the statistics counters.

EIP Protocol Tab



This Field	Displays
Peer IP	IP address of communication partner
Peer Status	Status of Peers, either Run or Idle. If peer does not provide run idle information, nothing can be displayed!
Connection Type	Displays the Connection Type, Originator or Target, that the controller acts as in this connection.
Connection State	The status of connection. • 1 = Connecting Configuring – In the process of opening a new connection. • 2 = Spare • 3 = ConnectionEstablished – Connection is active. • 4 = ConnectionTimedOut – Connection has timed out; will stay in this state at least for some time if WatchdogTimeoutAction is set to TimeoutManualReset or TimeoutDelayAutoReset. • 5 = ConnectionDeferredDelete – Connection is about to be deleted and waiting for child connections to be closed first. • 6 = ConnectionClosing – In the process of closing the connection.
Input	Associated input assembly Id with the connection or 0 if none. For scanner connections of the controller these field shows the assembly id data is read from.
Output	Associated output assembly id with the connection or 0 if none. For scanner connections of the controller these field shows the assembly id data is written to.
Sent	Number of sent packets on this connection. Counter wraps with 2^{32} packets.
Received	Number of received packets on this connection. Counter wraps with 232 packets.
Bad Messages	Number of received or dropped messages for that connection. You can reset this value by pressing Counter Reset.
PRPI	Produced Requested Packet Interval (µs).
CRPI	Consumed Requested Packet Interval (µs).
MinPITime	Minimum Packet Interval Time (µs).
MaxPITime	Maximum Packet Interval Time (µs).
LastPITime	Last Packet Interval Time (µs).
AvrPITime	Average Packet Interval Time (µs).

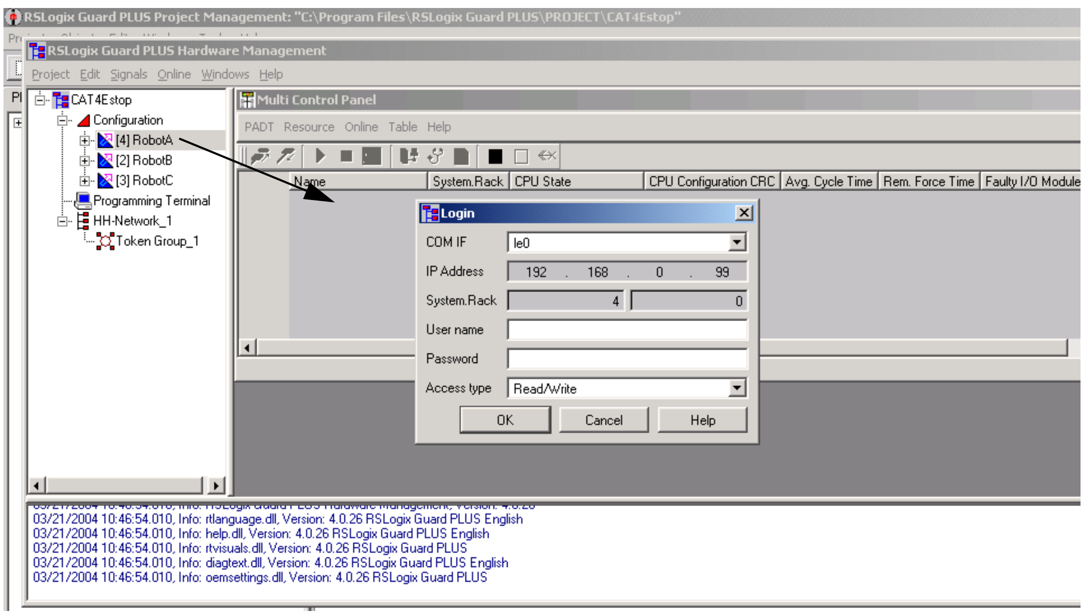
Use the Multi Control Panel

The Multi Control Panel lets you connect the programming terminal to more than one controller in the project in one window and to perform actions such as downloads, controller starts, invoking the force editor, and so forth simultaneously.

1. Open the Multi Control Panel by choosing Online>Multi Control Panel.

   When the Multi Control Panel is opened for the first time, it does not contain any controllers.

2. Add a controller to the Multi Control Panel by dragging and dropping the Resource from the project tree into the Multi Control Panel.



   After a controller has been dropped in the Multi Control Panel, the Login dialog box opens.

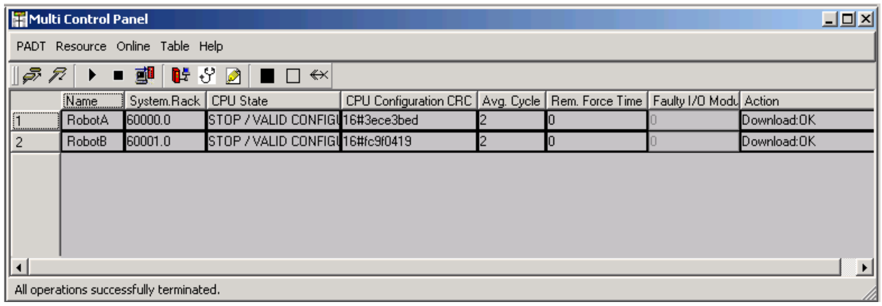
3. Type the correct Username and Password to connect the controller to the programming terminal.

   You must have Read/Write or Administrator rights (Access type) to download a routine into the controller.

4. Add as many controllers to the Multi Control Panel as you need.

5. Sort the list of controllers in the Multi Control Panel by clicking on the column headlines.

The Multi Control Panel displays this controller information.



This field	**Displays**
Name	the controller name
System.Rack	the controller ID
CPU State	the status of the controller CPU, such as Run, Stop, Stop/Valid Configuration, Stop/Invalid Configuration, and so forth.
CPU Configuration CRC	the checksum (cyclic redundancy check) of the CPU configuration, displayed in hexadecimal.
Avg. Cycle Time	the average CPU cycle time in milliseconds. This figure depends on the complexity of the logic and, because of the Schedule Time Slice, on the network load.
Rem. Force Time	the remaining force time in seconds (time until forcing is deactivated). Value is 0 when forcing is not active or disabled.
Faulty I/O Modules	the number of faulty IO modules. A fault can result from a hardware malfunction or from incorrect configuration.
Action	the display of a Multi Control Panel command and command status (for example, Start, Start:OK). The field is cleared after five seconds.

You can perform a Multi Control Panel command on one or more controllers. To select a single controller, follow these steps.

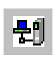
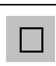
1. Click the line number left of the controller name.

   The boundaries of this line become thicker.

2. Select more controllers by using one of the following methods:
   - Hold down the CTRL key and click another line number to add that controller to your selection.
   - Use the SHIFT key to select controllers from line *x* to line *y*.
   - To select all the controllers, click Select All  on the tool bar.

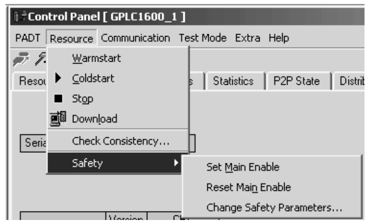
These commands can be carried out by using the Multi Control Panel buttons in the button bar.

Multi Control Panel Buttons

Button	Command
	Connect Connects the programming software to the selected controller(s) after loss of communication or manual disconnect. After manual disconnect, a new login with password is required.
	Disconnect Disconnects the programming software from the selected controller(s).
	Coldstart Performs a coldstart on the selected controller(s).
	Stop Stops the selected controller(s).
	Download Loads the routine(s) into the selected controller(s). Prior to download, the code generator must have successfully generated program code and the selected controller(s) must be in Stop mode. **Important:** You cannot download a routine into a controller other than the one for which the logic was created.
	Control Panel Starts the control panel for the selected controller(s). This command can be carried out for a single controller by choosing Online>Control Panel.
	Diagnostics Starts the diagnostics display for the selected controller(s). This command can be carried out for a single controller by choosing Online>Diagnostics.
	Force Editor Starts the force editor for the selected controller(s). This command can be carried out for a single controller by choosing Online>Force Editor.
	Select All Selects all controllers in the list.
	Deselect Deselects marked controllers.
	Remove Controller Removes the selected controller(s) from the list. Removing a controller from the Multi Control Panel also disconnects the communication.

Control Panel Resource Menu

To modify the safety settings of the controller, choose Safety from the control panel's Resource menu .



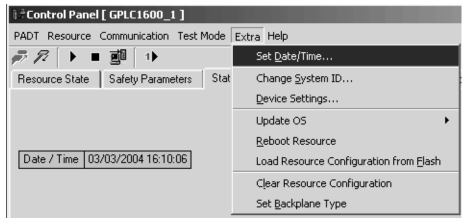
IMPORTANT Any settings you change via the Resource menu are directly updated in the controller and are saved in the project.

Menu Item	Description
Check Consistency	Compares the program running in the controller with the program you are editing in RSLogix Guard PLUS! software. If they match, your offline project has previously been downloaded to the GuardPLC controller.
Set Main Enable	Lets safety parameters be changed. You can only choose Set Main Enable when the controller is in Stop mode. For more information, see page 119.
Reset Main Enable	Prevents safety parameters from being changed. For more information, see page 119.
Change Safety Parameters	Changes the safety parameters, if Set Main Enable is activated. You must have Read/Write or Administrator access to be able to change safety parameters. For more information about these parameters, see page 119.

TIP Refer to the Using RSLogix Guard PLUS! Software with GuardPLC Controllers Programming Manual, publication 1753-PM001, for more information on the Warmstart, Coldstart, Stop, and Download menu items.

Control Panel Extra Menu

Use the Extra menu of the Control Panel to modify communication settings and change controller operation. You must have Administrator access to use most of these menu options as indicated in the table below.



Menu Item	Description
Set Date/Time	Sets the controller clock, if Set Main Enable is activated. Enter the date as mm/dd/yy and the time as hh:mm.
Change System ID (SRS)	Changes the system ID (SRS) of the controller. You must have Administrator access to be able to change the system ID (SRS).
Device Settings	Changes the Ethernet network parameters. You must have Administrator access and the controller must be in STOP mode.
Update OS	Lets you download new COM OS and CPU OS.
Reboot Resource	Reboots the controller. See Recover From a Failure_Stop on page 116.
Load Resource Configuration from Flash	Loads a copy of the last executable configuration to the controller
Clear Resource Configuration	Deletes the program memory of the controller and resets the configuration of the CPU and COM modules.
	GuardPLC 1200 and 2000 controllers only: Deletes the program memory of the controller and resets the configuration of the CPU and COM modules. This does not affect the battery-buffered memory for long term diagnostics, short term diagnostics, date and time settings, system ID (SRS), or IP address. To reset a controller to default settings, clear the controller and remove the back-up battery for at least 20 seconds. Removing the back-up battery: • deletes date and time. • deletes long term and short term diagnosis. • deletes the configuration saved in the battery-buffered memory. • deletes all user accounts. • does not delete the program memory. • does not reset the configuration of the CPU and COM modules. Use Online>Communication Settings and write the SRS back to the battery-buffered memory. This validates the configuration so you can restart the routine.

<table>
<tr><th>Menu Item</th><th>Description</th></tr>
<tr><td>Set Backplane Type</td><td>Restores backplane information.

The individual modules (CPU, COM, I/O) are linked to each other over the backplane. The controller requires this information to be able to conduct hardware tests. If the EEPROM that stores the backplane information loses its contents, use this menu option to write the backplane type back into the EEPROM.

You must have Administrator access to be able to set the backplane type.

To set the backplane type, follow these steps.
1. Load a project that is consistent with the connected controller type.

ATTENTION: If you try to write the backplane type of a controller (such as a GuardPLC 1200 controller) with the backplane type of another controller (such as a GuardPLC 2000 controller), the overwritten controller can no longer be used and must be repaired by the manufacturer.
2. Choose Set Backplane Type.

The backplane type is automatically entered into the dialog box.
3. Change the Backplane Version to 0.
4. Click OK to confirm the change.</td></tr>
</table>

Notes:

Diagnostics

Introduction

View Controller Diagnostics

The controller stores short term and long term diagnostics data. The number of entries the controller can save depends on the controller, as shown below.

Type of Data	GuardPLC 1200		GuardPLC 1600 and 1800		GuardPLC 2000	
	CPU	COM	CPU	COM	CPU	COM
number of short term entries	300	700	300	700	300	700
number of long term entries	1000	200	1000	200	1000	200

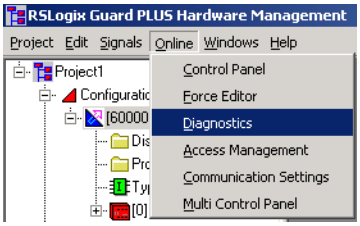
If the memory for short term entries is full and the controller needs to log another entry, the controller deletes the oldest entry.

If the memory for the long term entries is full and the controller needs to add a new entry, the controller deletes the oldest entry only if that entry is more than 7 days old. Otherwise, the new entry is rejected and a message is displayed in the diagnostics window.

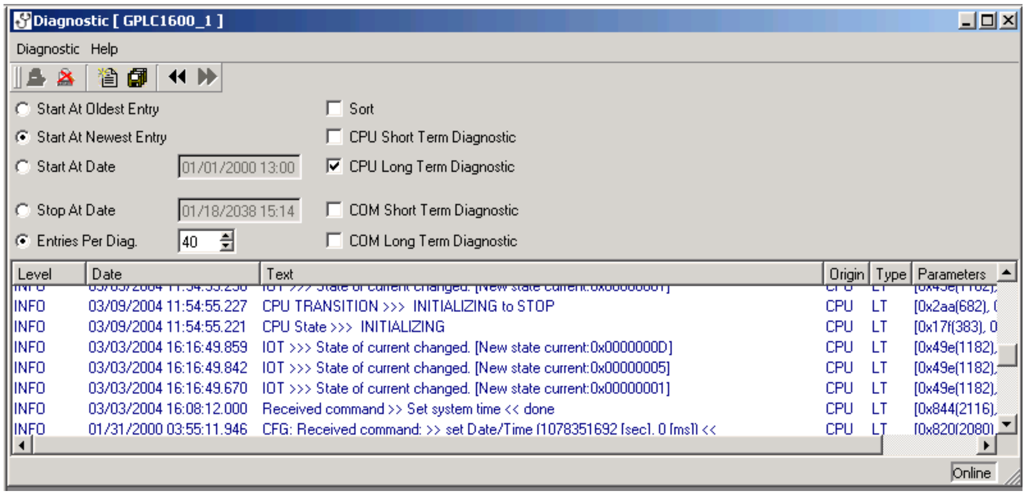
To display the diagnostics window, follow these steps.

1. Select the Resource and, from the Online menu, choose Diagnostics.

   If the Control Panel is already open, you do not have to login. Otherwise, the software asks you to log in.



2. After you successfully log in, the software displays the controller diagnostics.



This field	Displays
Level	whether the entry is Info, Warning, or Error.
Date	the date and time the entry was recorded.
Text	a description of the cause leading to the entry.
Origin	whether the cause of entry originated from the CPU or COM.
Type	whether the entry is short term (ST) or long term (LT).
Parameter	information direct from the CPU or COM. This data is only for error analysis by Rockwell Automation representatives.

TIP You can export diagnostic data to a text file for storage by choosing Export from the Diagnostic menu.

Choose Online or Offline Diagnostics

When you start the diagnostics window, Diag. Online is automatically activated. This signals that you want all diagnostics data transferred from the controller to the diagnostics buffer in RSLogix Guard PLUS! software. As long as Diag. Online is active, new diagnostic data is transferred to this buffer as it becomes available and if the filter you selected applies.

Diag. Offline disconnects communication with the controller. This ends the transmission of diagnostic data from the controller to the diagnostics buffer in RSLogix Guard PLUS! software.

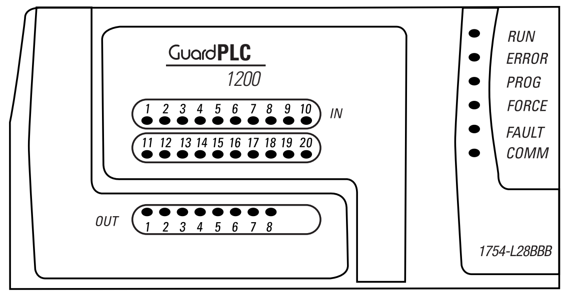
Filtering Diagnostic Data

Choose from these filters to determine what diagnostic data to display.

Filter	Description
Start At Oldest Entry	Displays all the data from the RSLogix Guard PLUS! software buffer starting with the oldest entry. The number of lines shown in the table depends on the Entries Per Diag. Enable Sorting defaults to disabled so that the data appears in chronological order from oldest to newest.
Start At Newest Entry	Displays all the data from the RSLogix Guard PLUS! software buffer starting with the newest entry. The number of lines shown in the table depends on the Entries Per Diag. Enable Sorting defaults to disabled so that the data appears in chronological order from oldest to newest.
Start At Date	Displays entries in chronological order starting at this date and time. The number of lines shown in the table depends on the Entries Per Diag. Enter the date as mm/dd/yy and the time as hh:mm.
Stop At Date	Displays entries in chronological order ending at this date and time. The number of lines shown in the table depends on the Entries Per Diag. Enter the date as mm/dd/yy and the time as hh:mm.
Entries Per Diag.	Determines the maximum number of entries to load into the buffer for the CPU and COM diagnostics. For example, if you enable short term and long term diagnostics for CPU and COM and you set Entries Per Diag. = 10, the diagnostic window contains a maximum of 40 entries (10 entries per diagnostic type). RSLogix Guard PLUS! software can buffer as many as 5000 entries per type of diagnostic.
Sort	If Sort is disabled, the diagnostic window displays entries in the order they were saved in the controller. If Sort is enabled, the diagnostic window automatically displays entries according to date.
CPU Short Term Diagnostic CPU Long Term Diagnostic COM Short Term Diagnostic COM Long Term Diagnostic	Enables or disables whether to display the diagnostic data for each type.

GuardPLC 1200 Controller Status Indicators

The GuardPLC 1200 controller has these status indicators.

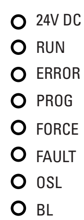


Indicator	State	Description
INput	On	Digital input channels are high (10 … 30V DC).
	Off	Digital input channels are off.
OUTput	On	Digital output channels are high.
	Off	Digital output channels are off.
RUN	On	This is the normal status of the controller. A routine, which has been loaded into the controller, is executed. The controller processes input and output signals, carries out communication, and performs hardware and software tests.
	Flashing	The controller is in Stop mode and is not executing a routine. All system outputs are reset. Stop mode can be triggered by setting the system variable AB-CPU/Emergency Stop to TRUE in the routine, or by direct command from the programming terminal.
	Off	The controller is in Failure_Stop (see ERROR).
ERROR	On	• A hardware error has been detected by the controller. In this case the controller goes to Failure_Stop and the execution of the routine is halted. Hardware errors are errors in the controller, in one or more of the digital input and output modules, or in the counters. • A software error in the operating system has been detected by the controller. • The watchdog has reported an error because of exceeded cycle time. All system outputs will be reset and the controller ceases all hardware and software tests. The controller can only be restarted by a command from the programming terminal.
	Flashing	If all the status indicators are on and ERROR blinks, the boot loader detected a corrupted operating system and is waiting for an operating system download.
	Off	No errors are detected.
PROGress	On	The upload of a new controller configuration is in progress.
	Flashing	The upload of a new operating system into the Flash ROM is in progress.
	Off	No upload of controller configuration or operating system is in progress.
FORCE	On	The controller is executing a routine (Run) and Force mode is activated by the user.
	Flashing	The controller is in Stop mode, but forcing has been saved and will be activated when the controller is started.
	Off	Forcing is off.

Indicator	State	Description
FAULT	On	The routine logic has caused an error. The controller configuration is faulty. The upload of a new operating system was not successful and the operating system is corrupted.
	Flashing	An error has occurred during a Flash ROM write cycle. One or more I/O errors have occurred.
	Off	None of the above errors have been detected.
COMMunication	On	The programming terminal, with Administrator or Read/Write access, is communicating with the controller via an Ethernet link.
	Off	No communication or read-only communication on an Ethernet link.

GuardPLC 1600 and GuardPLC 1800 Controllers and GuardPLC Distributed I/O

System Status Indicators



Indicator	State	Description
24V DC	On	24V DC operating voltage present.
	Off	No operating voltage.
RUN	On	This is the normal status of the controller. A routine, which has been loaded into the controller, is executed. The controller processes input and output signals, carries out communication and performs hardware and software tests.
	Flashing	The controller is in Stop mode and is not executing a routine. All system outputs are reset. Stop mode can be triggered by setting the Emergency stop system variable to TRUE in the routine, or by direct command from the programming software.
	Off	The controller is in Failure_Stop (see ERROR).
ERROR	On	A hardware error has been detected by the controller. The controller goes to Failure_Stop and the execution of the routine is halted. Hardware errors are errors in the controller, errors in one or more of the digital input and output modules, or errors in the counters. A software error in the operating system has been detected by the controller. The watchdog has reported an error due to exceeded cycle time. All system outputs will be reset and the controller ceases all hardware and software tests. The controller can only be restarted by a command from the programming software.
	Off	No errors are detected.

Indicator	State	Description
PROGress	On	The upload of a new controller configuration is in progress.
	Flashing	The upload of a new operating system into the Flash ROM is in progress.
	Off	No upload of controller configuration or operating system in progress.
FORCE	On	The controller is executing a routine (Run) and Force mode is activated by the user.
	Flashing	The controller is in Stop, but Forcing has been initiated and will be activated when the controller is started.
	Off	Forcing is OFF.
FAULT	On	The routine (logic) has caused an error. The controller configuration is faulty. The upload of a new operating system was not successful and the operating system is corrupted.
	Flashing	An error has occurred during a Flash ROM write cycle. One or more I/O errors have occurred.
	Off	None of the above errors has occurred.
OSL	Flashing	Emergency Operating System Loader is active.
BL	Flashing	Boot Loader unable to load operating system or unable to start COMM operating system loader.

Communication Status Indicators

Status indicators on the controllers and I/O modules display communication status information.

Safety-related GuardPLC Ethernet Communication

Communication via the GuardPLC Ethernet network is indicated via two small status indicators integrated into each RJ-45 connector socket.

Indicator	State	Description
Green	On	Full duplex operation
	Flashing	Collision
	Off	Half duplex operation, no collision
Yellow	On	Connection established
	Flashing	Interface activity

Non-safety-related Communication

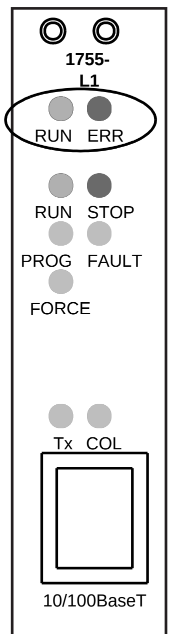
Active communication via the serial ports, COMM1 and COMM3, is indicated by a status indicator located above the port.

GuardPLC 2000 Controller Status Indicators

The GuardPLC 2000 controller has status indicators for:

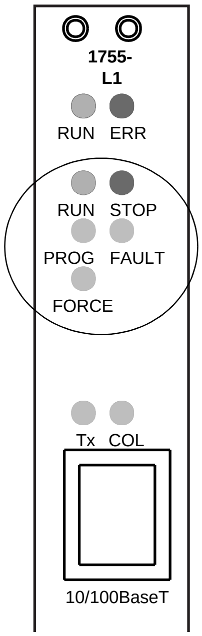
- module, both the program and the communication.
- controller and the system hardware.
- routine.
- Ethernet communication to the programming terminal.

Controller Indicators



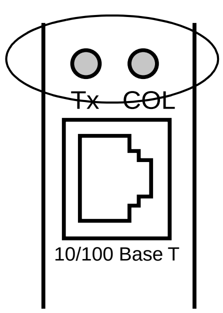
Indicator	Status	Description
RUN	On	This is the normal status of the controller (Run or Stop mode). The controller carries out communication and performs software tests.
	Flashing	Downloading an Operating System
	Off	The controller is in Failure_Stop (see ERR below), or there is no power supply.
ERR	On	The controller is in the Failure_Stop state and the execution of the routine is halted. All system outputs will be reset and the controller ceases all hardware and software tests. The operating system loader has found a flash error (FAULT is blinking).
	Flashing	The boot loader has found an error in the operating system in the flash (if all other indicators are ON); the download of a new operating system is awaited.
	Off	No errors are detected.

Routine Indicators

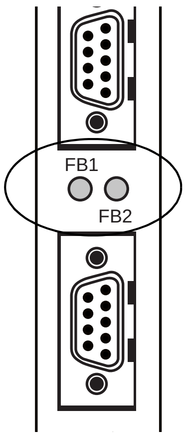


Indicator	Status	Description
RUN	On	The routine is in Run or Freeze.
	Off	The routine is in Failure_Stop.
STOP	On	The routine is in Stop or Failure_Stop.
PROG	On	The download of a new controller configuration is in progress.
	Flashing	The download of a new operating system into the flash ROM is in progress.
	Off	No download of controller configuration or operating system is in progress.
FAULT	On	The routine (user program) has caused an error. The controller configuration is faulty. The download of a new operating system was not successful and the operating system is corrupted.
	Flashing	An error has occurred during a flash ROM write cycle of the operating system. At least one I/O module error is present.
	Off	No errors have been detected.
FORCE	On	The controller is executing a routine (RUN) and one or more inputs and/or outputs may be forced by the user.
	Flashing	The controller is in Stop mode, but one or more inputs and/or outputs have been prepared for forcing and will be activated as soon as the controller is started.
	Off	No inputs and/or outputs are forced or are prepared to be forced.

Ethernet Communication Indicators



Indicator	Status	Description
Tx	On	Data is transmitting via the Ethernet network by the communication processor.
COL	On	A collision on the Ethernet network is detected.

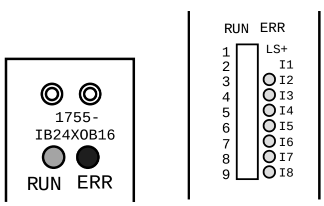


Serial Communication Indicators

Indicator	Status	Description
FB1	On	Field bus no. 1 is active
FB2	On	Field bus no. 2 is active (serial interface module)

IMPORTANT Only the bottom serial port on the GuardPLC 2000 controller is active, as indicated by the FB2 status indicator.

1755-IB24XOB16 Module Status Indicators



The 1755-IB24XOB16 digital combination input and output module (AB-DIO) has status indicators for:

- power supply.
- module status.
- I/O status.

Power Supply and Module Status

Indicator	Status	Description
RUN	On (green)	The module has the correct operating voltage (24V DC).
	Off	The module has no power.
ERR	On (red)	If the system is in Stop mode, one or more of the inputs or outputs is faulty, or the module is faulty. Use the RSLogix Guard PLUS! software to verify the location of the fault. If the module is faulty, replace the module immediately, or the safety-related operation of the GuardPLC 2000 controller is not maintained.
	Off	The module is operational.

I/O Status

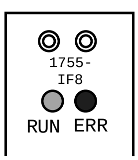
Status	Explanation
On (yellow)	• Input is high • Output is energized
Off	• Input is low • Output is de-energized

While the system is in Run mode, ERR is indicated continuously for both a module and a channel error. Depending on the type of error, the module switches off only a faulty output channel, but the operation of the other outputs continues, or all the output channels are switched off. The inputs are always in operation. A faulty input channel transmits Low-signal to the logic. If the entire module is switched off, all input and output channels are switched off.

1755-IF8 Analog Input Module Status Indicators

The 1755-IF8 analog input module (AB-AI) has status indicators for:

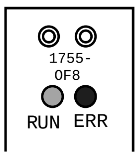
- power supply.
- module status.



Indicator	Status	Description
RUN	ON (green)	The module has the correct operating voltage (24V DC).
	OFF	The module has no power.
ERR	ON (red)	If the system is in Stop mode, one or more of the inputs or outputs is faulty, or the module is faulty. Use the RSLogix Guard PLUS! software to verify the location of the fault. If the module is faulty, replace the module immediately, or the safety-related operation of the GuardPLC 2000 controller is not maintained.
	OFF	The module is operational.

While the system is in Run mode, ERR is indicated continuously for both a module and a input channel error. Depending on the type of error, the module may switch off only one input channel (that is, a faulty channel transmits the value 0 to the logic, but the module continues operation with the remaining channels). If the entire module is switched off, all input channels transmit the value 0 to the logic.

1755-OF8 Analog Output Module Status Indicators



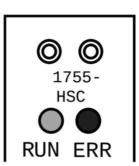
The 1755-OF8 analog output module (AB-AO) has status indicators for:

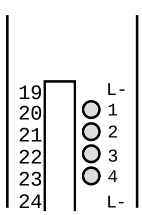
- power supply.
- module status.

Indicator	Status	Description
RUN	ON (green)	The module has the correct operating voltage (24V DC).
	OFF	The module has no power.
ERR	ON (red)	If the system is in Stop mode, one or more of the inputs or outputs is faulty or the module is faulty. Use the RSLogix Guard PLUS! software to verify the location of the fault. If the module is faulty, replace the module immediately or the safety-related operation of the GuardPLC 2000 controller is not maintained.
	OFF	The module is operational.

While the system is in RUN mode, ERR is indicated continuously for both a module and an output channel error. Depending on the type of error, the module may switch only one pair of output channels (1+2, …, 7+8) to the de-energized state (that is, the value 0V or 0 mA), but the module continues operation with the remaining channels. If the entire module is switched off, all output channels are switched to the de-energized state.

1755-HSC Combination High-speed Counter and Output Module Status Indicators





The 1755-HSC combination high-speed counter and output module (AB-CO) has status indicators for:

- power supply.
- module status.
- I/O status.

Power Supply and Module Status

Indicator	Status	Description
RUN	On (green)	The module has the correct operating voltage (24V DC).
	Off	The module has no power.
ERR	On (red)	If the system is in Stop mode, one or more of the inputs or outputs is faulty or the module is faulty. Use the RSLogix Guard PLUS! software to verify the location of the fault. If the module is faulty, replace the module immediately or the safety-related operation of the GuardPLC 2000 controller is not maintained.
	Off	The module is operational.

I/O Status

Indicator	Status	Description
1, 2, 3, 4	On (green)	The corresponding output is energized.
	Off	The corresponding output is de-energized.

While the system is in Run mode, ERR is indicated continuously for both a module and a counter channel error. Depending on the type of error, the module may switch off only one counter channel (that is, the counter transmits the value 0 to the logic, the output has no signal, but the module continues operation with the remaining counter channel). If the entire module is switched off, all counter channels are switched off.

Peer-to-peer Communication Overview

Introduction

Peer-to-peer Communication Basics

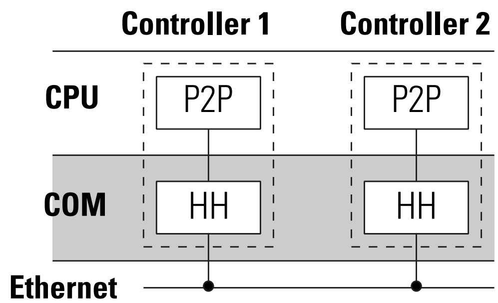
Peer-to-peer communication is used for data exchange between two or more controllers and distributed I/O on a GuardPLC Ethernet network. The GuardPLC Ethernet network is certified for use in SIL 3 and Cat. 4 applications and is designed to carry safety-related data. The controllers are usually connected via the Ethernet network, but other means of communication, such as telephone lines or two-way radios are also possible, using gateways from the Ethernet network to the respective technology.

The Peer-to-peer protocol is primarily responsible for:

- the communication between controller CPUs, including automatic connection setup.
- extended diagnostics.
- all safety-relevant features for correct data transfer.

Each controller is equipped with one or more 10/100 Base T Ethernet ports. The High-level High-speed (HH) protocol is implemented in the operating system of the GuardPLC 1200/1600/1800 controllers and of the GuardPLC 2000 communication module (COM) and interacts with the Ethernet port. The HH protocol is based on UDP/IP and IEEE 802.3 standards and is responsible for the collision-free data exchange via standard Ethernet networks in various network topologies.

As seen in the figure below, both the HH and the peer-to-peer protocols are vital for safe Ethernet Communication. HH protocol can be considered the wire or transport media through which messages are passed. Peer-to-peer (P2P) is the protocol that runs on the wire, making sure that the messages are transmitted over the HH connection within the watchdog time. P2P is the mechanism that qualifies the GuardPLC Ethernet network as a safety network.



TIP The peer-to-peer protocol is designated as a safe protocol according to DIN V 19250 (AK6), IEC61508 (SIL 3) and ISO 13849-1 (PLe/Cat. 4) respectively.

Networking Limitations

A peer-to-peer link is defined as communication from one GuardPLC controller to another GuardPLC controller, or from a GuardPLC controller to a distributed I/O module. A device on an Ethernet network must make a connection to another device on the Ethernet network for the two of them to communicate. Connections need to be established only between devices that wish to communicate with each other.

A single GuardPLC controller may have up to 64 connections to other devices on the GuardPLC Ethernet network (GuardPLC controllers, GuardPLC distributed I/O module, OPC servers, or programming terminals). Each connection can transfer up to 900 bytes of data in each direction (read and write). The data size is determined by the number of signals transferred between the devices.

In contrast, a GuardPLC distributed I/O module can have only one connection, the connection to the controller that owns it. The amount of data shared between a distributed I/O module and the controller is fixed and defined by the type of I/O module.

The total number of controllers, distributed I/O module, OPC servers, and programming terminals on a network is limited only by the number of available IP addresses and the network bandwidth (maximum 100 Mbps) of a segment of the network. However, large amounts of data flowing on the network will affect the network response time, and therefore the safety time of the system.

Network Configuration

Communication between GuardPLC controllers can be established via different kinds of Ethernet topologies. Both the HH protocol and the peer-to-peer protocol can be adapted to the network in use, to allow smooth and efficient data transfer.

You configure the HH protocol and the peer-to-peer protocol by setting parameters, either manually or with the help of network profiles. Network profiles are preset combinations of parameters you can choose to make configuration simpler.

To optimize data transfer and customize the configuration, you must have an extensive knowledge of the network in use and the operation of the parameters. The following sections summarize the most important HH and peer-to-peer protocol parameters.

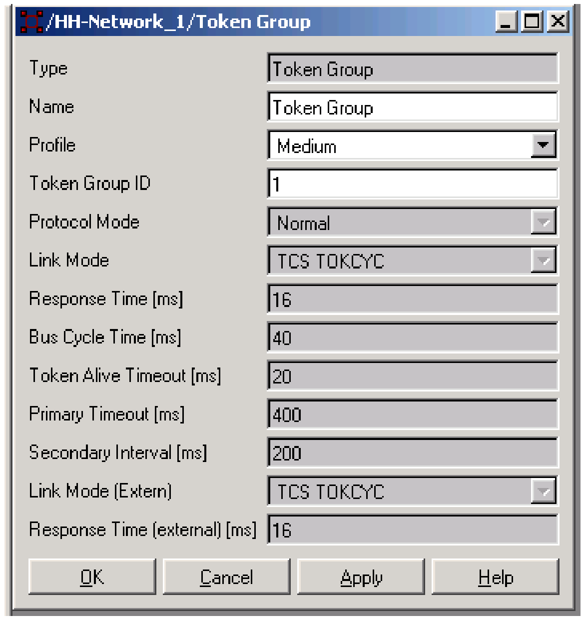
HH Protocol Parameters

The HH protocol parameters are displayed in the HH Network/Token Group dialog box. They can be preset by choosing one of two profiles.

- Fast
- Medium

The profiles are explained in HH Network Profiles on page 161.

TIP	While manual changes to the parameters are possible by choosing the None profile, keep in mind that ill-considered changes can disable communication completely.



Token Group ID

The Token Group ID is the numerical identifier for a token group. Each token group must have its unique Token Group ID.

Protocol Mode

Choose either Normal or RAW protocol mode.

Normal

In Normal mode, software token passing is ON, meaning that access to the Ethernet network is controlled via token passing. Only the controller that holds the token is allowed to access the network.

This mode is recommended for networks with slow hubs to avoid message collisions.

RAW

In RAW mode, software token passing is OFF. No token is created. Ethernet access is coordinated by hardware only. The affiliated Link Mode is TCS direct.

Data transfer is faster than in Normal Mode and message collisions are prevented by the switching and full-duplex mode ports.

This mode is recommended for networks, where full-duplex (recommended) LAN-switches are used exclusively, or the switches integrated into the GuardPLC 1600 and 1800 controllers can be used.

Link Mode

Choose either TCS Direct or TCS TOKCYC.

TCS Direct

In TCS Direct mode, safety-related data are sent as soon as they are prepared for transmission. Network media access is coordinated by hardware.

TCS TOKCYC

This link mode corresponds to Normal protocol mode. Safety-related data is sent when the controller receives the token. Network media access is coordinated by software.

Response Time

Response Time is the controller's maximum permissible Response Time for a network message. PES_1 (Programmable Electronic $System_1$) sends a message to PES_2 and expects the answer within the Response Timeout.

The actual values of the ResponseTime can be read in the HH Status of the Control Panel.

	Controller	LinkId	Status	RspT last [ms]	RspT avg [ms]	RspT max [ms]	RspT min [ms]
1	GPLC1200_2	2	connected	2	2	2	2
2	GPLC2000_1	3	connected	3	3	3	3

Token Cycle Time

This is the maximum permissible time for one token cycle. In other words, the time within which a controller expects the token.

The Token Cycle Time depends on the number of controllers in a token group and can be read on the HH Status tab of the Control Panel.

		last	avg	max	min
1	Token Cycle Time	11	8	36	5

Token Alive Timeout

The current holder of the token must send a token alive message to the Primary[1] controller within this time period or the Primary assumes the token is bad. If the token alive message is missing, a new token is created by the Primary.

Primary Timeout

Time, within which the Primary expects a check for liveliness from the Secondary[2] controller. If the liveliness check fails to appear, the Primary assumes that the present Secondary is disconnected. In this case, the Primary selects a new Secondary.

Secondary Interval

Time, after which the Secondary checks the Primary for liveliness. The Secondary Interval is less than the Primary Timeout.

Link Mode (Extern)

Same as Link Mode above, except for the connection is to a controller in another Token Group.

Response Time (Extern)

Same as Response Timeout above, except for the connection is to a controller in another token group.

(1) The Primary is the controller that generates and supervises the token.

(2) The Secondary is a controller in the same token group as the Primary. The Secondary supervises the Primary.

Peer-to-peer Protocol Parameters

All peer-to-peer protocol parameters are displayed in the Peer-to-Peer Editor. With the exception of the ResponseTime and the ReceiveTMO, which have to be configured by the user, all other peer-to-peer protocol parameters are automatically preset with the selection of a peer-to-peer profile. See Configure Peer-to-peer Communication on page 184 for detailed instructions on how to configure the peer-to-peer protocol.

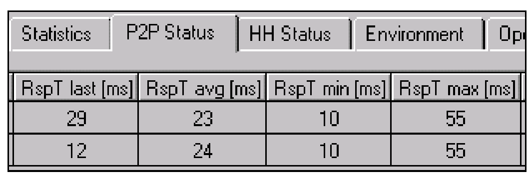
Message Response Time (ReponseTime)

ResponseTime is the user-configurable time it takes to receive an acknowledgement of a sent message from the recipient.

The ResponseTime is not a freely configurable parameter, but results from the physical conditions of the communication path and the configuration of the network protocol.

Because the ResponseTime influences the speed of message exchange, a test run is recommended to investigate network timing.

Use the P2P Status tab, in the Control Panel to display the minimum, maximum, and average ResponseTime.



The ResponseTime is the sum of the following variables, described in the table below.

$$ResponseTime = T_{GR1} + T_1 + T_{GR2} + T_3 + T_2$$

Response Time Variables

Variable	Definition
T_{GR1}	Message delay between two PES: $CPU_1 \rightarrow COM_1 \rightarrow network \rightarrow COM_2 \rightarrow CPU_2$
T_1	Time on CPU_2 to process all protocol stacks: $T_1 = CycleTime(CPU_2) \times n_2$ where n_2 is the number of cycles needed on CPU_2 to process all protocol stacks. Set the Communication Time Slice (see below) large enough to allow all protocol stacks to be processed in one cycle.
T_2	Delay of the acknowledgement on CPU_2: $T_2 = AckTMO + n_2 \times [0 \ldots CycleTime(CPU_2)]$ If AckTMO = 0 or ProdRate = 0, then $T_2 = 0$
T_{GR2}	Message delay between two PES: $CPU_2 \rightarrow COM_2 \rightarrow network \rightarrow COM_1 \rightarrow CPU_1$ (usually identical with T_{GR1})
T_3	Time on CPU_1 to process all protocol stacks: $T_3 = CycleTime(CPU_1) \times n_1$ where n_1 is the number of cycles needed on CPU_1 to process all protocol stacks. Set Communication Time Slice (see page 176) large enough to allow all protocol stacks to be processed in one cycle.

Receive Timeout (ReceiveTMO)

ReceiveTMO is the safety-related, user-configurable monitoring time, within which PES_1 must receive a correct response from PES_2.

TIP ReceiveTMO is also valid for the return path from PES_2 to PES_1.

If ReceiveTMO elapses, safety-related communication closes down and all imported (via communication) safety-related tags reset to their user-configurable initial values.

If the ReceiveTMO ≥ 2 x ResponseTime(minimum), the loss of at least one message can be handled without losing the Peer-to-Peer connection.

If the Receive]TMO is not ≥ 2 x ResponseTime (minimum), the availability of the Peer-to-Peer connection is guaranteed only in a collision- and noise-free network. However, this does not result in a safety problem for the CPU.

TIP The maximum permissible value for ReceiveTMO depends upon the application and is set in the Peer-to-Peer Editor along with the expected maximum ResponseTime and the profile.

Profile	Response Time	Receive TMO
Fast & Cleanroom	40	80
Fast & Cleanroom	100	100

Resend Timeout (ResendTMO)

Resend Timeout is the safety-related monitoring time of PES_1. If the receipt of a data transmission is not confirmed by PES_2 within this time period (ResendTMO), PES_1 repeats the data transmission.

Acknowledge Timeout (AckTMO)

Reception of data must be confirmed by the CPU with an ACK (acknowledge) message to the sender of the data. If the CPU is busy, ACK is delayed. Acknowledge Timeout is the maximum delay an ACK message may have.

The AckTMO cannot be entered manually, but is set in conjunction with a profile in the Peer-to-Peer Editor. For fast networks, AckTMO is zero.

Queue Length (QueueLen)

QueueLen describes the number of messages that may be transmitted without having to wait for an acknowledgement. It corresponds to the network bandwidth and delay.

QueueLen cannot be entered manually, but is set along with a profile in the Peer-to-Peer Editor.

Production Rate (ProdRate)

ProdRate is the minimum time interval between two data messages. The purpose of ProdRate is to limit the amount of data to a magnitude that can be transported to the recipient without overloading a (slow) communication channel. This results in an even load on the communication channel and avoids the reception of outdated data.

TIP A production rate of 0 means that a data message can be transmitted with each cycle of the user program.

Watchdog Time (WDZ)

Watchdog Time is the maximum permissible duration of a Run cycle on a PES. The Run cycle depends upon the complexity of the user program and the number of peer-to-peer connections.

Worst-case Reaction Time (T_R)

Worst-case Reaction Time is a safety-relevant application parameter. It is the time between the occurrence of a physical input signal change at PES_1 and the corresponding physical output signal change at PES_2.

$$\text{Worst-case Reaction Time } (T_R) \leq t_1 + t_2 + t_3 + t_4$$

Worst-case Reaction Time Variables

Variable	Definition
t_1	The worst-case time for the user program on PES_1 to process the input signal and prepare the data for transmission. 2 x WDZ (PES_1)
t_2	The additional transmission delay on PES_1. Equals 0 ms, if the ProdRate is 0. Otherwise: equals ReceiveTMO + WDZ (PES_1)
t_3	ReceiveTMO The maximum age of a message when received at PES_2.
t_4	The maximum time for the received data message to be processed by the user program on PES_2 and the output signal to be set.

The Worst-case ReactionTime T_R is process-dependent and has to be coordinated with the approving board. In the Peer-to-Peer Editor, the Worst-case ReactionTime can be read in the Worst Case column.

	Resource	Worst Case	Profile
1	GPLC1200_2	1180	Fast
2	GPLC2000_1	2100	Fast

HH Network Profiles

Two HH network profiles are used to configure the appropriate set of parameters for the network in use. The profiles, described below, can be chosen in the properties of the HH Network token group.

- Profile I: Fast
- Profile II: Medium

A third profile option, None, lets you set parameters manually. See The None Profile on page 167 for more information.

Profile I: Fast

This is the recommended profile. It provides the fastest data throughput, and covers approximately 95% of all application cases.

Use Fast for:

- applications that require fast data update rates within a token group[1].
- fast communication between two or more token groups[1], where the other token groups must run Fast as well.
- applications that require the shortest feasible Worst-case Reaction Time.

TIP Because Token Passing is switched off in the Fast profile, it is possible to generate a token group with only one controller. No second controller is needed to exchange the token. The single controller can communicate with other token groups containing more controllers.

(1) A token group consists of at least two controllers, which share the same token. Each controller must be a member of exactly one token group. A token group can work stand-alone or can exchange data with other token groups.

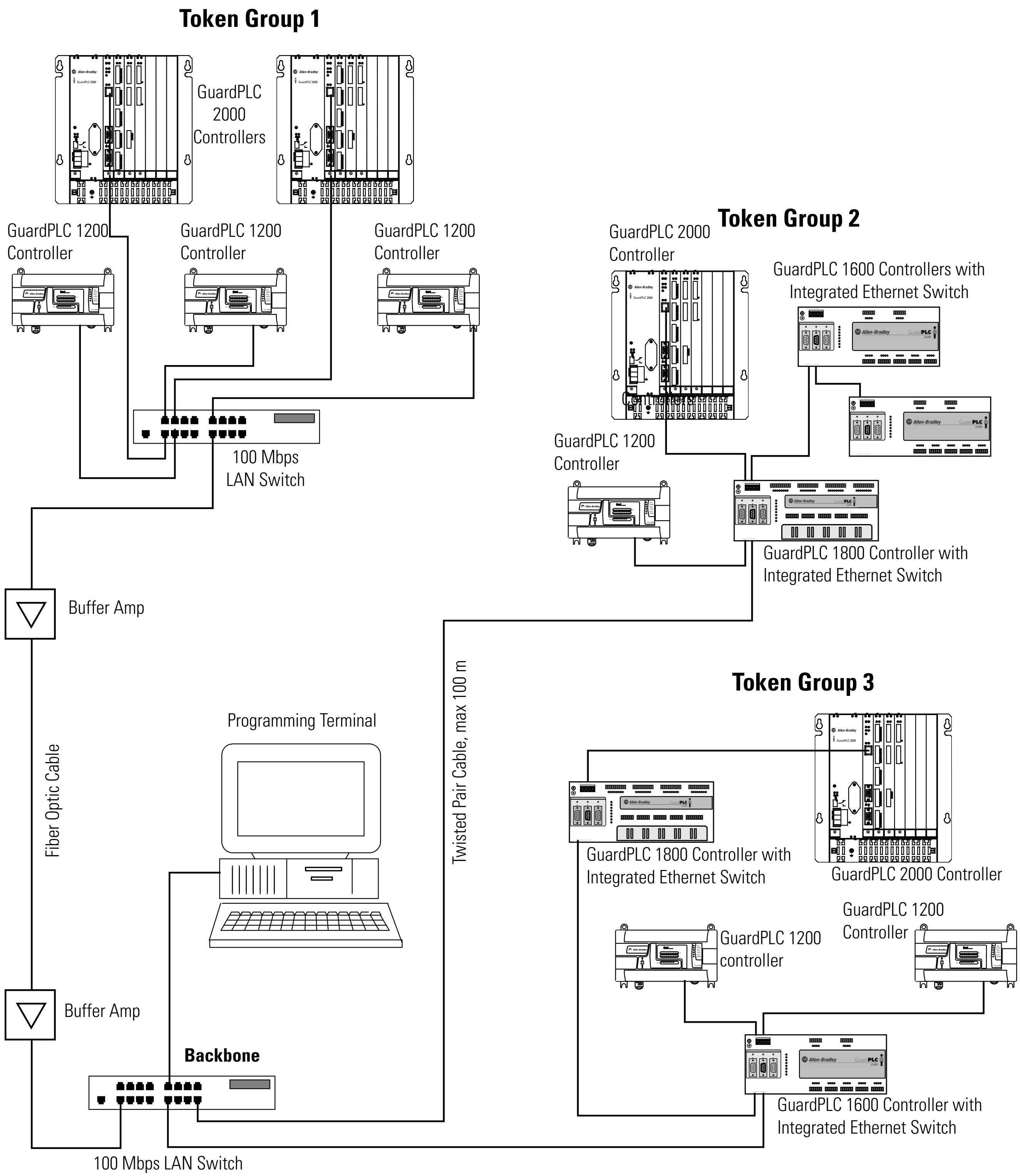
The minimum network requirements are outlined this table.

Minimum Ethernet Network Requirements for Profile I

Requirement	Definition
Fast	100 Mbps technology (100-Base TX)
Switched	Fast Ethernet (full-duplex recommended) LAN switches or integrated switches (GuardPLC 1600/1800 controller) required.
Cleanroom	No loss of data due to traffic overload, harsh environmental conditions, or network defects.

TIP The network can be shared with other applications, if sufficient bandwidth is provided.

Example of HH Network Profile I Topology



Profile II: Medium

This profile provides medium-speed data throughput and covers approximately 4% of all application cases. It is appropriate for applications where timing is not a critical factor. With the Medium profile, network media access within a token group and communication with external token groups is controlled by token passing. These external token groups must also run Medium profiles.

IMPORTANT In the Medium profile, a token group must be comprised of at least two controllers to carry out token passing, otherwise the controller configuration is erroneous. (Stop/Invalid Configuration).

Minimum Ethernet Network Requirements for Medium & Cleanroom

Requirement	Definition
Medium	10 Mbps technology (10-Base T) Hubs are used within the token groups and LAN switches connect one token group to another.
Clean	No loss of data due to traffic overload, harsh environmental conditions, or network defects.

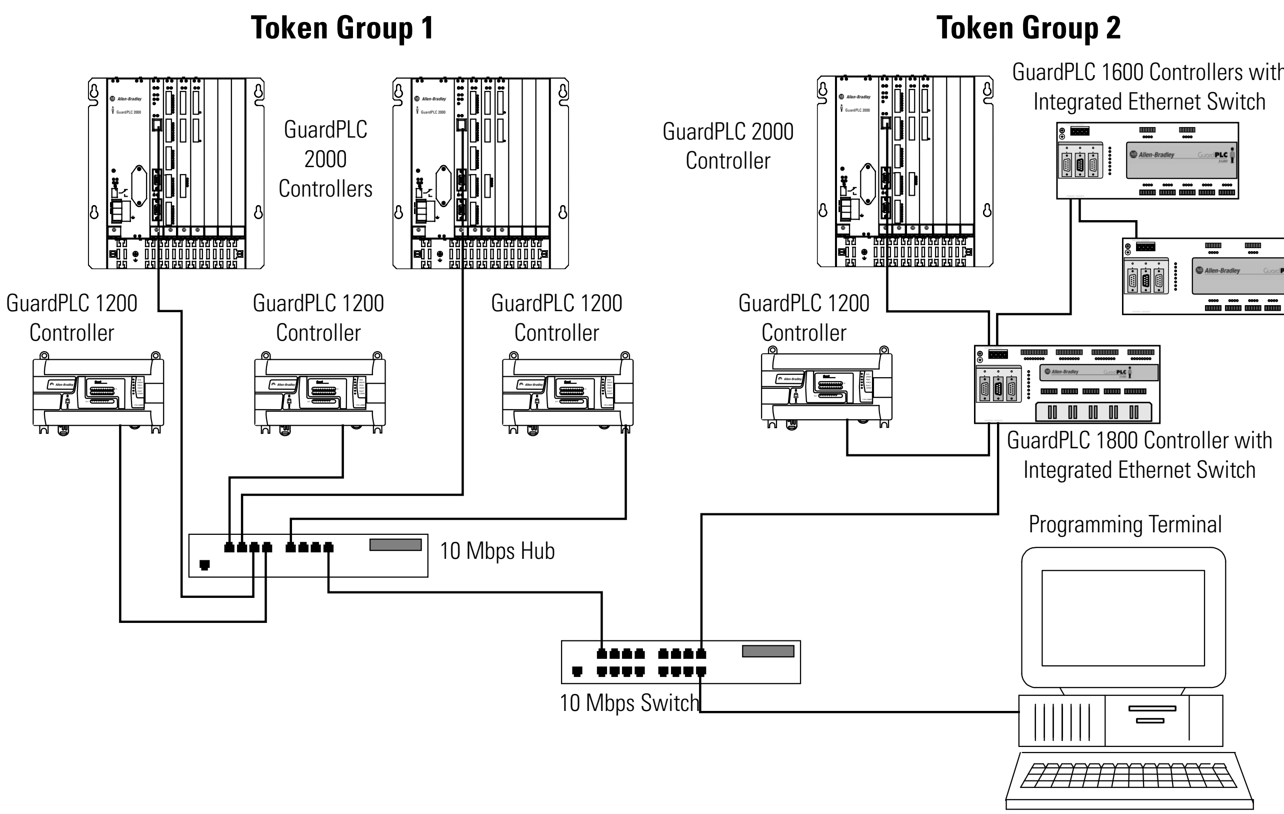
IMPORTANT The network must not be shared with other applications. Do not use more than one programming terminal (recommended). programming terminals increase network traffic, but do not participate in token passing.

Using LAN Switches and Hubs

When using a hub instead of a LAN switch to interconnect two or more controllers of the same token group, network access within the token group is no longer conducted by the hardware, but must be managed by token passing.

Each token group handles its token passing individually, depending on user settings, CPU cycle times, network topology, and so forth. This means that for two (or more) token groups, which are exchanging data, Token passing is not synchronized, resulting in a loss of messages between the Token Groups.

IMPORTANT	To minimize loss of messages, only one controller in a token group is allowed to exchange data with exactly one controller in a second token group. Furthermore, the overall number of links between token groups is limited to eight.



The illustration above shows an application, consisting of two token groups. The token groups equipped with hubs require token passing to coordinate network access within the token groups. The token groups are interconnected via a LAN switch.

In this network topology, only one controller in Token Group 1 is allowed to exchange data with one controller in Token Group 2. If Token Group 2 needs data from different controllers in Token Group 1, the "talking" controller in Token Group 1 must collect the data.

In the HH Network Profile II Configuration Topology example on page 167, only these links between Token Groups are allowed:

- A1 ↔ A2
- B1 ↔ B2
- C1 ↔ C2

To configure this scenario, the controllers are placed in their respective token groups.

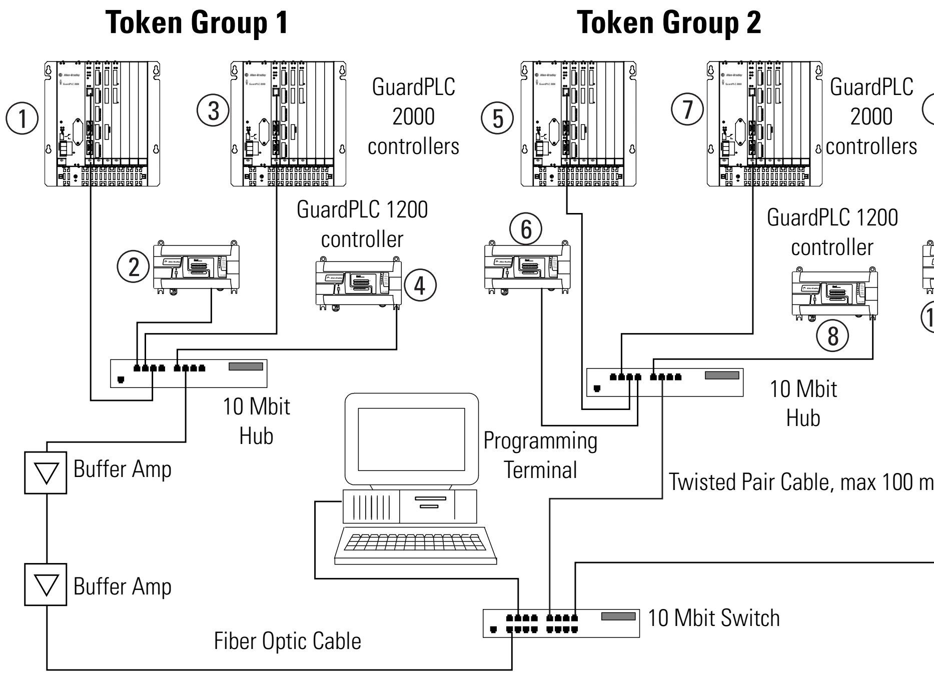
Token Group 1	Token Group 2	Token Group 3
Controller 1	Controller 5	Controller 9
Controller 2	Controller 6	Controller 10
Controller 3	Controller 7	Controller 11
Controller 4	Controller 8	Controller 12

In the Peer-to-Peer Editor, you create connections between controllers. For example, all controllers in Token Group 1 can communicate to each other, but Controller 1 can also communicate to Controller 5 in Token Group 2.

Token Group 1 Connections

Controller 1	Controller 2	Controller 3	Controller 4
Controller 2	Controller 1	Controller 1	Controller 1
Controller 3	Controller 3	Controller 2	Controller 2
Controller 4	Controller 4	Controller 4	Controller 3
Controller 5	—	—	—

HH Network Profile II Configuration Topology



The None Profile

The None profile is different from the profiles described previously because it has no pre-defined parameters. You must set all the parameters manually.

To set the parameters, choose either Fast or Medium from the HH Network/Token Group dialog box, and click Apply. This presets the parameters according to the profile.

To enable manual changes and activate the entry fields, choose None and click Apply again. The former parameter settings will be overridden and can then be changed.

Because the profiles Fast and Medium cover nearly all conceivable network topologies, None is recommended for evaluation purposes only. An extensive knowledge of the functions of the parameters, their value ranges, and their impact on the availability of the network is required for proper manual parameterization.

IMPORTANT The None profile should not be used in regular applications.

Peer-to-Peer Network Profiles

Due to the variety of parameters, manual network configuration is very complex and requires extensive knowledge of the parameters and how they influence one another.

To simplify the setup, RSLogix Guard PLUS! software provides six Peer-to-Peer profiles, which can be selected by the user, depending upon application requirements and the capabilities of the network.

Profiles are combinations of matched parameters that are automatically set when the user chooses a certain profile. The intention of all profiles is to optimize the data throughput on the network, which minimizes the ReceiveTMO and results in a low Worst Case ReactionTime.

For the definitions of the Peer-to-Peer network parameters, see page 157.

The six profiles, listed below, are described in the following sections:

- Fast & Cleanroom,
- Fast & Noisy,
- Medium & Cleanroom,
- Medium & Noisy,
- Slow & Cleanroom, and
- Slow & Noisy

Peer-to-Peer Profile I: Fast & Cleanroom

This profile provides the fastest data throughput for applications that require fast data update rates. It is also best for applications that require the shortest feasible Worst-Case ReactionTime.

Fast & Cleanrooom Characteristics

<table>
<tr><td rowspan="3">Minimum Ethernet network requirements(1)</td><td>Fast</td><td>100 Mbit technology (100 Base TX)</td></tr>
<tr><td>Switched</td><td>Fast Ethernet (full-duplex recommended) LAN switches or integrated switches
(GuardPLC 1600/1800 controller) required.</td></tr>
<tr><td>Cleanroom</td><td>No loss of data due to traffic overload, harsh environmental conditions or network defects.</td></tr>
<tr><td>Characteristics of the communication path</td><td colspan="2">Minimum delays
ResponseTime ≤ReceiveTMO ÷ 2 (otherwise ERROR)</td></tr>
<tr><td rowspan="3">Variables</td><td>ResponseTime</td><td>manually set in the Peer-to-Peer Editor</td></tr>
<tr><td>ReceiveTMO</td><td>manually set in the Peer-to-Peer Editor</td></tr>
<tr><td>WDZ (Watchdog Time)</td><td>manually set in the controller properties</td></tr>
<tr><td>Suitable HH network profile</td><td colspan="2">Fast</td></tr>
<tr><td>Peer-to-Peer parameter presets</td><td colspan="2">• QueueLen = 2
• Communication Time Slice large enough to process and send all data defined for transmission in one CPU cycle.
• ResendTMO
– if ReceiveTMO ≥ 2 x WDZ, then
ResendTMO = ReceiveTMO ÷ 2, or
ResendTMO = ResponseTime, whichever is greater
– if ReceiveTMO < 2 x WDZ, then
ResendTMO = ReceiveTMO
• AckTMO = 0
• ProdRate = 0</td></tr>
</table>

(1) The network can be shared with other applications, if sufficient bandwidth is provided.

Peer-to-Peer Profile II: Fast & Noisy

This profile provides fast data throughput for applications that require fast data update rates. It is good for applications that require the shortest feasible Worst-Case Reaction Time where minor loss of messages can be corrected.

Fast & Noisy Characteristics

Minimum Ethernet network requirements	Fast	100 Mbit technology (100 Base TX), if HH network profile Fast & Cleanroom is selected. 10 Mbit technology (10 Base T), if HH network profile Medium & Cleanroom is selected.
	Switched	Fast Ethernet (full duplex recommended) LAN switches, if HH network profile Fast & Cleanroom is selected. 10 MBit hubs, if HH network profile Medium & Cleanroom is selected. Or use switches integrated into the GuardPLC 1600/1800 controllers.
	Noisy	Low probability for loss of messages. Time for ≥ 1 repetitions.
Characteristics of the communication path	Minimum delays ResponseTime ≤ReceiveTMO ÷ 2 (otherwise ERROR)	
Variables	ResponseTime	manually set in the Peer-to-Peer Editor
	ReceiveTMO	manually set in the Peer-to-Peer Editor
	WDZ	manually set in the controller properties
Suitable HH network profile	Fast Medium (≤10 controllers in a Token Group)	
Peer-to-Peer parameter presets	• QueueLen = 2 • Communication Time Slice large enough to process and send all data defined for transmission in one CPU cycle. • ResendTMO – if ReceiveTMO ≥ 2 x WDZ, then ResendTMO = ResponseTime (≥ 1 Resend possible) – if ReceiveTMO < 2 x WDZ, then ERROR • AckTMO = 0 • ProdRate = 0	

Peer-to-Peer Profile III: Medium & Cleanroom

This profile provides medium data throughput for applications where only a moderate data update rate is required and where the Worst Case Reaction Time is not a critical factor. It is well-suited for virtual private networks (VPN), where data exchange is slow due to safety devices (firewalls, encoding/decoding), but error-free.

TIP Normally use the profile Medium & Noisy (see page 172).

Medium & Cleanroom Characteristics

Minimum Ethernet network requirements	Medium or Fast	10 MBit (10 Base T) or 100 Mbit technology (100 Base TX) or network with both 10 MBit and 100 MBit components. LAN switches required.
	Clean	No loss of data due to traffic overload, harsh environmental conditions or network defects. Time for ≥ 0 repetitions.
Characteristics of the communication path	Moderate delays ResponseTime ≤ReceiveTMO (otherwise ERROR)	
Variables	ResponseTime	manually set in the Peer-to-Peer Editor
	ReceiveTMO	manually set in the Peer-to-Peer Editor
	WDZ	manually set in the controller properties
Suitable HH network profile	Fast Medium (≤10 controllers in a Token Group)	
Peer-to-Peer parameter presets	• QueueLen = 3 • Communication Time Slice large enough to process and send all data defined for transmission in one CPU cycle. • ResentTMO – if ReceiveTMO ≥ 2 x WDZ, then ResendTMO = ResponseTime (≥ 0 Resends possible) – if ReceiveTMO < 2 x WDZ, then ResendTMO = ReceiveTMO • AckTMO = ReceiveTMO or AckTMO = AckTMOMax, whichever is smaller • ProdRate = ResponseTime ÷ 4	

Peer-to-Peer Profile IV: Medium & Noisy

The Medium and Noisy profile provides medium data throughput for applications where only a moderate data update rate is required. It is good for applications where the Worst Case ReactionTime is not a critical factor. Minor loss of messages can be corrected.

Medium & Noisy Characteristics

<table>
<tr><td rowspan="2">Minimum Ethernet network requirements</td><td>Medium or Fast</td><td>10 MBit (10 Base T) or 100 Mbit technology (100 Base TX) or network with both 10 MBit and 100 MBit components.
Usage of hubs possible.</td></tr>
<tr><td>Noisy</td><td>Low probability for loss of messages.
Time for ≥ 1 repetitions.</td></tr>
<tr><td>Characteristics of the communication path</td><td colspan="2">Moderate delays
ResponseTime ≤ReceiveTMO ÷ 2</td></tr>
<tr><td rowspan="3">Variables</td><td>ResponseTime</td><td>manually set in the Peer-to-Peer Editor</td></tr>
<tr><td>ReceiveTMO</td><td>manually set in the Peer-to-Peer Editor</td></tr>
<tr><td>WDZ</td><td>manually set in the controller properties</td></tr>
<tr><td>Suitable HH network profile</td><td colspan="2">Medium or Fast</td></tr>
<tr><td>Peer-to-Peer parameter presets</td><td colspan="2">• QueueLen = 3
• Communication Time Slice large enough to process and send all data defined for transmission in one CPU cycle.
• ResendTMO
– if ReceiveTMO ≥ 2 x WDZ, then ResendTMO = ResponseTime (≥ 1 Resend possible)
– if ReceiveTMO < 2 x WDZ, then ERROR
• AckTMO = ReceiveTMO or AckTMO = AckTMOMax, whichever is smaller
• ProdRate = ResponseTime ÷ 4</td></tr>
</table>

Peer-to-Peer Profile V: Slow & Cleanroom

This profile provides low data throughput for applications where only a low data update rate is required from remote controllers, via communication paths, whose conditions cannot be predicted by the user.

TIP Normally use the profile Slow & Noisy (see page 174).

Slow & Cleanroom Characteristics

Minimum Ethernet network requirements	Slow	Primarily for data exchange via ISDN, leased line or slow line-of-sight radio link.
	Clean	No loss of data due to traffic overload, harsh environmental conditions or network defects. Time for ≥ 0 repetitions.
Characteristics of the communication path	Moderate to long delays ResponseTime ≤ReceiveTMO, otherwise ERROR	
Variables	ResponseTime	manually set in the Peer-to-Peer Editor
	ReceiveTMO	manually set in the Peer-to-Peer Editor
	WDZ	manually set in the controller properties
	N	number of link partners a controller can talk to defined in the Peer-to-Peer Editor
Suitable HH network profile	Medium or Fast	
Peer-to-Peer parameter presets	• QueueLen = 4 • Communication Time Slice large enough to process and send all data defined for transmission in one CPU cycle. • ResendTMO – if ReceiveTMO ≥ 2 x WDZ, then ResendTMO = ResponseTime (≥ 0 Resends possible) – if ReceiveTMO < 2 x WDZ, then ResendTMO = ReceiveTMO • AckTMO = ReceiveTMO or AckTMO = AckTMOMax, whichever is smaller • ProdRate = ResponseTime ÷ 4	

Peer-to-Peer Profile IV: Slow & Noisy

This profile provides low data throughput for applications where only low data update rates are required. It is primarily for data exchange via poor quality telephone lines or distorted radio links.

Slow & Noisy Characteristics

<table>
<tr><td rowspan="2">Minimum Ethernet network requirements</td><td>Slow</td><td>Data transfer via telephone, satellite link, radio, and so forth.</td></tr>
<tr><td>Noisy</td><td>Low loss of data due to distortions on the communication path or network defects.
Time for ≥ 1 repetitions.</td></tr>
<tr><td>Characteristics of the communication path</td><td colspan="2">Moderate to long delays
ResponseTime ≤ReceiveTMO ÷ 2, otherwise ERROR</td></tr>
<tr><td rowspan="2">Variables</td><td>ResponseTime</td><td>manually set in the Peer-to-Peer Editor</td></tr>
<tr><td>ReceiveTMO</td><td>manually set in the Peer-to-Peer Editor</td></tr>
<tr><td>Suitable HH network profile</td><td colspan="2">Medium or Fast</td></tr>
<tr><td>Peer-to-Peer parameter presets</td><td colspan="2">• QueueLen = 4
• Communication Time Slice large enough to process and send all data defined for transmission in one CPU cycle.
• ResendTMO
– if ReceiveTMO ≥ 2 x WDZ, then ResendTMO = ResponseTime (≥ 1 Resend possible)
– if ReceiveTMO < 2 x WDZ, then ERROR
• AckTMO = ReceiveTMO or AckTMO = AckTMOMax, whichever is smaller
• ProdRate = ResponseTime ÷ 4</td></tr>
</table>

Configure Peer-to-Peer Communication

Introduction

Using peer-to-peer communication, you can exchange signals between controllers by dragging signals onto pages that create controller-to-controller connections. For example, controller 1 could send three signals (out1, out2, and out3) to controller 2. Controller 2 can then use these signals as inputs within its function block code.

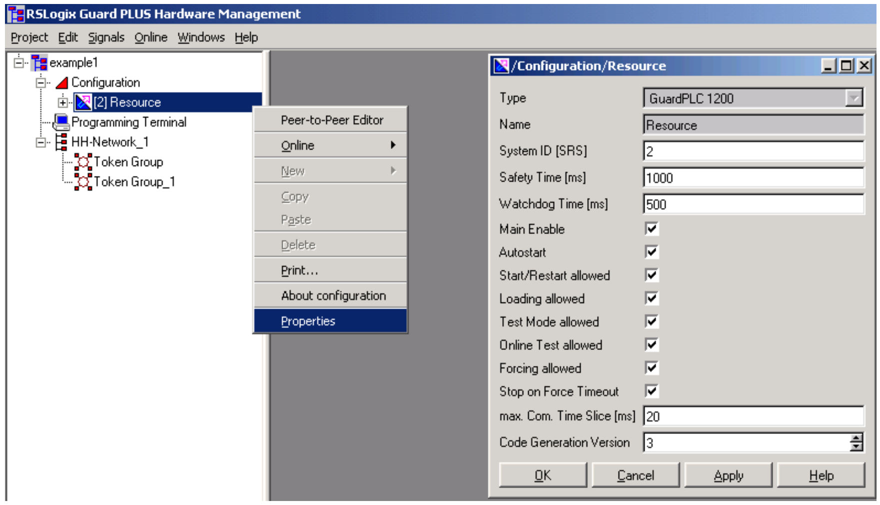
Considerations for Using Peer-to-peer

Before you start a project that exchanges data between several controllers, you should become familiar with the requirements of your application. Questions about the network design, which should be answered prior to developing the project, include the following:

- Is timing a critical factor of the application? This is the most important question!
- How many controllers will be involved?
- Is it necessary to establish an Ethernet network exclusively for the application, or can an existing network be shared?
- How far away from each other are the controllers?
- Are transportation media, other than the Ethernet network, needed (such as telephone lines, radios, fiber optics, and so forth)?
- Is it necessary for each controller to communicate with all other controllers?
- Can some functions of the application be grouped and executed separately by an isolated group of controllers (token group)?

Set Peer-to-Peer Controller Properties

Right-click Resource and choose Properties to set the timing parameters and switches according to the requirements of your application.



The Communication Time Slice and Code Generation Version settings are needed for peer-to-peer network parameterization.

Communication Time Slice

The Communication Time Slice is the time in milliseconds reserved for a controller to carry out and complete all communication tasks in one CPU cycle.

The minimum Communication Time Slice depends on the number of communication connections (n) a controller has.

The minimum Communication Time Slice (CTS_{min}) is calculated as follows.

For $n \leq 13$:	CTS_{min} $(n \leq 13) = n \times 1\ ms + 4\ ms$
For $n > 13$:	CTS_{min} $(n > 13) = n \times 1.3\ ms$

IMPORTANT Do not set the Communication Time Slice below the calculated value. If the Communication Time Slice is too small, it takes more than one CPU cycle to carry out the pending communication tasks. Therefore, more time is needed to complete the communication tasks, which degrades performance and could result in a communication shutdown due to a communication timeout (ReceiveTMO).

The time actually needed for communication adds to the CPU cycle time. A short Communication Time Slice limits the communication time to a low value. This prevents the CPU cycle time from being noticeably influenced by network occurrences. Although a Communication Time Slice well above the minimum value may result in cycle time on the local machine slowing down a bit if network traffic is heavy, it is not necessarily negative.

If you are transferring safety I/O over the network, you need a Communication Time Slice high enough to guarantee that the communication are completed every cycle. If it takes more than one cycle to read/write safety I/O, your safety time will need to increase to compensate.

If you are only transferring status data over the network, then a lower Communication Time Slice is permissible, because it leaves more time in the cycle for your program to run. It's likely to be acceptable even if it takes more than one cycle to read the status.

Check the CPU short-term diagnostics for any Time Slice expired entries and increase the Communication Time Slice if necessary, before the application goes into regular operation. In the Statistics of the Control Panel, Number of Time Slices higher than 1 also indicate a Communication Time Slice that is too short. Number of Time Slices indicates the number of cycles it took for communication to complete.

The maximum Communication Time Slice depends on the application and is calculated as follows.

WDZ ≥ Communication Time Slice (max) + Application Execution Time

In other words, the Communication Time Slice plus Application Execution Time must not exceed the Watchdog Time.

EXAMPLE

If the controller on page 176 has 10 connections, the minimum Communication Time Slice is:

CTS_{min} = 10 x 1 ms + 4 ms = 14 ms.

CTS_{min} is increased by 6 milliseconds to provide a safety margin.

CTS_{min} = 20 ms

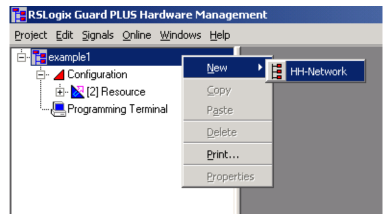
With a Watchdog Time of 500 ms, this leaves 480 ms for the application to be executed.

Code Generator Version

To compile the logic correctly for your type of controller, set Code Generator Version to three (3) for RSLogix Guard PLUS! software. Set to version two (2) for RSLogix Guard software.

Create a Peer-to-peer Network

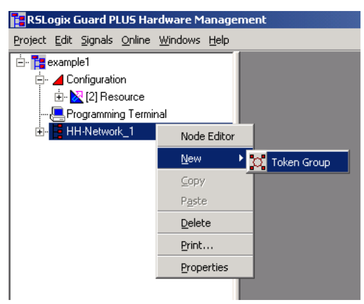
To create a peer-to-peer network, right-click the project in the Hardware Management window and choose New>HH-Network.



You can right-click HH-Network and Rename the entry, if desired.

Create Token Group(s)

A single token group is automatically created with the HH network. If you need more, create token groups by right-clicking HH-Network and choosing New>Token Group.



Expand the HH-Network, right-click Token Group(s) and rename the Token Group(s), if desired.

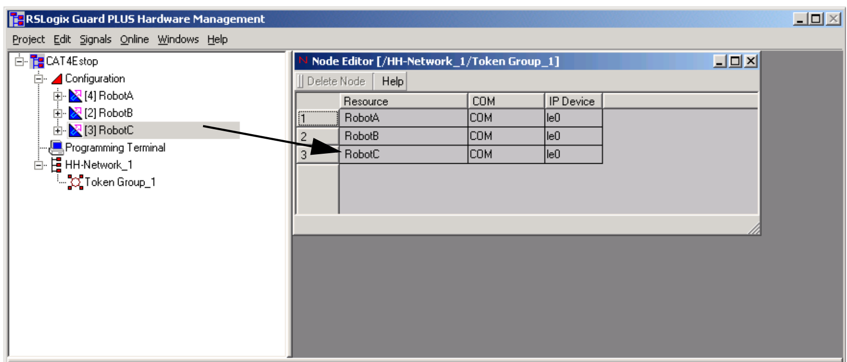
Add Controllers to Token Group(s)

A controller must be a member of only one token group. To add a controller to a token group, follow these steps.

1. Expand the HH-Network, right-click a token group, and choose Node Editor.

   The Node Editor is empty when you open it for the first time.

2. Click a controller in the tree view and drag and drop it in the Node Editor.



Configure Token Group(s)

1. Right-click the token group and choose Properties.

2. In the HH-Network/Token Group dialog box, choose a profile.

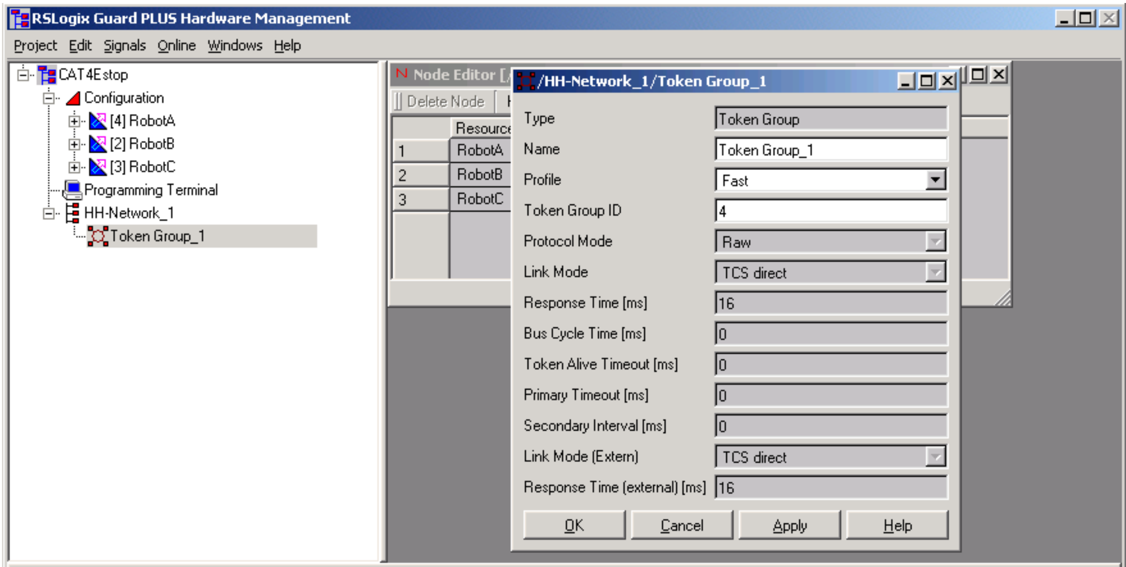
   For a description of the HH-Network profiles, see page 161. In general, Fast works with most network topologies.

3. Enter a Token Group ID.

   The Token Group ID must be greater than 0. If you create more than one token group, each token group must have a unique ID.

4. Do not make changes to the other settings in this dialog box.

   See page 153 for the description of the HH protocol parameters.



IMPORTANT You must choose identical profiles for token groups that you want to interconnect. If Link Mode (External) does not match, communication between token groups is impossible.

Design the Logic

Create Peer-to-peer Signals

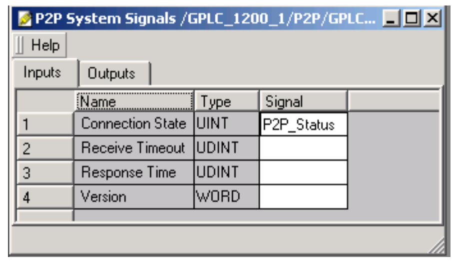
Signals are transferred among controllers over the peer-to-peer network. Consider the following when creating signals:

- You can create as many signals as you need in the logic for all controllers.
- You can add signals anytime.
- Signals with the same name can be used on more than one controller without influencing each other (LOCAL variable), as long as they are not exchanged via network.
- Signals that are intended for network exchange, must have the same name on the participating controllers. Whether a signal is written to or read from the network is defined in the Peer-to-Peer Editor as explained in Configure Peer-to-peer Communication on page 184.

Use Peer-to-peer System Signals

The status of the peer-to-peer communication as well as some timing parameters can be evaluated in the user program by means of system signals. Furthermore, the user program can control how a peer-to-peer connection is setup.

Input System Signals



These system signals can be used as inputs for the application:

- Connection State. Using the Connection State system signal of the Peer-to-Peer Editor, the user program can evaluate the status of the communication between two controllers. This table shows the possible values for the Connection State system signal and the corresponding status.

Value	Status	Description
0	CLOSED	Communication path is closed. No attempt to connect.
1	TRY_OPEN	Communication path is closed. Attempt to connect.
2	CONNECTED	Communication path is open. No attempt to connect.

- Receive Timeout, in milliseconds, is set by the user.

  For more information see Receive Timeout (ReceiveTMO) on page 158 and Define Peer-to-peer Parameters on page 186.

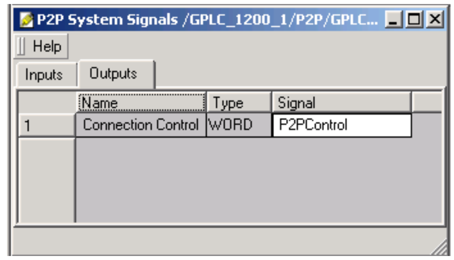
- Response Time, in milliseconds, is the actual value of the last answer message and is identical to RspT last in the P2P status of the Control Panel.

  For more information, see Reconfigure ResponseTime on page 195.

- Version indicates the CRC for the peer-to-peer configuration between two controllers. The CRC must be identical to establish communication.

Output System Signal

Using the output system Connection Control signal, the user program can control how the peer-to-peer connection is setup.



Connection Control Values

Value	Setting	Description
0x0000	Autoconnect	After loss of peer-to-peer communication, the controller tries to re-establish communication in the next CPU cycle. This is the standard mode of operation.
0x0100	Toggle_Mode 0	These modes allow automatic connect with Disable after loss of communication. If Toggle_Mode is 0 and communication is lost (Connection State = CLOSED), a connect is performed only after Toggle_Mode is set to 1 by the user program. If Toggle_Mode is 1 and communication is lost, a connect is performed only after Toggle_Mode is set to 0 by the user program.
0x0101	Toggle_Mode 1	
0x8000	Disabled	Peer-to-peer communication is disabled. No attempt to connect.

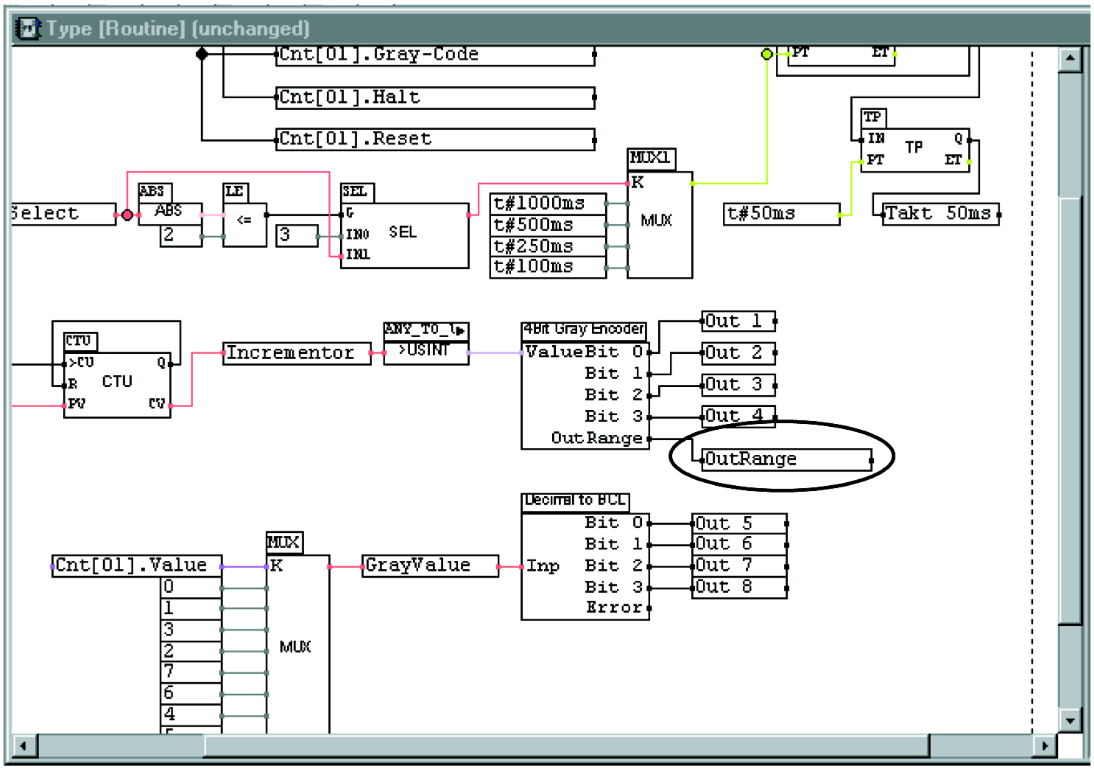
IMPORTANT If the P2PControl signal, in the illustration above, is set to 32768, peer-to-peer communication is disabled. If Connection Control is not set by the application, the default is 0 and Autoconnect is enabled.

Design the Logic for all Controllers

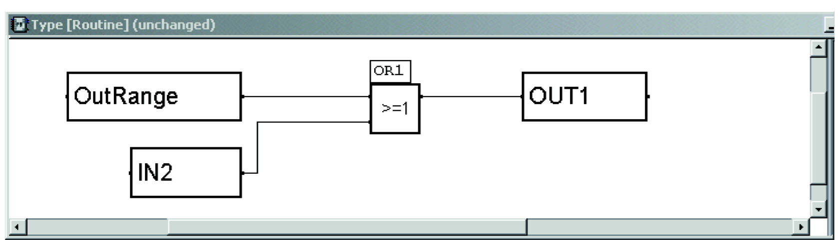
Design the logic for the controllers, considering the variables intended for network exchange.

The following examples show part of the routines for controllers Robot A and Robot B, respectively. To evaluate the state of the OutRange signal in Robot B, use the same signal name (OutRange) as an input for the logic of Robot B. OutRange is sent over the Ethernet network, via Peer-to-Peer, from Robot A to Robot B, which uses it as an input.

Design Logic for Robot A



Design Logic for Robot B



Configure Peer-to-peer Communication

As discussed in the following sections, you configure peer-to-peer communication by:

- defining controller connections.
- assigning the HH-Network.
- choosing a peer-to-peer profile.
- defining peer-to-peer parameters.
- defining process signals for exchange.

Define Controller Connections

To define all of the controllers each controller can communicate with, follow these steps.

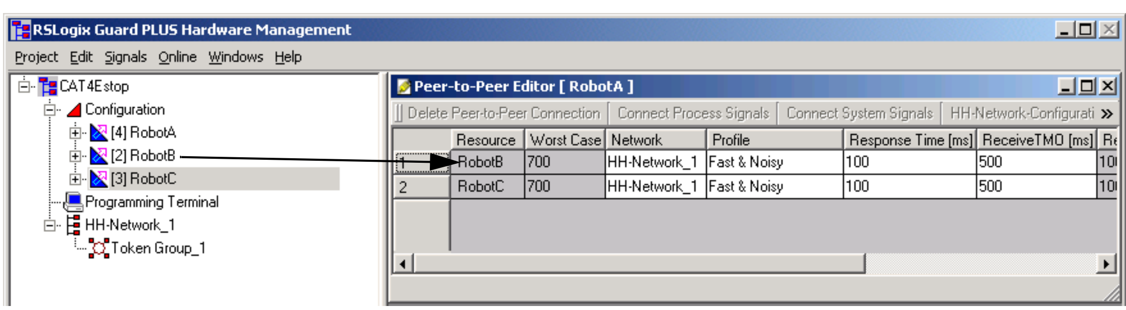
1. Right-click the resource you want to define controller connections for and choose Peer-to-Peer Editor.

   The title bar of the Peer-to-Peer Editor shows the name of the selected controller. When the Peer-to-Peer Editor is opened for the first time, it does not contain any entries.

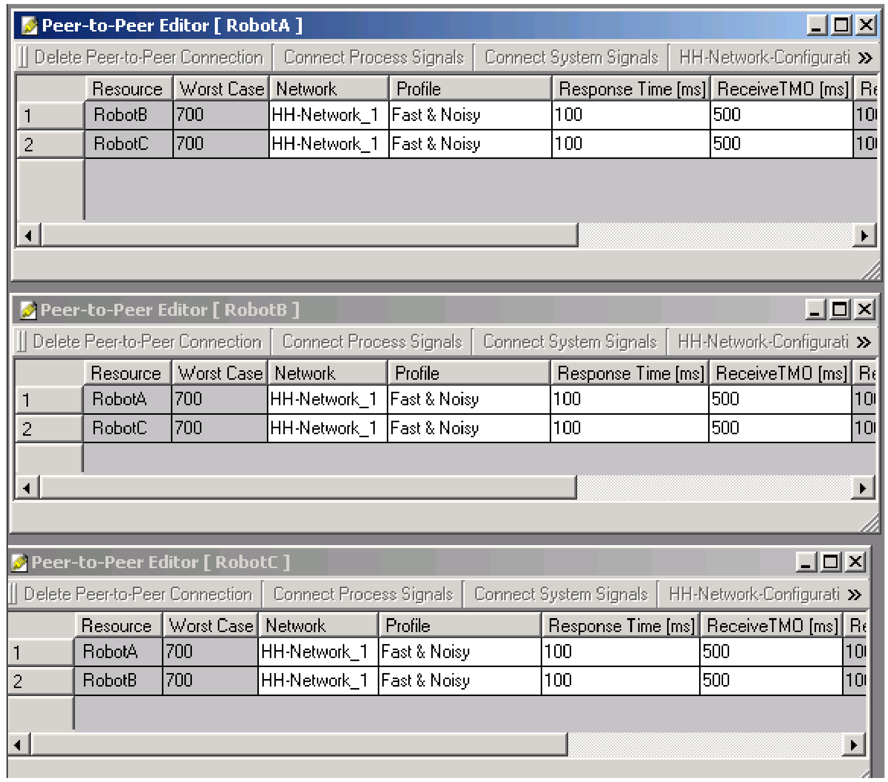
2. In the project tree, click a resource and drag and drop it in the Peer-to-Peer Editor.

3. Repeat step 2 to add more controller connections.

   In the example below, RobotA (title bar) has a connection to RobotB and RobotC. Because the return path is automatically added, you do not need to drag RobotA onto the Peer-to-Peer editors of RobotB or RobotC.



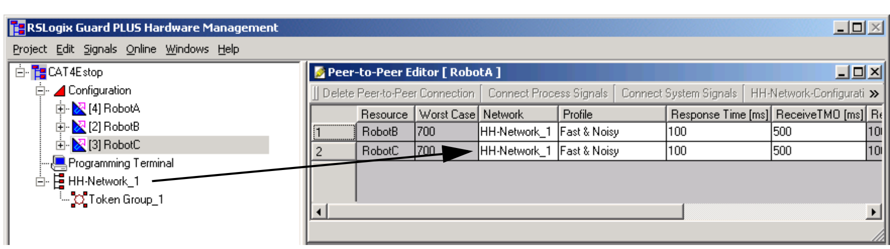
This example shows how the three Peer-to-Peer Editors would appear if connections existed between all three controllers.



Assign HH-Network

Peer-to-peer communication requires the HH-Network, which must be entered in the Peer-to-Peer Editor.

To assign the HH-Network, click the HH-Network in the tree view and drag and drop it in the Network column of the Peer-to-Peer Editor. The return path is automatically updated with the HH-Network.

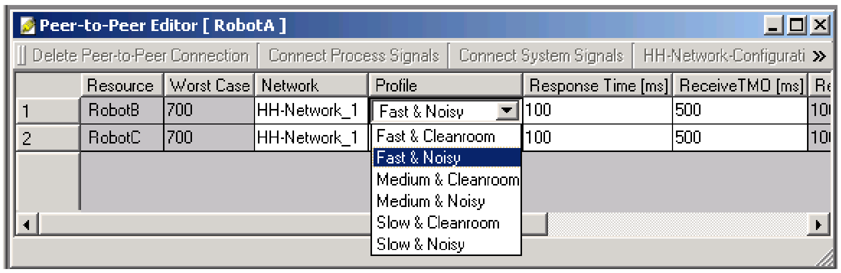


Choose a Peer-to-peer Profile

1. Click in the Profile column and choose one of the profiles.

   Make sure that the profile is suitable for your network topology and matches the HH profile.

   See page 161 for a detailed description of all the profiles.



2. Click outside the table or press the Return key to activate the selection.

   The profile of the return path is automatically updated with the new profile.

Define Peer-to-peer Parameters

The most important timing parameter of a safety related installation is the Safety Time. Safety Time is the time a process can run with incorrect controller outputs without affecting the safety of the process.

See the GuardPLC Controller Systems Safety Reference Manual, publication 1753-RM002 for more details on the Safety Time.

The Worst Case Reaction Time (T_R) is the time within which two linked controllers must detect the occurrence of a physical input signal at PES_1 and put out the resulting physical output signal at PES_2.

To guarantee the integrity of the application, the requirement below must always be fulfilled.

$$T_R < \text{Safety Time}$$

When you choose a peer-to-peer profile, most parameters are automatically preset. Because ReceiveTMO (safety-relevant) is part of the Worst Case ReactionTime T_R (see Peer-to-peer Protocol Parameters on page 157), ReceiveTMO must be calculated and set manually by overwriting the default value in the Peer-to-Peer Editor.

For profiles where ProdRate = 0 (Fast & Cleanroom, Fast & Noisy), ReceiveTMO is:

$$\text{ReceiveTMO} = T_R - 2 \text{ x } \text{WDZ}(\text{PES}_1) - 2 \text{ x } \text{WDZ}(\text{PES}_2)$$

For profiles where ProdRate ≠ 0, ReceiveTMO is:

$$\text{ReceiveTMO} = [T_R - 3 \text{ x } \text{WDZ}(\text{PES}_1) - 2 \text{ x } \text{WDZ}(\text{PES}_2)] \div 2$$

Calculate the ReceiveTMO with the suitable formula and overwrite the default value in the Peer-to-Peer Editor.

Profile	Response Time [ms]	ReceiveTMO [ms]
Fast & Cleanroom	100	500

In first approximation, the ResponseTime can be calculated as:

$$\text{ResponseTime} = \text{ReceiveTMO} \div 2$$

Overwrite the default value of the ResponseTime with the calculated value.

TIP Setting the ResponseTime this way allows the controller to resend a message, in case of unexpected message loss. For best network performance, the ReceiveTMO and the ResponseTime are optimized after the project has been compiled, loaded and started on the controllers. At that time, the actual ResponseTimes and the actual cycle times can be read in the Control Panel.

Define The Signals to Exchange Between Each Controller Connection

1. Right-click a resource in the project tree and choose Peer-to-Peer Editor.

   The Peer-to-Peer Editor opens.

2. Click a line number (leftmost column) in the Peer-to-Peer Editor table.

   This selects a controller with which the controller, named in the headline of the Peer-to-Peer Editor, exchanges data.

3. Open the Signal Editor by choosing Editor from the Signals menu.

4. Click Connect Process Signals in the Peer-to-Peer Editor.

5. Arrange the Signal Editor and the Peer-to-Peer (P2P) Process Signals dialog boxes side by side.

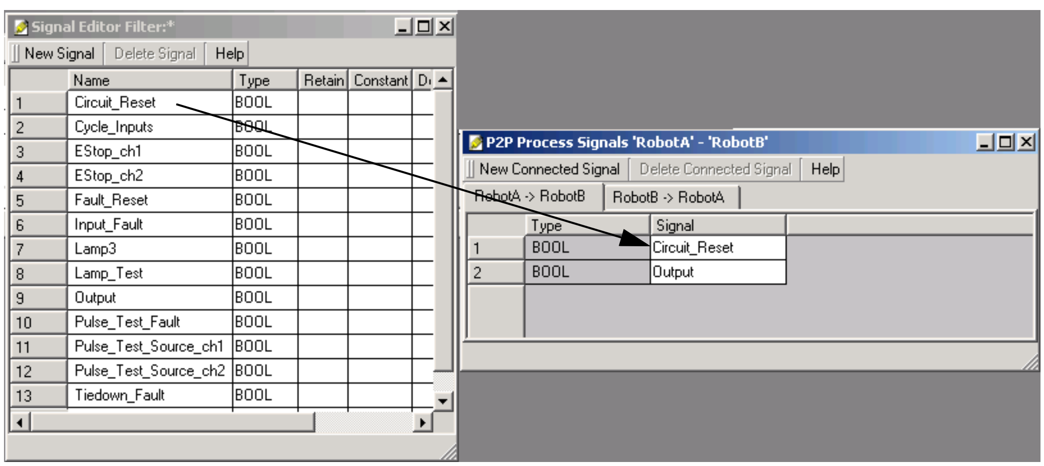
   When you open it for the first time, the P2P Process Signals dialog box is empty.

6. Using the tabs below the button bar of the P2P Process Signals, choose the direction of data exchange.

   In the example below, the direction of data exchange is from RobotA to RobotB.

7. In the Signal Editor, click a signal name and drag & drop it in the P2P Process Signals.

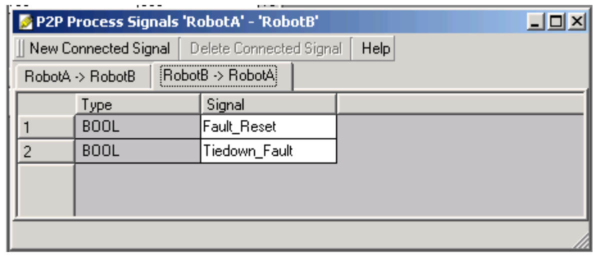
   You can also add signals by using the New Connected Signals button. This creates a new line in the list, in which you must enter the case-sensitive signal name exactly as defined in the Signal Editor.



TIP Sending a signal from one controller to another ($PES_1 \rightarrow PES_2$) makes the value of this signal available in PES_2. To process this value in the logic of PES_2, identical signal names must be used in the logic of both PES_1 and PES_2.

8. Change the direction of data exchange with the tab and define the return signals.

   The illustration below shows the signals that RobotB sends to RobotA.

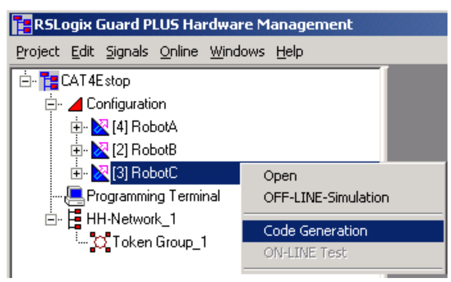


Compile and Download

Compile Logic

If changes, such as adding or deleting a tag, are made to a connection between two controllers, the code must be recompiled for both controllers.

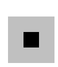
To compile logic, right-click the resource (controller) in the RSLogix Guard PLUS! Project Management window, and choose Code Generation.



If code generation is not successful, carefully check the Error-state viewer in the Hardware Management window for error messages and correct the errors.

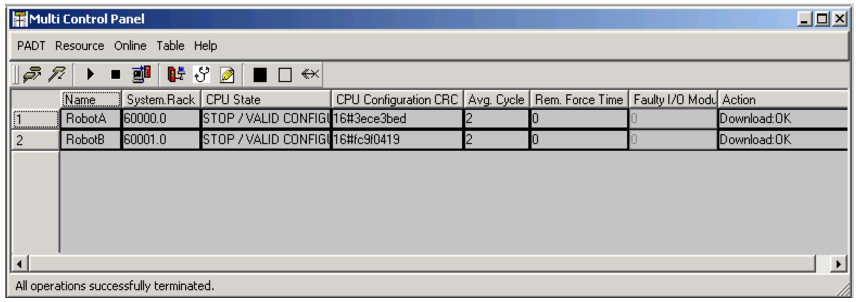
Start Download

1. Using the Multi-Control Panel, click Select all  to select all controllers.

2. Click Stop  to make sure that all controllers are in Stop mode.

3. Click Download to start the simultaneous download for all selected controllers.

   The Action column shows the command that is currently executed or a short status message. In the example below, the downloads have completed successfully.



4. After successful download, the CPU Status is Stop/Valid Configuration.

5. Select all controllers again if necessary, and click Coldstart to start the application.

Network Optimizing

With the initial network settings made in the HH protocol and Peer-to-Peer protocol, communication is likely to work, but the settings can be optimized for homogenous network load and faster message exchange.

IMPORTANT

If there is no real need to reduce Worst Case ReactionTime, do not make changes to the WDZ and the ReceiveTMO!

Only optimize the ResponseTime.

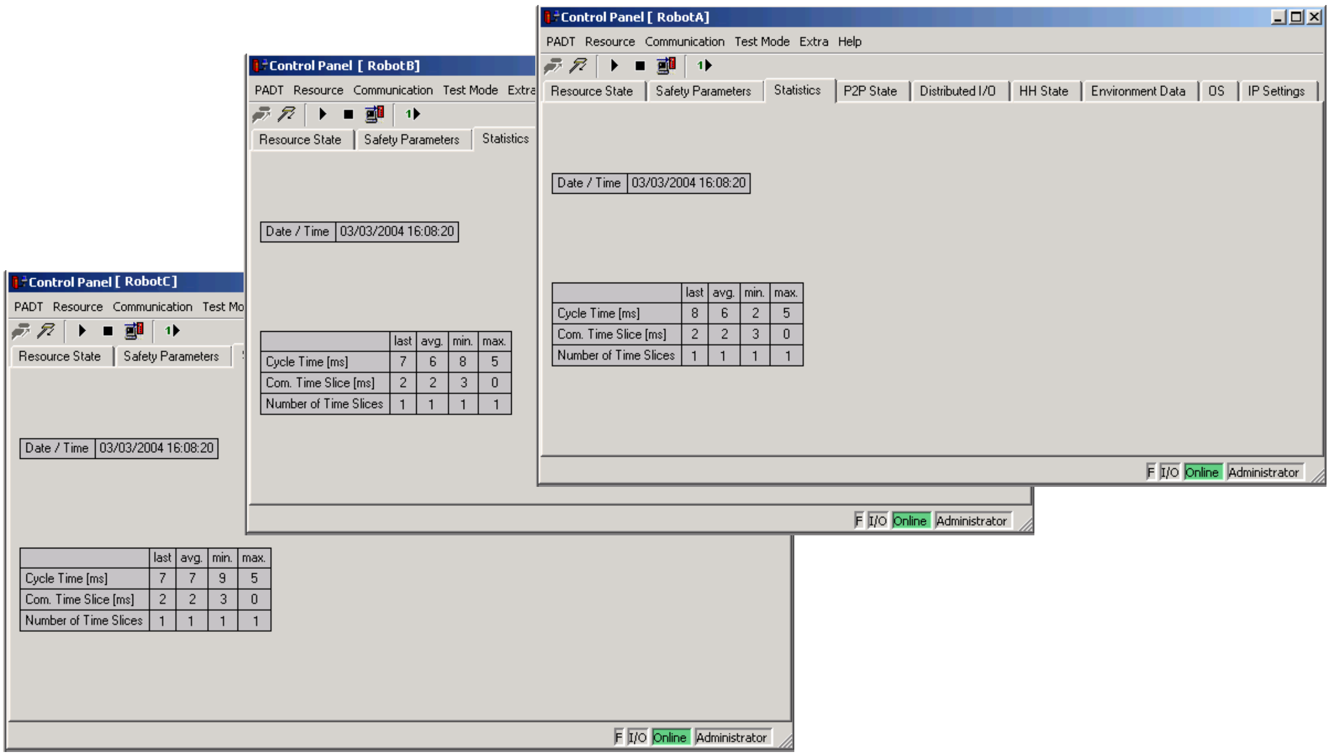
A high WDZ or ReceiveTMO does not degrade performance, but an optimized ResponseTime increases availability.

Before starting the optimization steps, let the project run for several hours. Test as many operating conditions as possible to address timing factors that may prevent a project from running after optimization.

Check Routine Timing

1. In the Multi Control Panel, select all controllers and click Control Panel.

2. In the Control Panels of each controller, click the Statistics tab.



3. Write down the maximum Cycle Time for each controller.

4. Write down the maximum Com. Time Slice for each controller.

IMPORTANT

Before you continue to optimize settings, make sure that Number of Time Slices (see above) is not greater than 1. If Number of Time Slices max is greater than 1, more than one CPU cycle is needed to carry out all communication tasks.

In this case, you need to determine if it is permissible for communication to take multiple cycles to complete. This depends on how many cycles can be completed within the safety time.

If you need to increase the Com. Time Slice, start the code generator again, and download and start the new routine on the controller.

Reconfigure Watchdog Time

To optimize the Watchdog Time to the lowest possible value, you must know the maximum CPU cycle time. Cycle Time max., as displayed on the Statistics tab of the Control Panel, is the value that occurred so far, but is not necessarily the maximum value that can occur depending on network and process conditions.

If the maximum Cycle Time cannot be estimated, run the project for several hours and under as many conditions as possible.

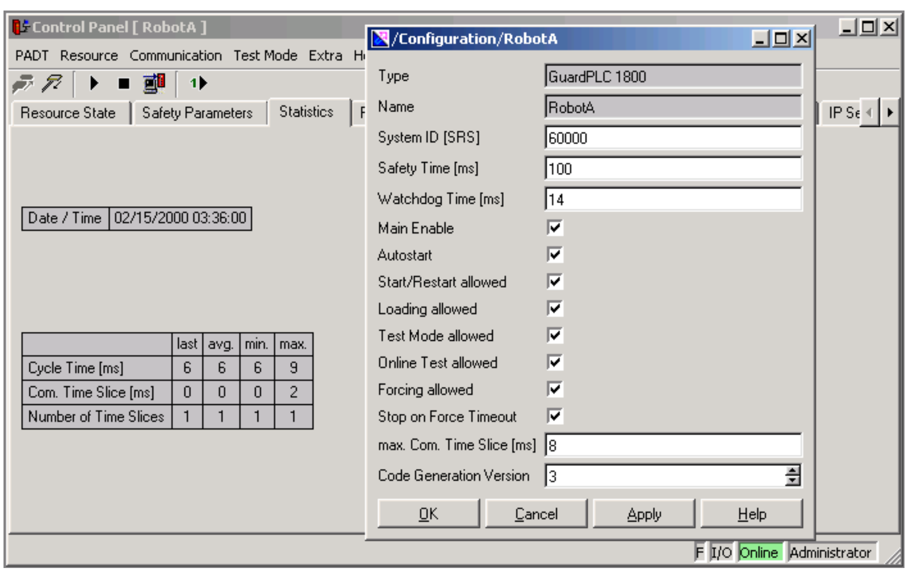
Follow these steps to reconfigure the Watchdog Time.

1. In the project tree, right-click the first resource and choose Properties.
2. Calculate a Margin of Safety, MoS:

   MoS = 0.1 x (Cycle Time max.)
   MoS should be at least 6 ms. If MoS < 6 ms, then
   MoS = 6 ms
3. Readjust the Watchdog Time:

   Watchdog Time = (Cycle Time max.) + (MoS)

   In the example on the following page, the new Watchdog Time is: 8 ms + 6 ms = 14 ms.



4. For all controllers in your project, re-adjust the Watchdog Times to their individual optimum values.

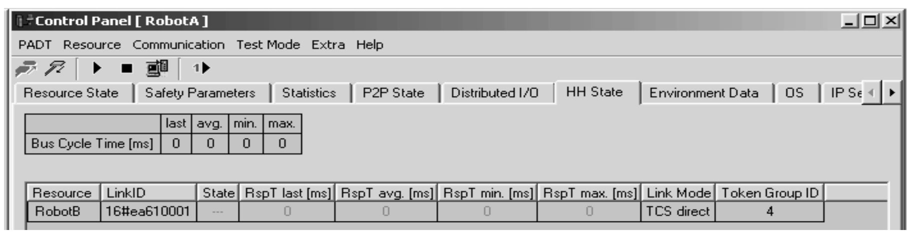
   TIP After these modifications, you must re-compile the project with the Code Generator and download the routines in the controllers again.

5. Start the project and let it run for a while.

6. If you encounter controller errors due to a Watchdog Time that is too short, increase the Watchdog Time. Otherwise, continue with the network optimization.

Check HH Status

In the Control Panel, click the HH Status tab.



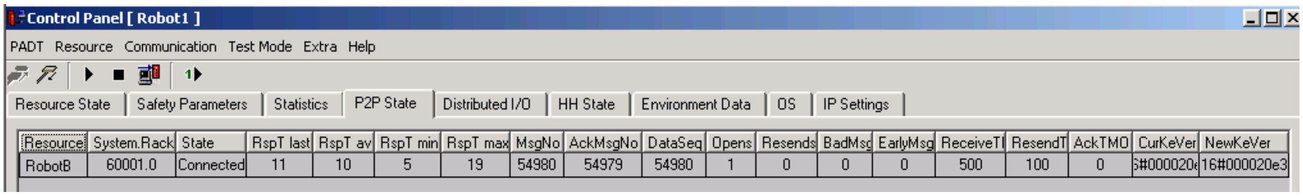
The HH Status displays the following information.

Parameter	Explanation
Bus Cycle Time	Time in milliseconds for a Token cycle. The value is 0, if Token Passing is off (any Cleanroom profile).
Resource	Name of the controller
LinkId	Controller network ID
State	Status of the communication
RspT	• If Link Mode is TCS direct (Token Passing OFF), RspT is the ResponseTime of the HH profile for a message from $PES_1 \rightarrow PES_2 \rightarrow PES_1$, based on the network hardware and topology. This parameter cannot be changed by the user. • If Link Mode is TCS TOKCYC (Token Passing ON), RspT is part of the Bus Cycle Time.
Link Mode	• TCS direct when Token Passing is OFF. • TCS TOKCYC when Token Passing is ON.
Token Group ID	ID of the Token Group

Read the RspT min parameter. This is the minimum time needed for the communication modules (COM) of two controllers to talk to each other. Refresh RspT values with Communication>Update HH State, if Token Passing is OFF.

Check Peer-to-peer Status

In the Control Panel, click the P2P Status tab.



The P2P Status displays the following information.

Parameter	Description
Resource	Name of the controller
System.Rack	Network ID of the controller
State	Status of the communication
RspT (last, avg, min, max)	Measured ResponseTime for a message from $PES_1 \rightarrow PES_2 \rightarrow PES_1$, based on the network hardware, CPU cycle time, and Peer-to-Peer profile. This parameter will be optimized later.
MsgNr	Counter (32-bit resolution) for all messages sent to a controller. In the illustration above, Robot A has sent message no. 54980 to Robot B.
AckMsgNr	The number of the received message that the controller has to acknowledge. In the illustration above, Robot A has acknowledged message no. 54979 from Robot B.
DataSeq	Counter (16-bit resolution) for sent messages, which contain process data. In the illustration above, Robot A has sent data message no. 54980 to Robot B.
Opens	Number of successful connects to a controller. A figure higher than 1 indicates that a controller dropped out and has been reconnected.
Resends	Counter (32-bit resolution) for messages that have been resent due to an elapsed ResendTMO.
BadMsgs	Counter (32-bit resolution) for received messages that are corrupted, or are not expected at that instant. A corrupt message, for example, is a message with a wrong sender or with a faulty CRC. An unexpected message, for example, is an 'Open' command, when the controllers are already connected.
EarlyMsgs	Counter (32-bit resolution) for received messages that are not in the correct sequence. If a message drops out and is lost at the addressee, there is a gap in the received messages, and the next message comes early.
Receive Tmo	Receive Timeout as entered by the user (see Define Peer-to-peer Parameters on page 186).
ResendTMO	Resend Timeout as set by the profile.
AckTmo	Acknowledge Timeout as set by the profile.
CurKeVer	CRC for the peer-to-peer configuration. Identical to the Peer-to-Peer system signal version (see page 181).
NewKeVer	Reserved for future use.

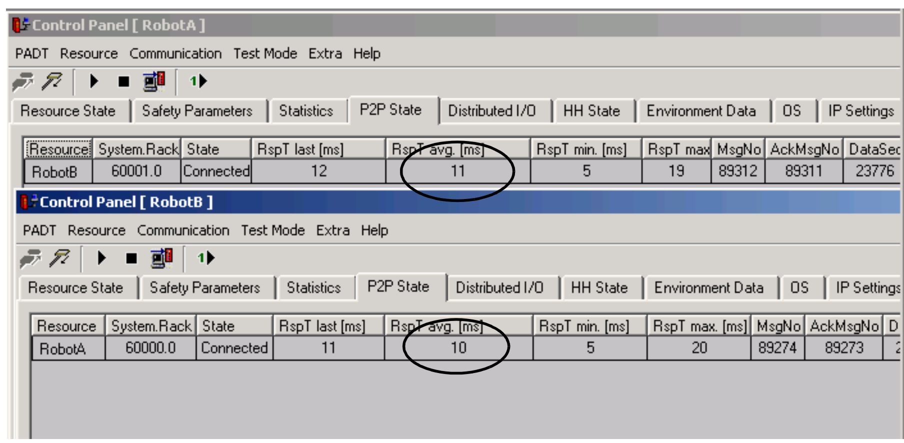
Reconfigure ResponseTime

The ResponseTime initially configured in Define Peer-to-peer Parameters on page 186 was derived from theoretical considerations and was chosen conservatively, to start the network running. The ResponseTime actually needed is usually much smaller than the theoretical value and can be optimized to improve network performance.

To optimize the ResponseTime, follow these steps.

1. Open the Control Panels for all controllers in the project and choose P2P State.

2. Position the horizontal slider so that you can read the ResponseTime.



3. Compare the RspT avg of two linked controllers for the forward and return path.

   Values for RspT avg may jump a bit.

4. Watch both readings for a couple of seconds and pick the largest value.

   Your reading need not be accurate to the millisecond.

5. Note the larger of the two values.

   The example on page 195 shows RespT avg for Robot A → Robot B (11 ms) and Robot B → Robot A (10 ms).

6. Compare the RspT max of two linked controllers for the forward and return paths.

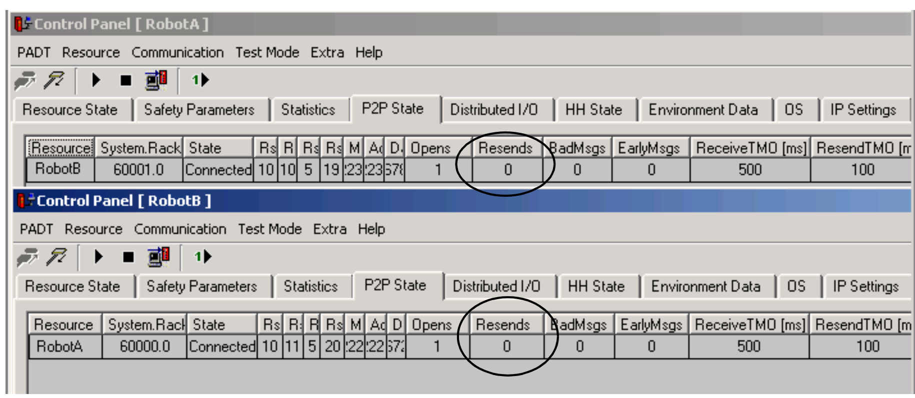
   Note down the larger of the two values.

   The example on page 195 shows RspT max for Robot A → Robot B (19 ms) and Robot B → Robot A (20 ms).

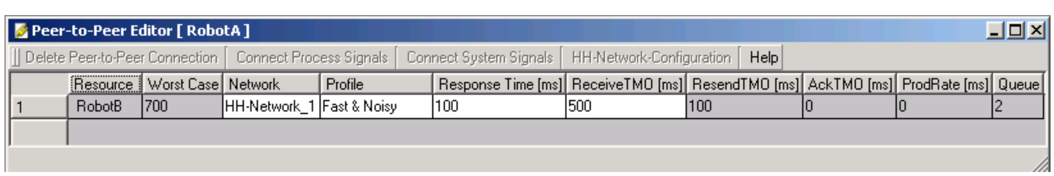
7. In the P2P State tab, check the entries for Resends and EarlyMsgs.

   a. If the entries for both Resends and EarlyMsgs are 0, no messages have been repeated. In this case, delete the noted RspT avg.

   b. If one or more entries for Resends or EarlyMsgs is not 0, messages have been repeated. In this case, delete the noted RspT max.



8. Enter the remaining noted value for RspT, either avg or max, in the ResponseTime of the Peer-to-Peer Editor.



Reconfigure Receive Timeout

1. Set the new ReceiveTMO to: 2 x ResponseTime.
2. The Worst Case Reaction Time is optimized and displayed in the Peer-to-Peer Editor (see above).
3. Compile the project.
4. Download the routines in the controllers again.
5. Start and test your application.

Notes:

Introduction to EtherNet/IP Communication

Introduction

EtherNet/IP Communication Overview

EtherNet Industrial Protocol (EtherNet/IP) is an open networking standard communication protocol. GuardPLC 1600 and GuardPLC 1800 controllers can connect to other EtherNet/IP devices, such as other controllers, HMIs or distributed I/O blocks.

To use the EtherNet/IP network, the GuardPLC 1600 or GuardPLC 1800 must meet these requirements.

Operating System	Version
CPU	6.28
COM	10.36

A GuardPLC controller can be configured as an EtherNet/IP scanner (originator) and/or adapter (target). Signals are exchanged between the scanner and the adapter in packets within the user-defined time (Requested Packet Interval).

GuardPLC Controller as an Adapter

To configure a GuardPLC controller as an adapter, configure the input and output assemblies in the GuardPLC controller by using RSLogix Guard PLUS! software and then connect signals to the I/O assemblies.

RSLogix Guard PLUS! software is used to create EtherNet/IP assemblies for the GuardPLC controller. An adapter input assembly (IN_120) and output assembly (OUT_121) are created automatically when EtherNet/IP protocol is added to the controller. You can use these standard assemblies or create your own by using RSLogix Guard PLUS! software.

The GuardPLC controller can be used as a Class 1 adapter, a Class 3 adapter, or as an unconnected adapter to communicate to Logix controllers, PLC-5 or SLC 5/05 controllers, or PanelView Standard terminals. See Chapter 19 for information on using the GuardPLC controller as an adapter.

Class 1 Connections

GuardPLC assemblies may have various sizes and have signals of different types associated with them. An EtherNet/IP scanner can establish Class 1 connections to the GuardPLC controller to read from the input assemblies and write to the output assemblies. When establishing a Class 1 connection, the data is addressed by using the unique instance number of the assembly object. This is similar to establishing a Class 1 connection to an I/O module but different than establishing a Class 1 connection to Logix controllers where data is addressed by a name.

Class 3 Connections

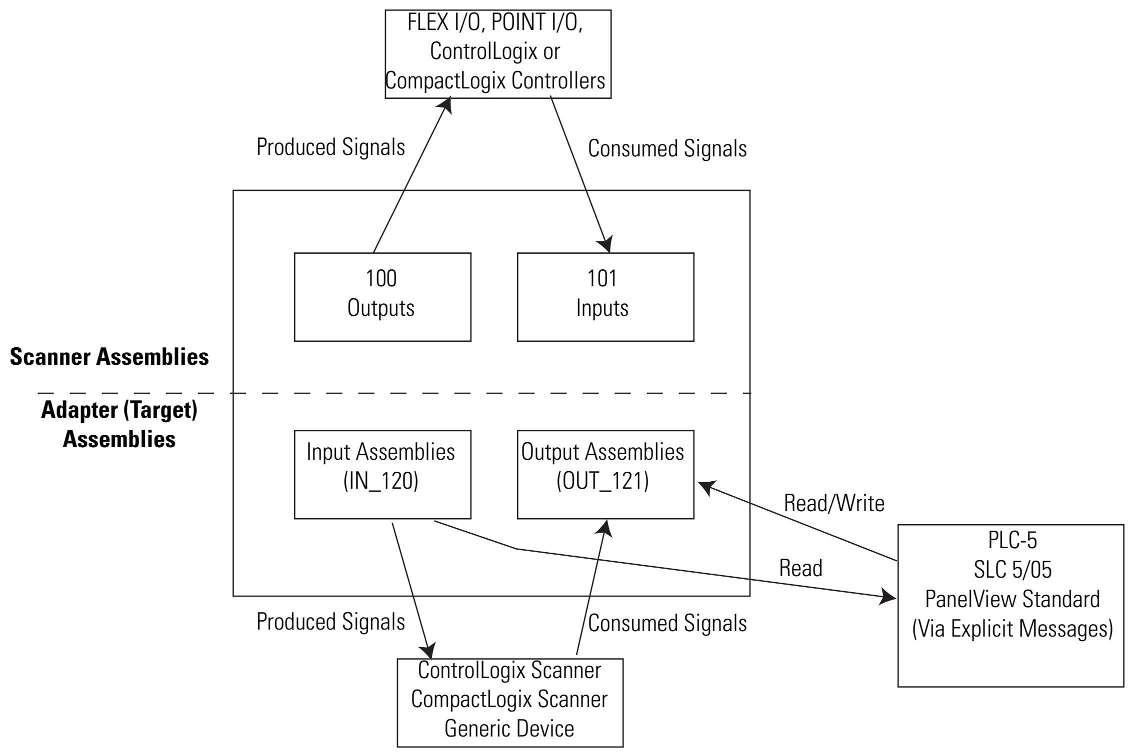
An EtherNet/IP scanner may be used to establish Class 3 connections to the GuardPLC controller. The Class 3 connection can be used to send explicit requests to any of the implemented objects, including Identity, Assembly, PCCC, Connection Configuration, Port, TCP/IP and Ethernet Link. Connected explicit requests may be used to read assembly data from an input adapter assembly and write data to the output assembly.

Unconnected Adapter

Using the GuardPLC controller as an unconnected adapter is similar to using it as a Class 3 adapter. In both cases, an explicit message is sent from the client to the GuardPLC controller, addressing one of the built-in objects, including Identity, Assembly, PCCC, Connection Configuration, Port, TCP/IP and Ethernet Link. In the case of an unconnected adapter, the message is not sent over a connection, but is sent as a single, independent request.

GuardPLC Controller as a Scanner

The scanner data memory is divided into input and output buffers of assemblies. The input area is used for signals received from the target (consumed data). The output area is used for signals transmitted to the target (produced signals). Each I/O assembly must have a corresponding signal connection. Signal connections are configured by using RSLogix Guard PLUS! software. The scanner data memory is configured via a scanlist by using RSNetWorx for EtherNet/IP software. To enable the GuardPLC controller to scan I/O, set up the controller as a scanner. See Chapter 20 for information on using the GuardPLC controller as a scanner.



Data Limits

IMPORTANT	In addition to the Ethernet/IP protocol, other protocols (for example, PROFIBUS-DP, TCP S/R, and others) can also be executed on a GuardPLC controller at the same time. A total of 16284 bytes of data can be transmitted and received per GuardPLC controller. These 16284 bytes can be arbitrarily divided between the protocols. However, the system signals for the configured assemblies must be subtracted from the maximum of send and receive data.

GuardPLC Controller as an Adapter

Up to 64 assemblies of any type (input or output) can be configured in one GuardPLC controller acting as a target, as long as the maximum transmit or receive data is not exceeded. However, because there are always 2 scanner assemblies, the true maximum for adapter assemblies is 62. These assemblies must have instance numbers in the range of 120…183. All input adapter assemblies and the input scanner assembly together should not exceed 16K in size. Likewise, all output adapter assemblies and the output scanner assembly together should not exceed 16K in size.

If an adapter assembly is used for Class 1 PCCC access, its size is limited only by the total buffer size for all of the assemblies listed above. However, if the adapter assembly is used for Class 1 implicit access, the size of the assembly should not exceed 502 bytes. This is a limitation that EtherNet/IP protocol puts on any EtherNet/IP adapter. These 502 bytes include a Run/Idle status header, if the output assembly is configured to use the header. When the Run/Idle header is used, the actual maximum size for the data is 498, because the header uses 4 bytes. A similar limitation applies for explicit CIP access.

If the adapter assembly is used only for PCCC access, its size can exceed the 502 byte limit. Any one PCCC command cannot address more than 244 bytes. However, an offset can be specified to allow access to any assembly portion up to a maximum of 16K.

GuardPLC Controller as a Scanner

The Scanner (GuardPLC controller) can connect up to 32 connections, which can be configured in different targets.

Signal Connections

It is your responsibility to allocate assemblies to be of the desired connection size. You do this by assigning signals, created in the Signal Editor, to the scanner buffers or adapter assemblies.

For more information on creating signals by using the Signal Editor, refer to the Using RSLogix Guard PLUS! Software with GuardPLC Controllers Programming Manual, publication 1756-PM001.

Software Required to Configure EtherNet/IP Communication

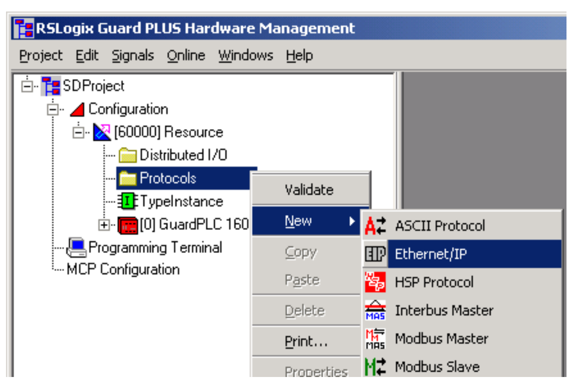
This table lists the software required to make EtherNet/IP connections.

Function	Software
communication	RSLinx
EtherNet/IP Configuration	RSNetWorx for EtherNet/IP
Programming Application Logic	RSLogix Guard PLUS!, Program Management, version 4.1 or later
	RSLogix Guard PLUS!, Hardware Management, version 7.56.10 or later

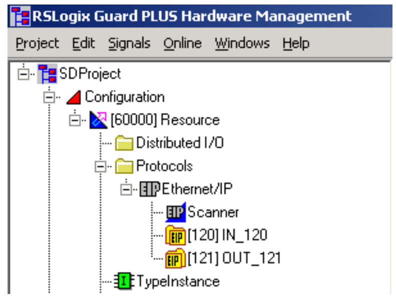
Add EtherNet/IP Protocol to the Resource

1. Expand the Resource folder in the project tree.

2. Right-click the Protocols folder under your Resource and choose New>EtherNet/IP.



RSLogix Guard PLUS! software creates an EtherNet/IP branch under the Protocols folder where it adds the scanner and the adapter assemblies.



Scanner defines the GuardPLC controller's scanner I/O space, which consists of two buffers: one to store input data and one to store output data.

The controller's adapter input assembly, [120]IN_120, contains data that is produced by the GuardPLC controller. The controller's adapter output assembly, [121]OUT_121, contains the data that is consumed by the GuardPLC controller.

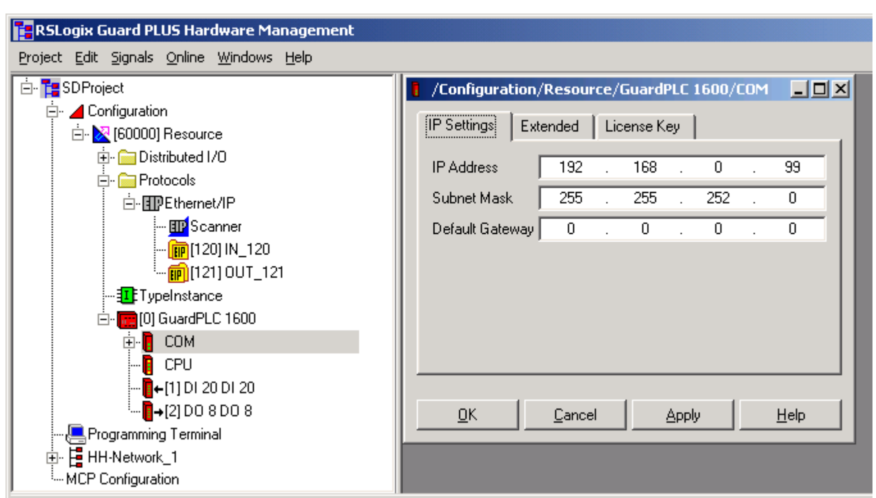
View the Controller IP Settings

You need to know the IP settings for the GuardPLC controller when you configure a device to communicate with it over the EtherNet/IP network.

To view and configure the IP settings for the GuardPLC controller, follow these steps.

1. Expand the controller in the project tree.

2. Right-click COM and choose Properties.



Parameter	Description
IP address	The IP address uniquely identifies the module. The IP address is in the form xxx.xxx.xxx.xxx where each xxx is a number between 0…255. These are reserved values you cannot use: • 127.0.0.1 • 0.0.0.0 • 255.255.255.255
subnet mask	Subnet addressing is an extension of the IP address scheme that allows a site to use a single network ID for multiple physical networks. Routing outside of the site continues by dividing the IP address into a net ID and a host ID via the class. Inside a site, the subnet mask is used to redivide the IP address into a custom network ID portion and host ID portion. This field is set to 0.0.0.0 by default. If you change the subnet mask of an already-configured module, you must cycle power to the module for the change to take effect.
gateway	A gateway connects individual physical networks into a system of networks. When a node needs to communicate with a node on another network, a gateway transfers the data between the two networks. This field is set to 0.0.0.0 by default.

For more information on the EtherNet/IP network, refer to these publications from Rockwell Automation:

- EtherNet/IP Performance Application Solution, publication ENET-AP001
- EtherNet/IP Modules in Logix 5000 Control Systems User Manual, publication ENET-UM001

Configuring Communication Between the Controller and a PanelView PLUS Terminal

To enable communication between a GuardPLC 1600 or GuardPLC 1800 controller and PanelView PLUS terminal, you need the following software"

- RSLinx Enterprise, version 5.0 (CPR9)
- FactoryTalk View Studio Machine Edition, version 5.00.00 (CPR9)
- RSLogix Guard PLUS, version 4.1 (Build 6111)

This section guides you through:

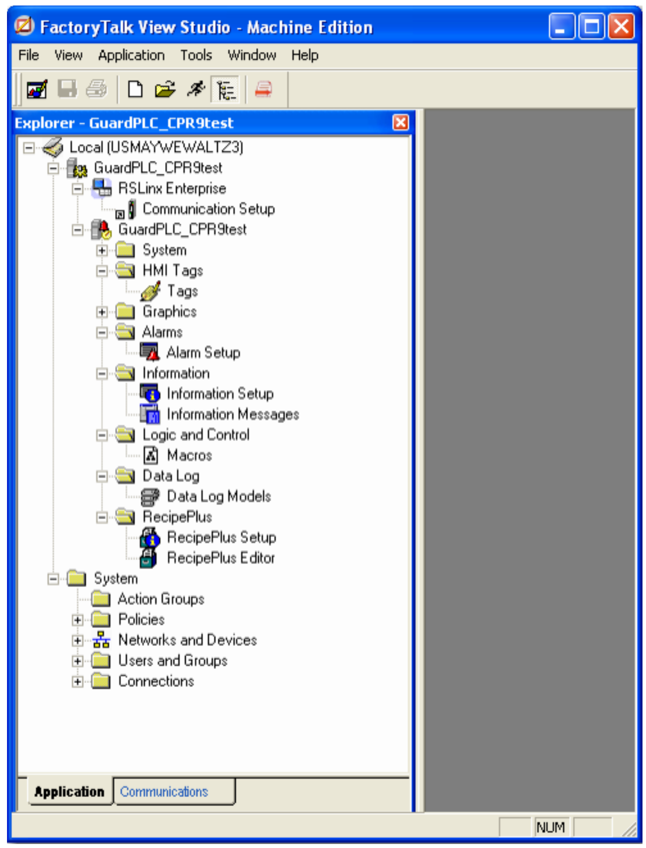
- setting up FactoryTalkView Studio Machine Edition software
- adding Ethernet/IP protocol to your RSLogix Guard PLUS project
- creating a graphic display that can read and write INT and BOOL data to and from the GuardPLC controller

Set Up FactoryTalk View Studio Machine Edition Software

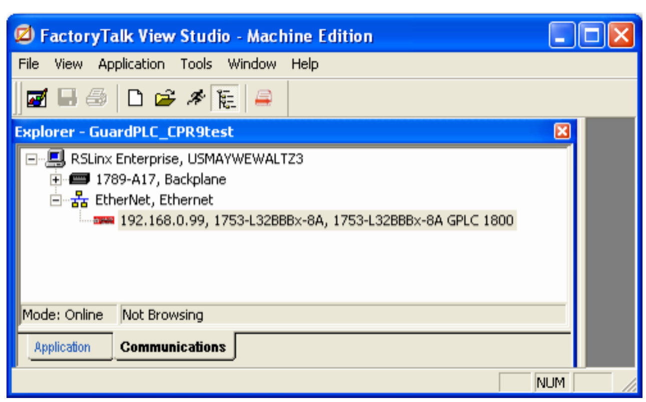
Follow these steps to setup FactoryTalk View Studio Machine Edition software.

1. Open FactoryTalk View Studio software.

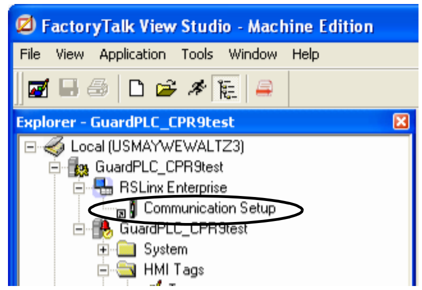
2. Add the RSLinx Enterprise server to your application.



3. On the Communications tab, verify that RSLinx Enterprise software can browse and locate the GuardPLC controller.



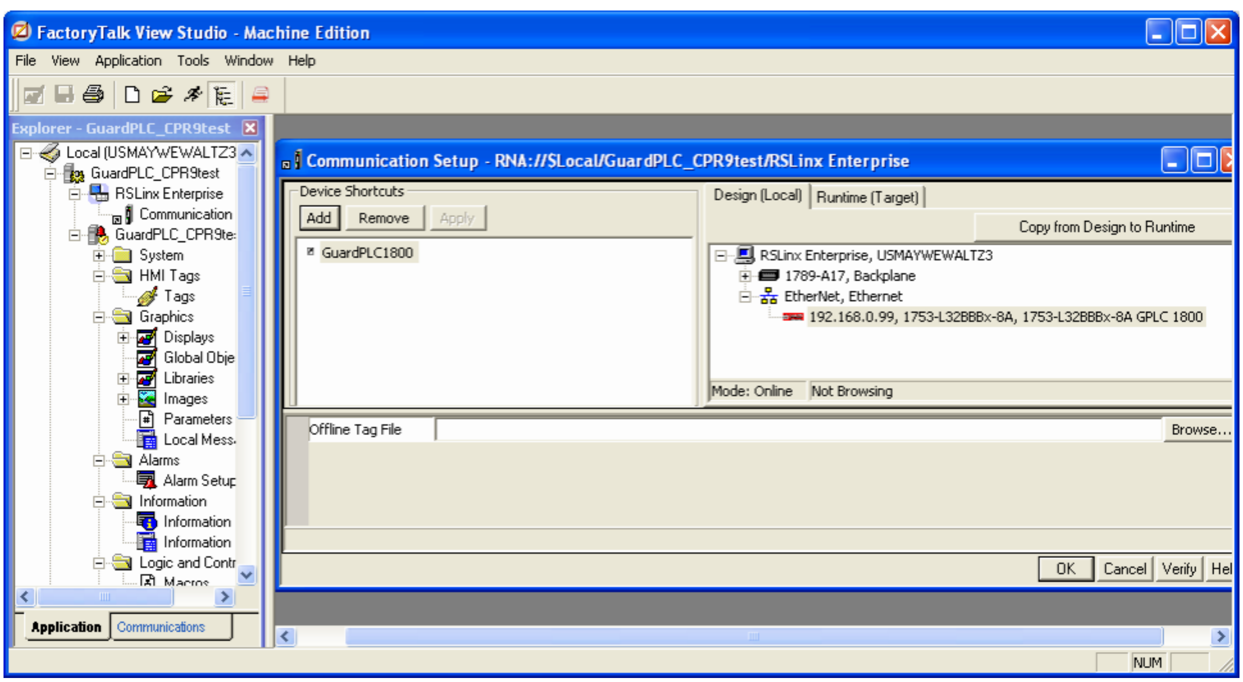
4. To add a shortcut for the GuardPLC controller to your application, double-click Communication Setup under the RSLinx Enterprise Server.



5. On the Design (Local) tab, select the GuardPLC controller.

6. On the Device Shortcuts pane, click Add and type a name for the shortcut.

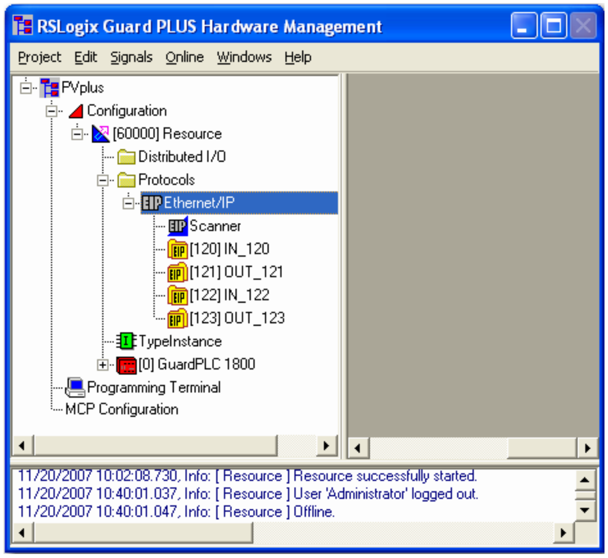
   When you choose a name for the shortcut, note that because there is no tag browsing for GuardPLC controllers, you will have to type this shortcut name for each object in your graphic displays.



Add Ethernet/IP Protocol to Your Project

Next, you need to add the Ethernet/IP protocol to your project in RSLogix Guard PLUS software. Follow these steps.

1. In the Hardware Management window of RSLogix Guard PLUS software, right-click Protocols and choose Add Ethernet/IP.



By default, the software creates one input assembly (120) and one output assembly (121). Input and output are referenced to the scanner. Thus, an input assembly is used to send data from the GuardPLC controller to the PanelView Plus terminal. An output assembly is used to send data from the PanelView Plus terminal out to the GuardPLC controller.

For simplicity, use separate assemblies for each of the four types of data transfer, as shown above.

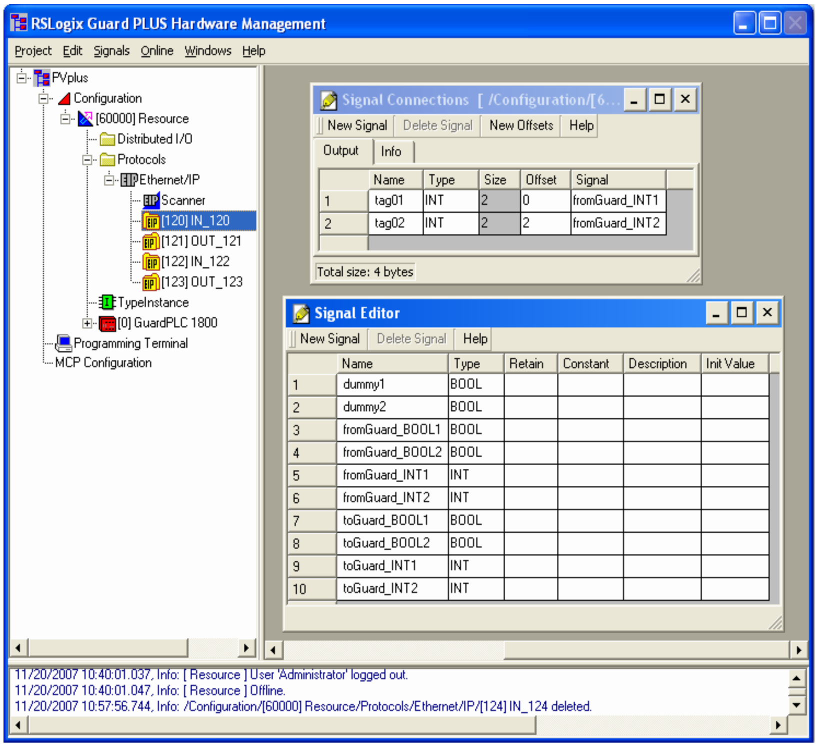
- Reading integers from the GuardPLC controller
- Reading BOOLs from the GuardPLC controller
- Writing integers to the GuardPLC controller
- Writing integers to the GuardPLC controller

2. To add an assembly, right-click Ethernet/IP, choose New and then either input or output assembly.

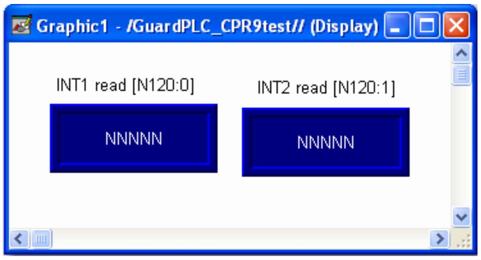
Read Integers from the Controller and Display Them on the PanelView Plus Terminal

This example uses input assembly 120 and shows how two integers can be read by the PanelView Plus terminal. Two INT tags, fromGuard_INT1 and fromGuard_INT2, were used in the controller as shown.

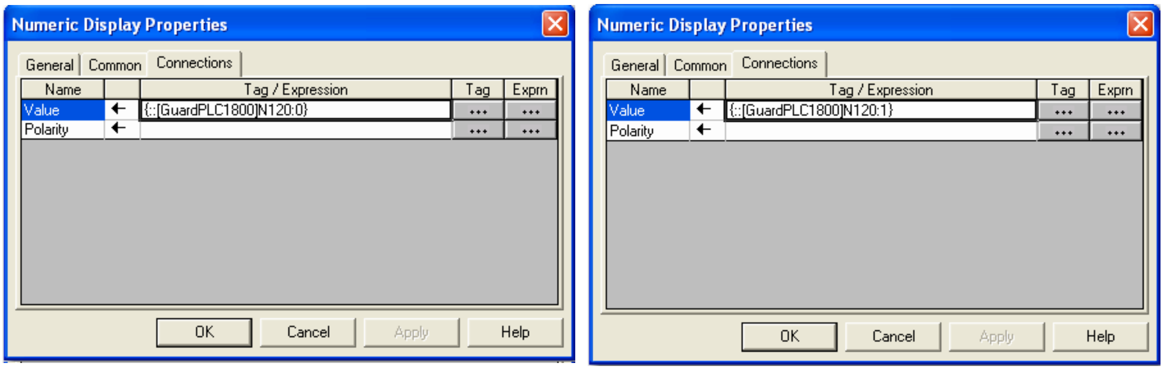
The names, tag01 and tag02, in the input assembly window could be any names unique to the GuardPLC controller. The offsets must be renumbered by using the New Offsets tab. The order of this offset determines the order in which these tags appear in the buffer.



The numeric display objects shown below read the two integers from the GuardPLC controller. Tags N120:0 and N120:1 were used to match the input assembly used in the GuardPLC controller. The GuardPLC controller does not use the ‘N’; it is required for FactoryTalk View software.

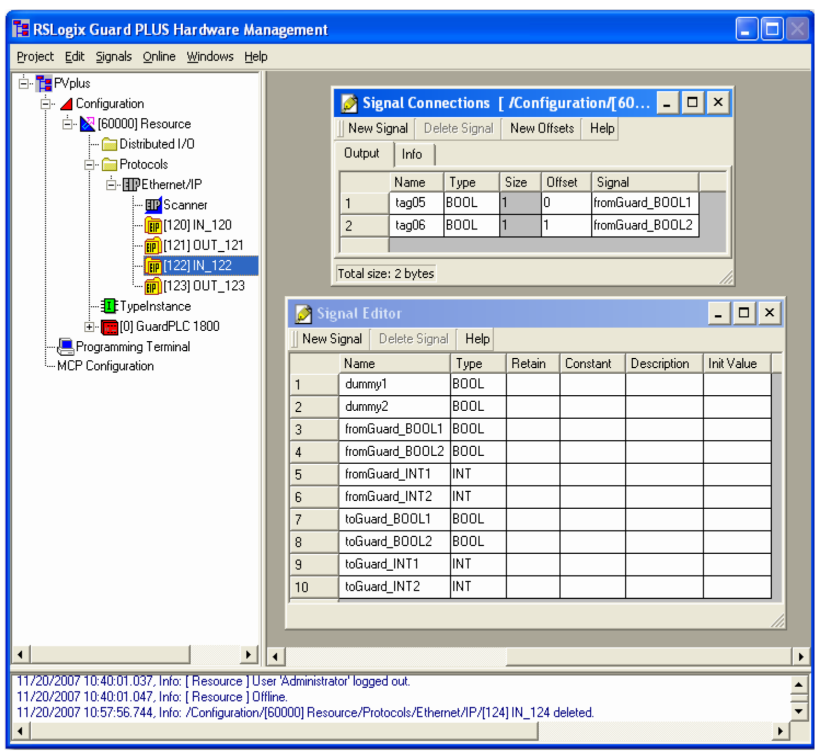


N120:0 corresponds to the first INT tag in the GuardPLC assembly 120. N120:1 corresponds to the second INT tag in the GuardPLC assembly 120.

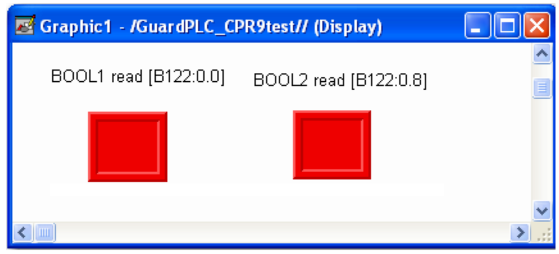


Read BOOLs from the GuardPLC Controller and Display Them on the PanelView Plus Terminal

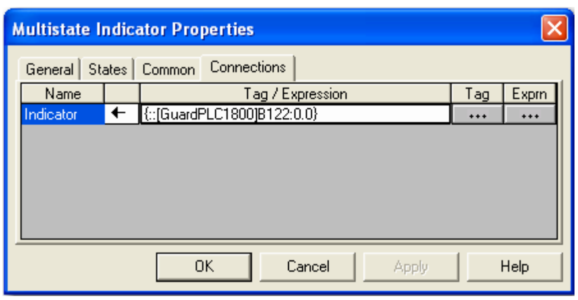
This example uses input assembly 122. Two BOOL tags, fromGuard_BOOL1 and fromGuard_BOOL2, were used in the controller as shown.

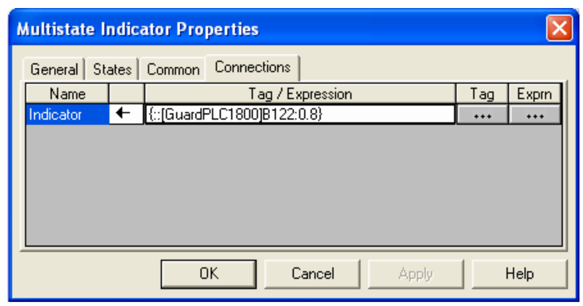


The multistate indicator objects shown below read the two BOOLs from the GuardPLC controller. Tags B122:0 and B122:1 were used to match the input assembly used in the GuardPLC controller. The GuardPLC controller does not use the 'B'; it is required for FactoryTalk View software.



B122:0.0 corresponds to the first BOOL tag in the GuardPLC assembly 122. B122:0.8 corresponds to the second BOOL tag in the GuardPLC assembly 122.

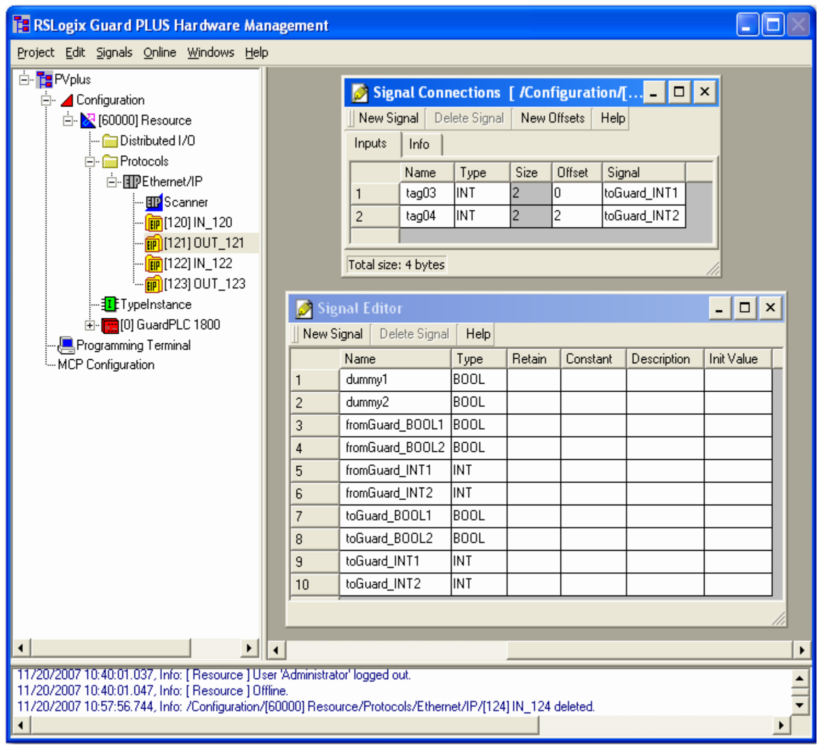




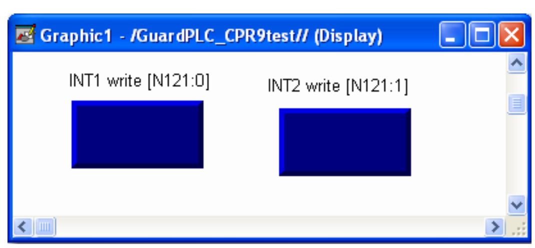
TIP GuardPLC is a BYTE machine. BOOL tags take up a complete BYTE in the buffer. That is why .0 and .8 are used in the VIEW tags to read the first bit from the GuardPLC byte. If a third BOOL tag was read, the address in the VIEW tag would be B122:1.0.

Writing Integers to the GuardPLC Controller from the PanelView Plus Terminal

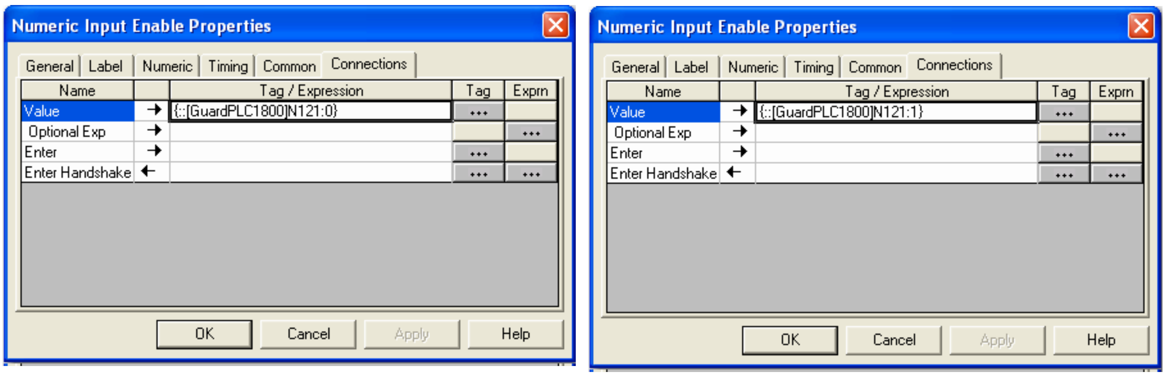
This example uses output assembly 121 and shows how two integers can be written by the PanelView Plus terminal. Two INT tags, toGuard_INT1 and toGuard_INT2, were used in the controller as shown.



The numeric input objects write the two integers to the GuardPLC controller. Tags N121:0 and N121:1 were used to match the output assembly used in the GuardPLC controller. The GuardPLC controller does not use the 'N'; it is required for FactoryTalk View software.



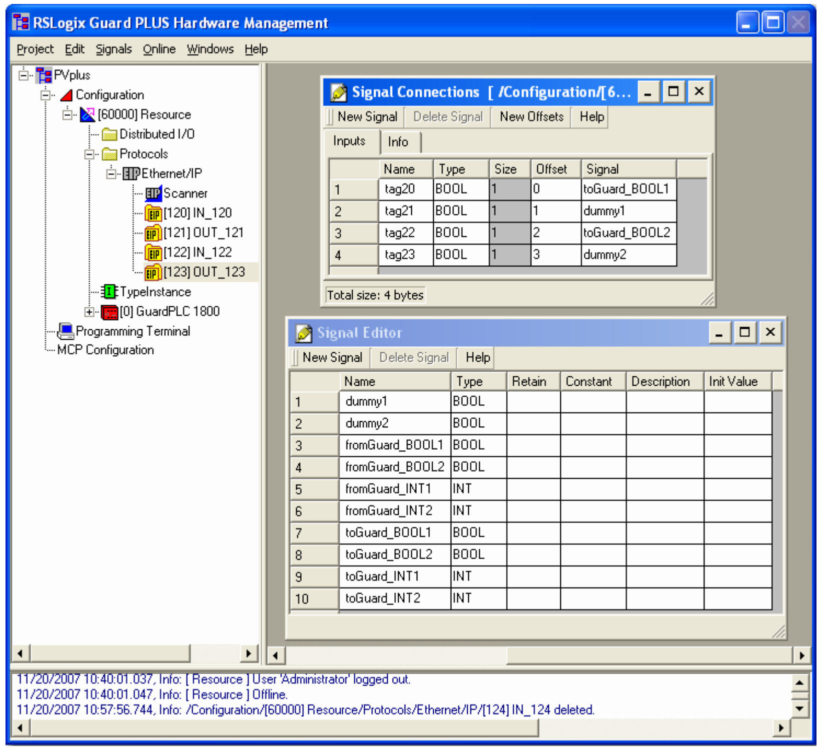
N121:0 corresponds to the first INT tag in the GuardPLC assembly 121. N121:1 corresponds to the second INT tag in the GuardPLC assembly 121.



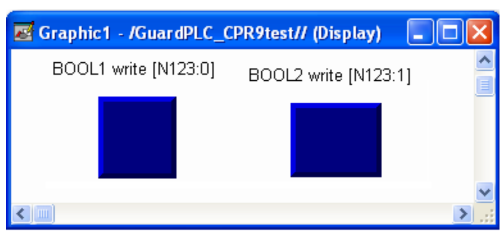
Writing BOOLs to the GuardPLC Controller from the PanelView Plus Terminal

This example uses output assembly 123. Two BOOLs are written by the PanelView Plus terminal to the controller. Four BOOL tags, toGuard_BOOL1 and toGuard_BOOL2 and two dummy tags, were used in the controller as shown on the following page.

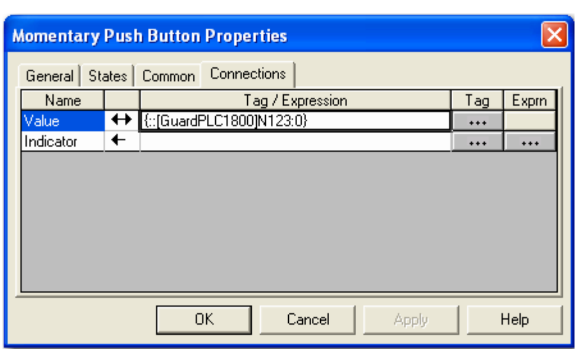
TIP The dummy tags are required because BOOL extensions cannot be used on the write tags within the PanelView Plus terminal. INT tags must be used on the terminal side. Because an integer is 2 bytes, a dummy is needed to fill this space in the controller's buffer. A BOOL tag takes up a complete byte in the GuardPLC controller's buffer.

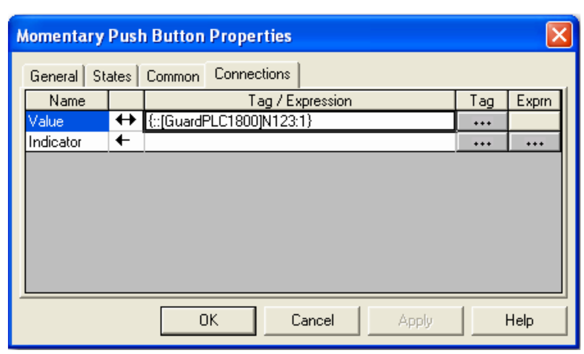


These momentary pushbutton objects write the two integers to the GuardPLC controller. Tags N123:0 and N123:1 were used to match the output assembly used in the GuardPLC controller. The GuardPLC controller does not use the 'N'; it is required for FactoryTalk View software.



N123:0 corresponds to the first two BOOL tags in the GuardPLC assembly 123. The first tag changes between 0 and 1; the second is the dummy tag. N123:1 corresponds to the next two BOOL tags in the GuardPLC assembly 123.





Chapter 19

Use GuardPLC Controller as an Adapter

Introduction

Configure the GuardPLC Controller as an Adapter

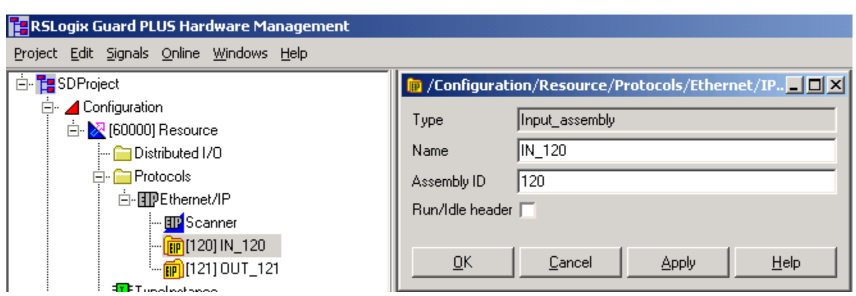
Make sure the GuardPLC controller resource has the EtherNet/IP protocol added under the Protocols folder in the RSLogix Guard PLUS! Hardware Management project tree. If it does not, see page 203 for instructions on adding EtherNet/IP protocol.

Configure the Adapter Input Assembly

Input assemblies contain data that is produced by the GuardPLC controller and consumed by a scanner.

1. You can use the default input assembly IN_120 or create a new input assembly by right-clicking EtherNet/IP in the project tree and choosing New > Input Assembly.

2. Modify the input assembly properties, if desired, by right-clicking the input assembly and choosing Properties.



3. Type the name for the input assembly in the Name field.

   The Assembly ID can be any number from 120…183. All Assembly IDs under the same EtherNet/IP folder must be unique.

   If the Run/Idle header box is checked, the assembly uses a Run/Idle header. This four-byte header contains Run/Idle information about the GuardPLC controller that can be used in the scanner's application logic. The GuardPLC controller sends this Run/Idle header along with the data in the assembly when it is read.

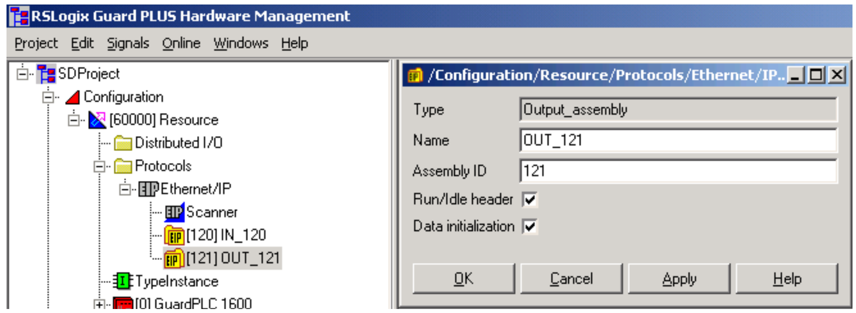
   Usually this box should be unchecked. Normally, the Run/Idle header will always be used for output assemblies and sometimes used for input assemblies. However, this may not hold true for connections to non-Rockwell Automation scanners.

   If the Run/Idle header is checked, the input data size specified by the scanner should be four bytes larger than the actual GuardPLC controller input assembly size. This is necessary because the input Run/Idle header, unlike the output one, is not stored in the GuardPLC assembly, it is automatically added by the GuardPLC controller when it sends the packet. So, if both input and output assembly Run/Idle flags are checked, the input size specified by the scanner should be four bytes larger than the target assembly size and the output size specified by the scanner should be four bytes smaller than the target assembly size.

Configure the Adapter Output Assembly

1. You can use the default output assembly OUT_121 or create a new output assembly by right-clicking EtherNet/IP in the project tree and choosing New > Output Assembly.

2. Modify the default output assembly properties, if desired, by right-clicking the output assembly and choosing Properties.



3. Type the name for the output assembly in the Name field.

   The Assembly ID can be any number from 120…183. All Assembly IDs under the same EtherNet/IP folder must be unique.

   If the Run/Idle header box is checked, the assembly uses a Run/Idle header. The default is checked. Typically, output assemblies always use the Run/Idle header. Checking the Run/Idle header box indicates that the first 4 bytes of the data received by the GuardPLC controller contains the Run/Idle header produced by the scanner. These 4 bytes are stored in the beginning of the assembly buffer and you can use the associated signal in the GuardPLC controller's application logic that depends on the scanner's Run/Idle state.

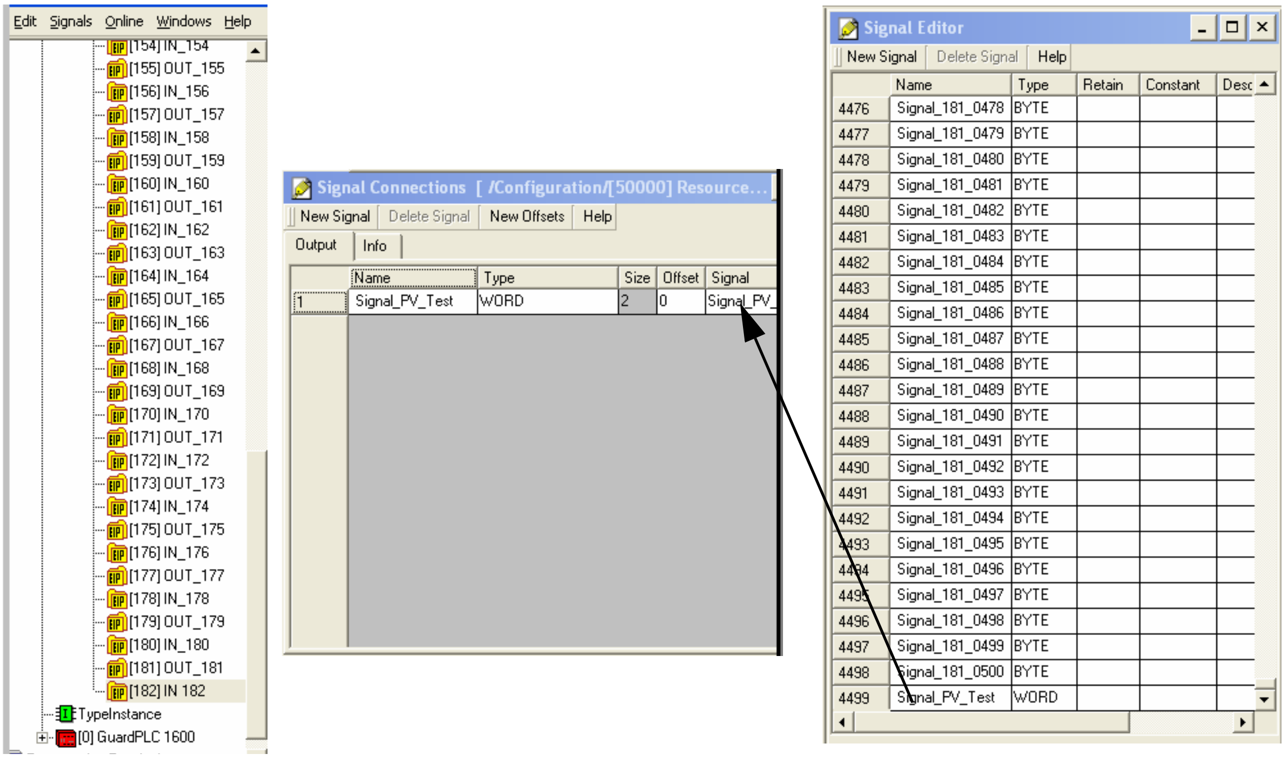
   If the Data initialization box is checked, the controller uses the consumed initial values if the corresponding I/O connection disconnects. If it is not checked, the controller does not use initial values and the data stays in its last state. The default is checked.

Connect Signals to the Adapter Assemblies

The Signal Connections dialog box is used to assign signals created in the Signal Editor to the appropriate tab, either input or output.

1. To open the Signal Connections dialog box, right-click an Assembly and choose Connect Signals.

The example below shows the Signal Connections dialog box for an input assembly. Signals created in the Signal Editor are assigned to connections to the Output tab for the input assembly.



2. Drag the signals from the Signal Editor to the Signal Connections tab.

3. After assigning the signals, either assign the offsets manually or click New Offsets and choose Renumber at the Renumber Offsets prompt.

   The offsets are byte offsets.

   When assigning offsets manually, make sure there are no holes in the assembly buffer and that the next signal starts where the previous signal ended.

   If the scanner is a Logix controller, be sure that:

   - the Run/Idle header is checked for output assemblies.
   - the Run/Idle header is unchecked for input assemblies.
   - output assemblies have 4 extra bytes in the beginning to hold the Run/Idle header. These can be 1 DWORD or 2 WORD or 4 byte signals.

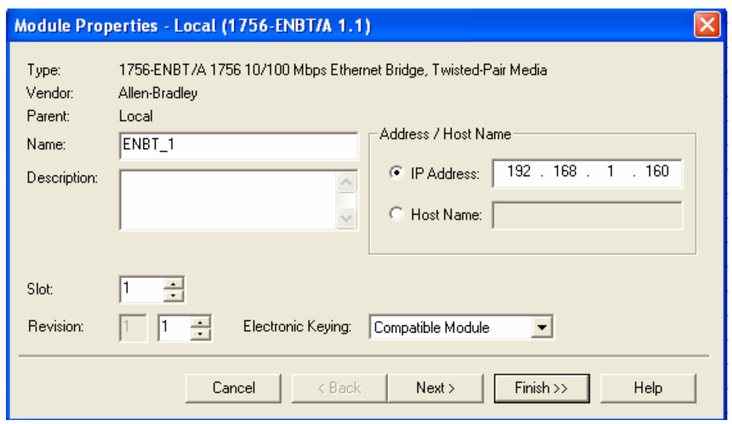
Open a Class 1 Connection from a Logix Controller to the GuardPLC Controller

The following example demonstrates making a connection to a Logix controller, specifically a ControlLogix controller, with a 1756-ENBT or 1756-ENET module to a GuardPLC controller. You can also open connections to CompactLogix controllers. In a Class 1 connection, data is cyclically exchanged based on a time interval (RPI).

Configure the Logix Controller in RSLogix 5000 Software

1. In RSLogix 5000 software, create a new project for the Logix controller.

2. Add the Ethernet adapter module to the I/O Configuration
   a. Right-click I/O Configuration and choose New Module.
   b. In the Select Module Type dialog box, click the 1756-ENBT or 1756-ENET module type.
   c. Click OK.
   d. In the Module Properties dialog box, type the IP address and the slot number of the 1756-ENBT module.

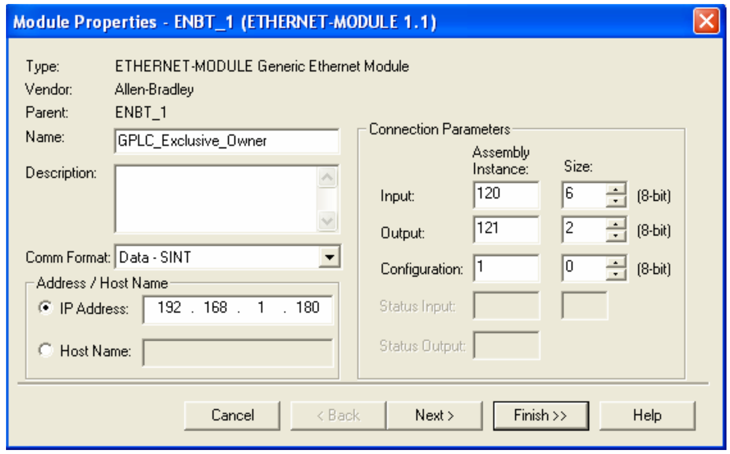


   e. Click Finish.

   RSLogix 5000 software displays the new 1756-ENBT module under the I/O Configuration.

3. Right-click the new 1756-ENBT icon and choose New Module.

4. Choose Generic Ethernet Module from the list and click OK.



5. Type the connection name in the Name field.

6. Type the IP address of the GuardPLC controller in the IP Address field.

7. Enter the Configuration Assembly Instance as 1 and its size as 0 because the configuration data instance will not be used by the GuardPLC controller.

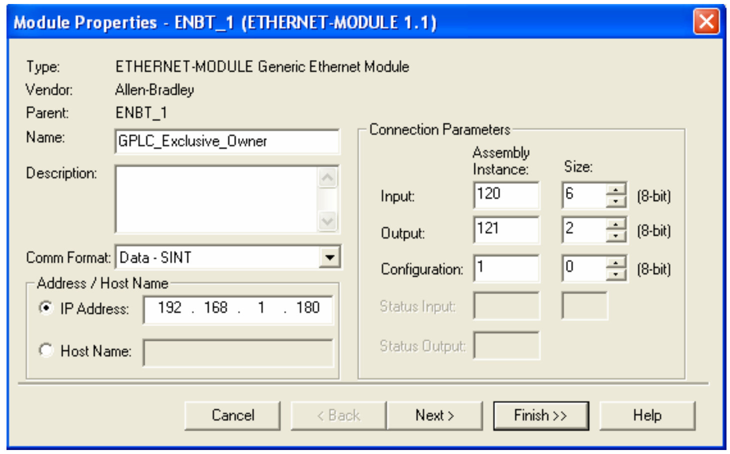
Configure the Type of Connection

GuardPLC controllers support these types of Class 1 connections:

- Exclusive Owner — both sides are cyclically producing data for one another.
- Input Only — more than one scanner can listen to the same data produced by a single GuardPLC controller.
- Listen Only — the first scanner to establish a connection to the GuardPLC controller becomes the owner of the connection. When that scanner closes the owner connection, all subsequent Listen Only connections are also closed.

These connection types are explained in more detail in the following sections.

Exclusive Owner



To establish an exclusive owner connection, follow these steps.

1. Choose Data — SINT in the Comm Format Field.
2. Type the GuardPLC controller's Input Assembly instance number in the Input Assembly Instance field.
3. Type the size of the Input Assembly in the Input Size field.

IMPORTANT This entry must exactly match the size of the input assembly, or the GuardPLC adapter controller will return an error.

The size of the input assembly is determined during the signal connection process.

4. Type the GuardPLC controller's Output Assembly instance number in the Output Assembly Instance field.
5. Type the size of the Output Assembly minus 4 bytes in the Output Size field.

   The data size in RSLogix 5000 software does not include the 4 bytes of the Run/Idle header, but these 4 bytes must be part of the GuardPLC controller's output assembly, because the ControlLogix controller sends the 4-byte Run/Idle header to the GuardPLC controller.

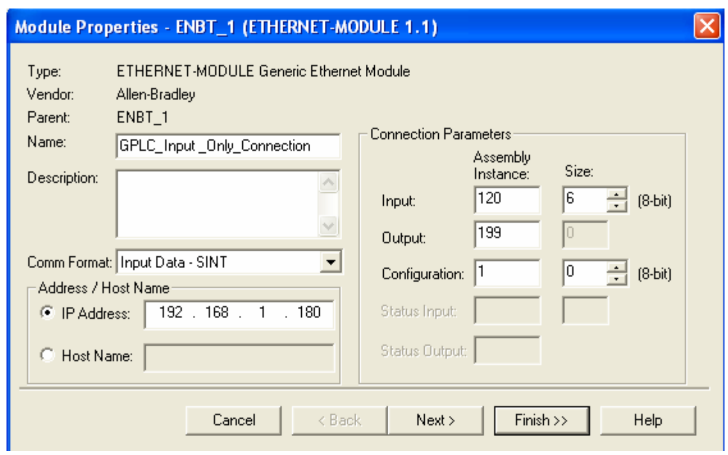
   For example, if you created an output assembly of 6 bytes (6 BYTE signals assigned in RSLogix Guard PLUS! software), you must enter an Output Size of 2 in RSLogix 5000 software, because only the last 2 bytes contain the actual data.

6. Click Next and type the desired packet rate for this connection in milliseconds.

7. Click Finish.

Input Only Connections

When you use input only connections, you can create more than one Class 1 scanner connection to the GuardPLC controller, specifying the same input assembly instance. The GuardPLC controller specifies the same multicast address for input data to all scanners asking for the same input assembly instance. The GuardPLC controller only produces the data once and all scanners receive the same input data. No output data will go from the scanners to the GuardPLC controller. All input only connections are independent from each other. When one of them times out, the others remain active.



To open an input only connection, follow these steps.

1. Choose Input Data — SINT in the Comm Format field.

2. Type the GuardPLC controller's Input Assembly instance number in the Input Assembly Instance field.

3. Type the size of the input assembly in bytes in the Input Size field.

IMPORTANT	This entry must exactly match the size of the input assembly, or the GuardPLC adapter controller will return an error. The size of the input assembly is determined during the signal connection process.

4. Type the Output Assembly instance number as 199.

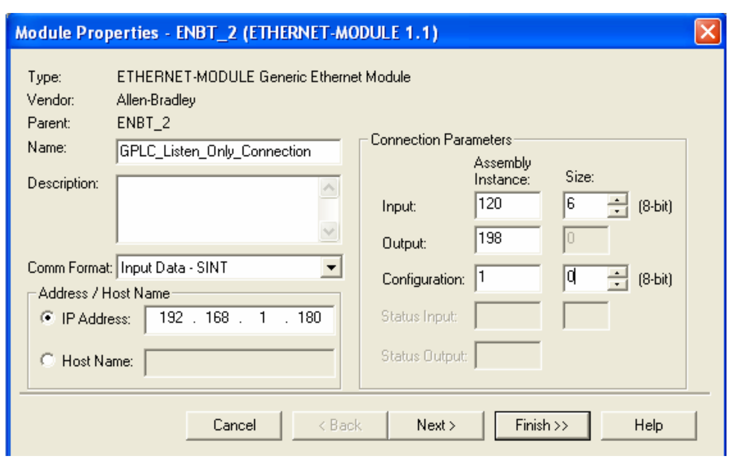
   This is the heartbeat instance number, a virtual number that is not associated with any real assembly. It indicates to the GuardPLC controller that there will be no data coming from the scanner.

5. Click Next and type the desired packet rate for this connection in milliseconds.

6. Click Finish.

Listen Only Connections

Listen only connections are similar to input only connections, but all subsequent input only connections are dependent upon the first input only connection, which is the owner connection. When an owner connection is closed, all subsequent listen only connections are also closed.



To establish a listen only connection, follow these steps.

1. Choose Input Data — SINT in the Comm Format field.

2. Type the input assembly instance number in the Input Assembly Instance field.

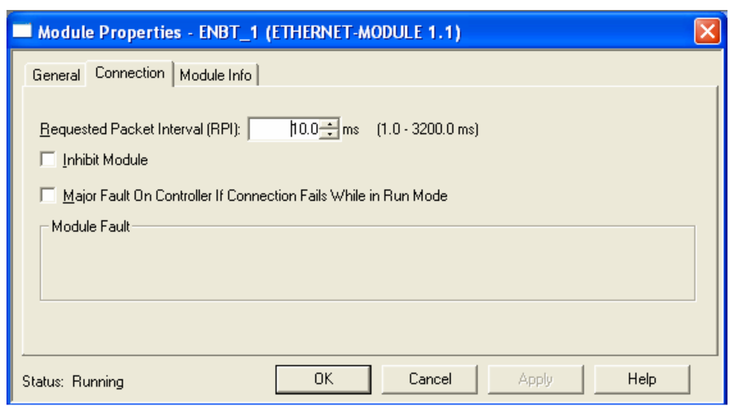
3. Type the size of the input assembly in bytes in the Input Size field.

IMPORTANT	This entry must exactly match the size of the input assembly, or the GuardPLC adapter controller will return an error. The size of the input assembly is determined during the signal connection process.

4. Type 199 for the first Output Assembly Instance number and 198 for all subsequent listen only connections.

   Number 198 is the Listen Only instance number, a virtual number that is not associate with any real assembly.

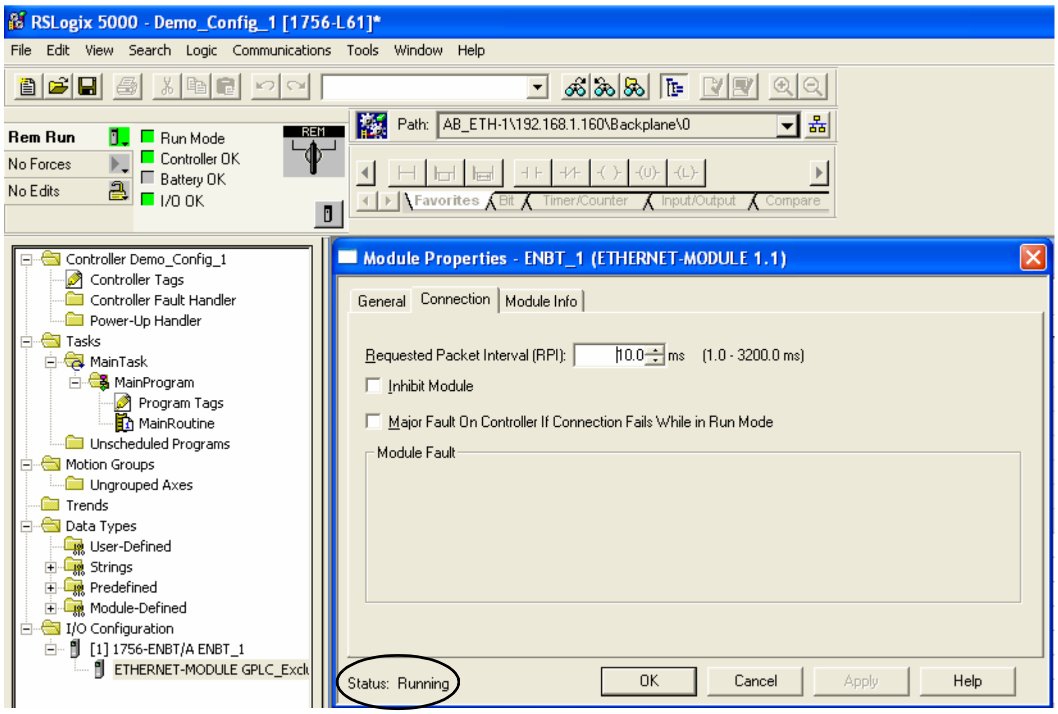
5. Click Next and type the desired packet rate for this connection in milliseconds.



6. Click OK.

Download and Go Online

Download new changes to the Logix controller and go online. Double-click the new connection icon under I/O Configuration. If the connection is established successfully, RSLogix 5000 software displays the status as Running in the Module Properties dialog box. If an error occurred, it is displayed in the Module Fault field of the Connection tab of the Module Properties dialog box.

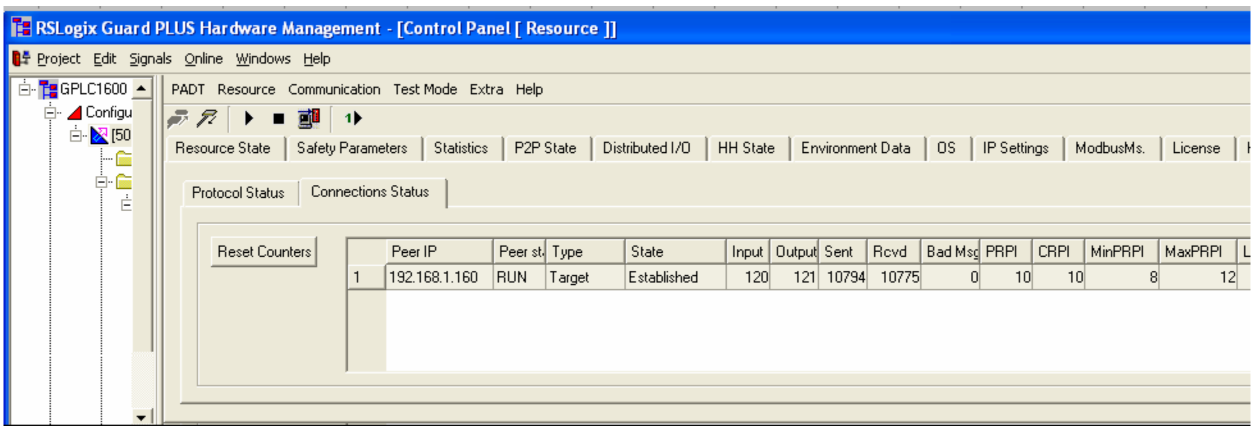


Monitor Connection Status

To monitor the status of your connections, follow these steps.

1. Go online with the GuardPLC controller by using RSLogix Guard PLUS! software.

2. Switch to the EIP tab of the Control Panel and click the Connection Status tab.



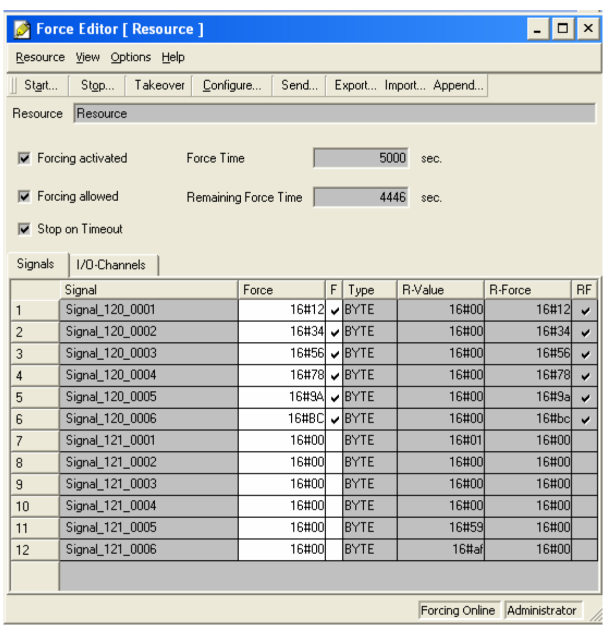
You can view the connection's EtherNet/IP statistics, described in the table below.

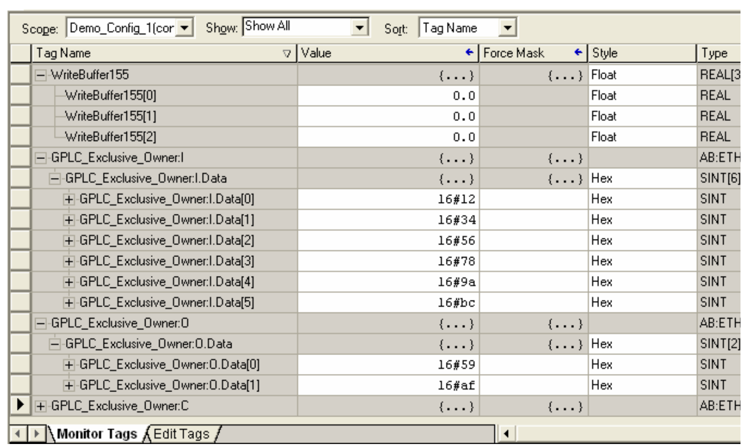
Statistic	Description
Peer IP	Reports the IP address of the scanner, in this case the 1756-ENBT
Peer Status	Indicates whether the scanner, in this case the Logix controller, is in Run or Idle mode. This is displayed only for exclusive owner connections, because input only connections ignore any data coming from the scanner, including the Run/Idle header.
Type	Displays the connection type
State	Displays the status of the connection
Input	Reports the assembly instance numbers that this connection services
Output	
Sent	Displays the total number of sent or received packets over this connection
Rcvd	
PRPI	Displays the producing packet rate requested when scheduling this connection
CRPI	Displays the consuming packet rate requested when scheduling this connection
MinPRPI, MaxPRPI, LastPRPI, and AvrPRPI	Corresponds to the actual minimum, maximum, last, and average producing packet rates observed over this connection

Use the Force Editor to Test the Connection

You can use the Force Editor in the RSLogix Guard PLUS! software and the I/O controller tags in RSLogix 5000 software to test the connection between the GuardPLC controller and the Logix controller. Under normal operating conditions, the GuardPLC application program will change and update the data being read and update the data being read by the Logix controller. By using the Force Editor, you can force changes to the input assembly and see this change reflected in the Logix tag. In the example below, the Force Editor is configured to display Signal_120_xxxx and Signal_121_xxxx. Signal_120_xxxx is set in RSLogix Guard PLUS! software and the data is received in the GPLC_Exclusive_Owner:I.Data tag in RSLogix 5000 software. Likewise, after GPLC_Exclusive_Owner:O.Data is modified in RSLogix 5000 software, the changes are visible in the Signal_121_xxxx signals in RSLogix Guard PLUS! software.

Note that the first four bytes in the GuardPLC controller's output assembly, Signal_121_0001 to Signal_121_0004, are the Run/Idle header received by the Logix controller.





For more information on forcing, refer to the Using RSLogix Guard PLUS! Software with GuardPLC Controllers Programming Manual, publication 1753-PM001.

Remove or Inhibit a Connection

You can remove a connection in RSLogix 5000 software by going offline, right-clicking the connection icon, and choosing Delete. Download to apply the changes.

You can also Inhibit a connection in Run mode, by double-clicking the connection icon and checking the Inhibit box on the Connection tab.

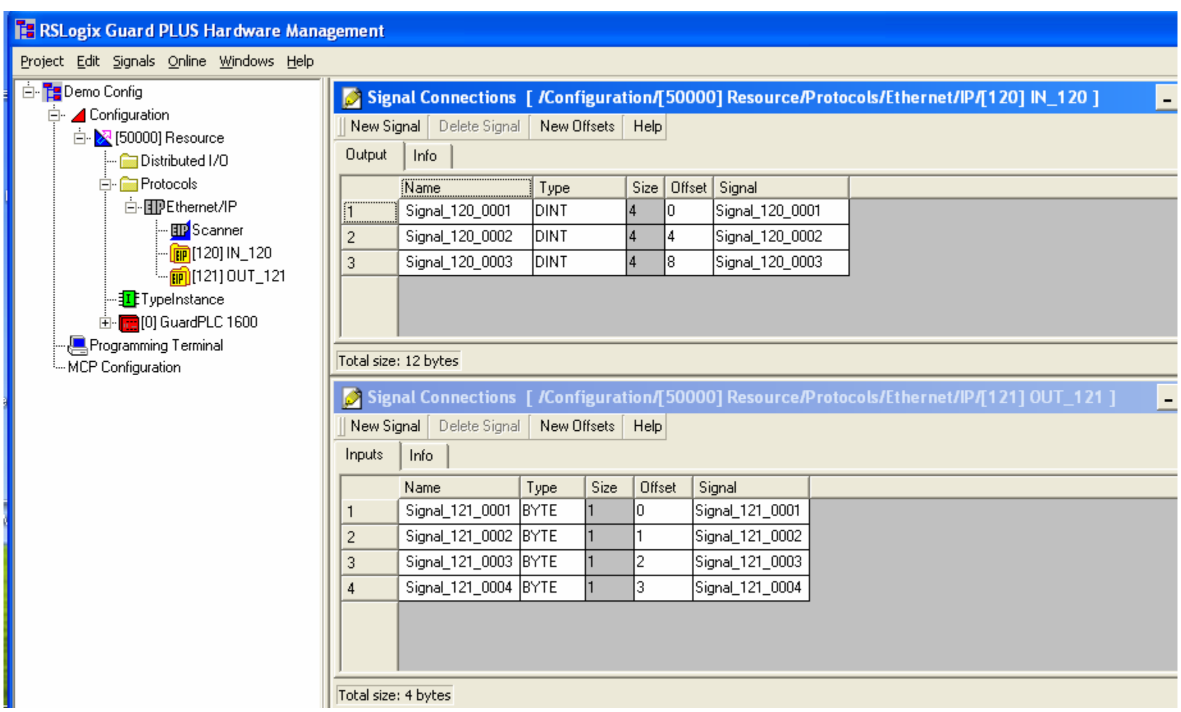
Open a Class 3 Connection from a Logix Controller

In a Class 3 connection, data is exchanged by using an explicit message instruction (MSG). Every time the MSG is executed in the Logix controller, data is exchanged with the GuardPLC controller.

Configure the GuardPLC Controller Assemblies

In RSLogix Guard PLUS! software, set up the appropriate assemblies and connect the signals. In this example, we connected signals to the input and output assemblies as shown below.

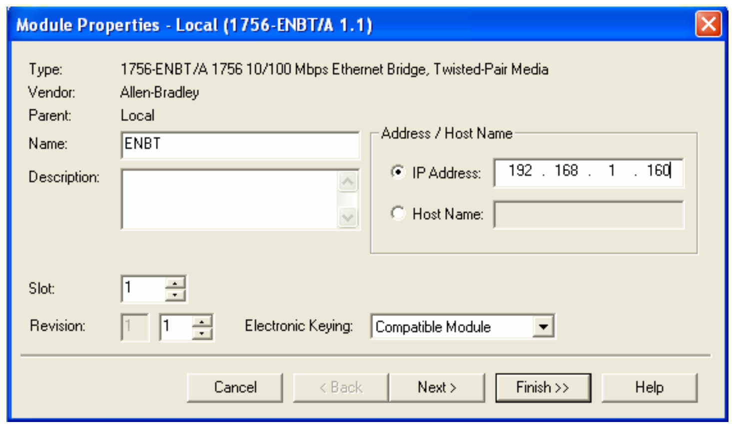
Make sure the Run/Idle header box is unchecked as Class 3 connections do not use a Run/Idle header.



Create a Project for the Logix Controller

1. In RSLogix 5000 software, create a new project for the Logix controller.

2. Add the Ethernet adapter module to the I/O Configuration.
   a. Right-click I/O Configuration and choose New Module.
   b. In the Select Module Type dialog box, choose the 1756-ENBT or 1756-ENET module type and click OK.
   c. In the Module Properties dialog box, enter the IP address and the slot number of the module.



   d. Click Finish.

   RSLogix 5000 software displays the new 1756-ENBT module under the I/O Configuration.

Create Tags to Read and Write Assembly Data

1. Double-click Controller Tags and choose the Edit Tags tab.

2. Add an Enable BOOL tag, which will start the connected messaging example.

3. Add a TIMER_CONN timer tag to set the packet rate for the Class 3 connection.

4. Create MSG_READ and MSG_WRITE message tags, which are used for read and write messages.

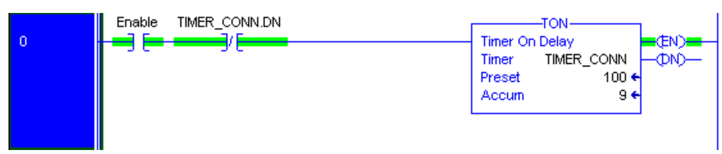
5. Add a ReadBuffer tag with type DINT[3] and a WriteBuffer tag with type SINT[4].

   These types correspond directly to the signal types of the GuardPLC adapter assemblies. When explicit CIP messaging is used to read and write assemblies, the tag being written to or read from must be of the same or larger size than the assembly size in the GuardPLC controller. The tag types should match the signal types associated with the target assembly in RSLogix Guard PLUS! software.

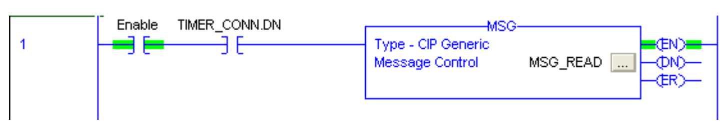
   For more information on programming Logix controllers, refer to the Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001

Create Ladder Logic

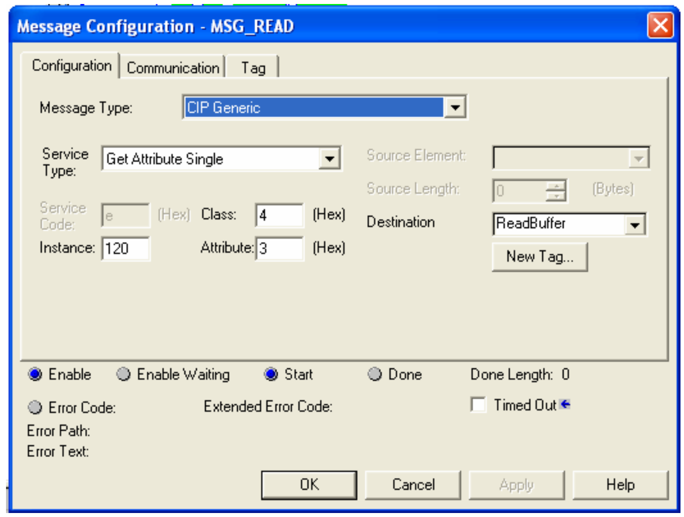
1. Switch to the Main Routine window in RSLogix 5000 software.
2. Build the first rung containing the following instructions:
   - Examine On Enable tag to start the connected messaging.
   - Examine Off TIMER_CONN.DN.
   - A timer instruction with the control tag TIMER_CONN and a preset of 100. This is the rate at which Class 3 messages are sent by the Logix controller.



3. Build the second run containing the following instructions:
   - Examine On Enable tag.
   - Examine On TIMER_CONN.DN.
   - Message instruction with the control tag MSG_READ.



4. Configure the message parameters as follows.



a. Set Service Type to Get Attribute Single.

b. Set Class to 4 (assembly)

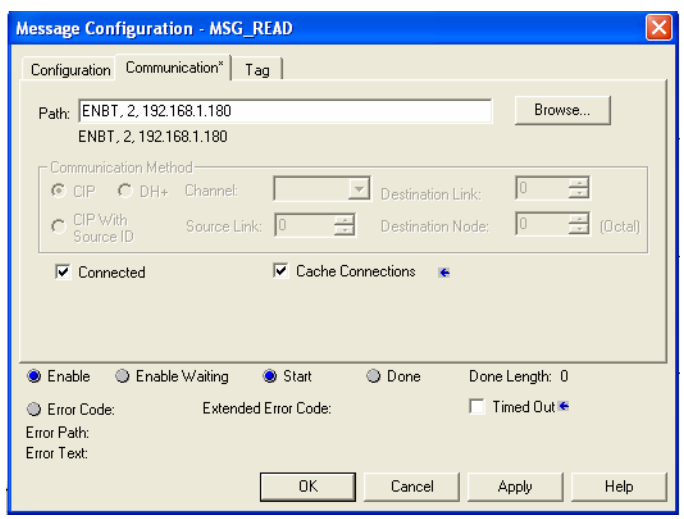
c. Set Instance to 120. This is the assembly instance number that will be read from.

d. Set Attribute to 3 (assembly data).

e. Set Destination to ReadBuffer.

5. Switch to the Communication tab and enter this text in the Path field: ENBT,2,<GuardPLC IP address>.

Here, 2 is the EtherNet/IP port of the 1756-ENBT module.



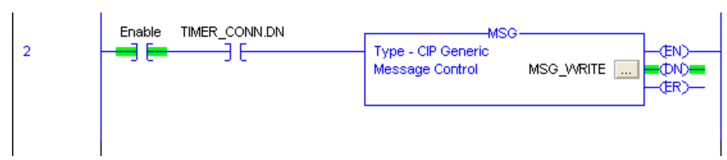
6. Check the Connected and then the Cache Connections boxes.

   The Connected option ensures that messages are sent over a Class 3 connection, not as unconnected ones.

   Cache Connections is the default option. If it is checked, the connection is opened the first time the controller is in Run mode and the rung condition is true. In this example, the rung condition is true when Enable value is true and the timer has expired (DN flag is set). This connection remains open until the controller goes to Program mode.

   If Cache Connections is unchecked, a connection is opened every time the controller is in Run mode and the rung condition becomes true. The Logix controller opens the connection, sends an explicit message over the new connection and then closes the connection immediately. The next time the rung condition is true, the whole sequence is repeated: open connection, send message, close connection.

7. Build the third rung containing these instructions:
   - Examine on Enable tag
   - Examine on TIMER_CONN.DN
   - Message instruction with the control tag MSG_WRITE



8. Configure the message parameters as follows:
   a. Set Service Type to Set Attribute Single.
   b. Set Class to 4 (assembly).
   c. Set Instance to 121.
      This is the assembly instance number that will be written to.

   d. Set Attribute to 3 (assembly data).
   e. Set Source Element to WriteBuffer.
   f. Set Source Length to 4 bytes.
      The Source tag can be larger in size than the target GuardPLC assembly. However, the Source Length should exactly match the size of the assembly, otherwise an error occurs.

This Class 3 example uses the Cache Connections option. A connection with this flag is opened when the controller switches to Run mode and the rung condition is true. In our example, the rung condition is true when Enable value is true and the timer has expired (DN flag is set). When the rung condition is False, the connection remains open.

If the Enable tag is changed to false, the connection still remains open. To maintain the open connection, the Logix controller periodically sends the last message with the same data sequence number. This same data sequence number indicates to the GuardPLC controller that this is just a keep alive message and that the data has not changed. If this is a write message, the GuardPLC controller still responds to it, but ignores the data that came with it because it knows the data has not changed. This periodic frequency is set by default to 7.5 seconds, meaning that every 7.5 seconds a 'keep alive' message will be sent to keep the connection open.

Once Enable is set back to true, the messages are sent with every transition of the rung condition from false to true. In this example, a message is sent when the timer times out at 100 ms, and every time it has a new data sequence count. So, if the write data changes, this change is communicated to the GuardPLC controller no later than 100 ms past the data change tick.

The connection is closed when the controller transitions to Program mode.

Download and Go to Run

1. Download to the Logix controller and switch the controller to Run.

2. Set Enable to true.

Both messages should show the Done flag set. If an Error flag is set, double-click the message instruction to see the error description.

Verify the Data Exchange

Follow these steps to verify the data exchange.

1. In RSLogix 5000 software, switch to the Controller Tags tab.

2. Set the WriteBuffer display type to Hex. Enter 16#12, 16#34, 16#ab, 16#cd in the WriteBuffer.

3. Set the ReadBuffer type to Decimal.

   The ReadBuffer is set to Decimal because RSLogix Guard PLUS! software displays DINT types in decimal format only.

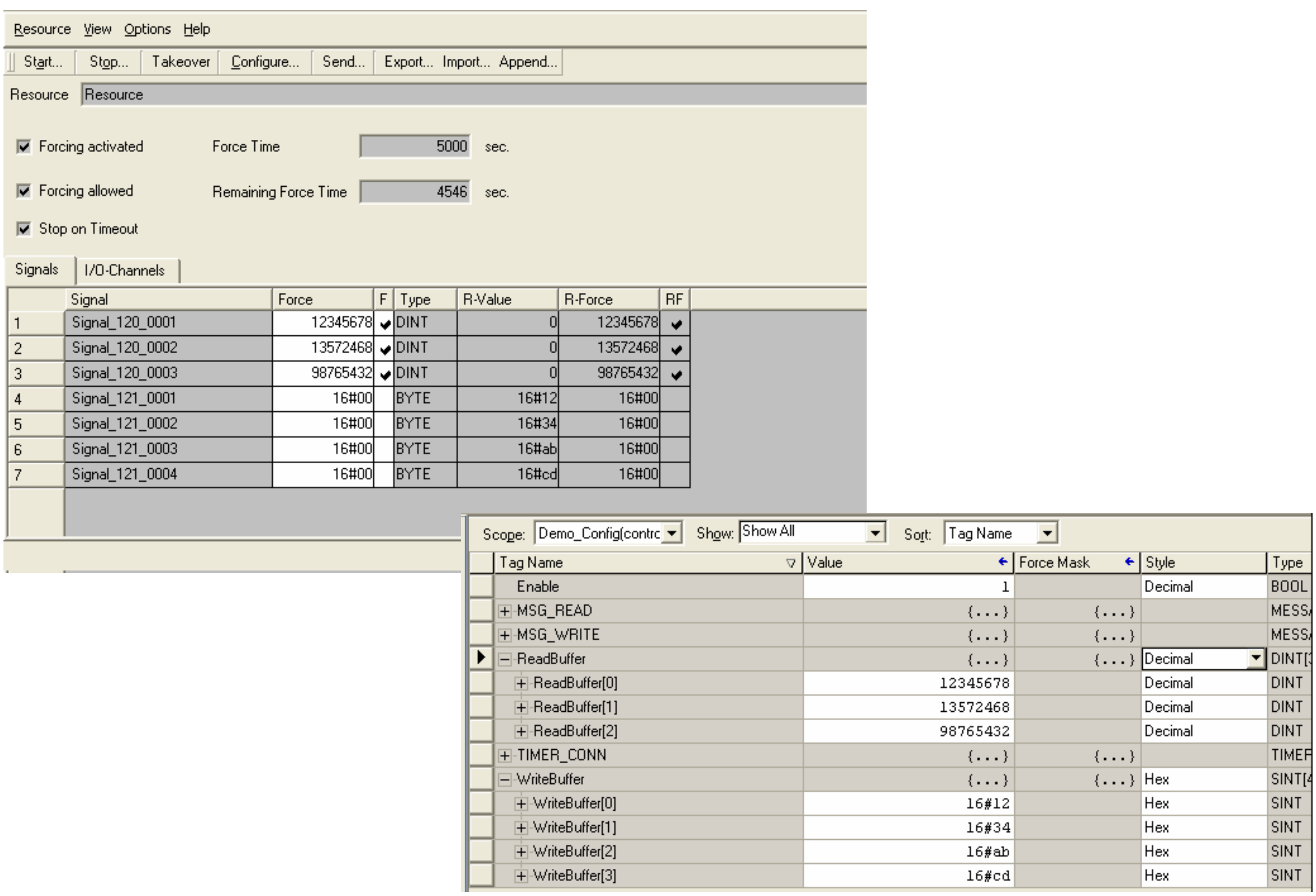
4. Configure the Force Editor menu in RSLogix Guard PLUS! software to display all signals for assemblies IN_120 and OUT_121.

5. Set signals for the IN_120 assembly to values 12345678, 13572468, 98765432.

6. Start forcing to send the new signal values.

7. Verify that RSLogix 5000 software displays the same values in the ReadBuffer.

8. Verify that the OUT_121 signals show 16#12, 16#34, 16#ab, 16#cd.



Use a GuardPLC Controller as an Unconnected Adapter

Using the GuardPLC controller as an unconnected adapter is similar to using it as a Class 3 adapter. In both cases, an explicit message is sent from the client to the GuardPLC controller, addressing one of the built-in objects, including Identity, Assembly, PCCC, Connection Configuration, Port, TCP/IP and Ethernet Link. In the case of an unconnected adapter, the message is not sent over a connection, but is sent as a single independent request.

The table below illustrates the differences between unconnected and Class 3 connection requests.

Unconnected Request	Class 3 Connection Request
The request can be sent immediately over an established TCP session.	The request requires a connection to be established before it can be sent.
When the adapter goes offline, the client is unaware until the next time a request is sent.	The client is notified by the connection timeout logic that the adapter is no longer responding.
The adapter processes every request independently from the previous ones.	The request is sent over an established transport and, therefore, requires less adapter processing.
In the case of a Logix controller, a client request is sent every time the controller is in the Run state and the rung condition is true.	In the case of a Logix controller, a client request is not only sent every time the controller is in the Run state and the rung condition is true, but is also sent periodically to keep the connection open

TIP In general, use a Class 3 connection when data should be exchanged on a regular basis. Use unconnected requests when data should be sent occasionally and the connection does not need to be maintained.

To use the GuardPLC controller as an unconnected adapter with a Logix controller, follow the steps in Open a Class 3 Connection from a Logix Controller on page 228. However, when configuring the message instruction, do not check the Connected box on the Communication tab, as described on page 232.

Use Unconnected PCCC Messaging from a PLC-5 or SLC 5/05 Controller

The GuardPLC controller and PLC-5 or SLC 5/05 controllers exchange data via PCCC read/write unconnected messages from the PLC-5 or SLC 5/05 controller to the GuardPLC controller.

The PLC-5 or SLC 5/05 controllers and GuardPLC controllers must be connected to the EtherNet/IP network. Channel 2 on the PLC-5 controller or Channel 1 on the SLC 5/05 controller must be configured for EtherNet/IP communication.

Refer to the Enhanced and Ethernet PLC-5 Programmable Controllers User Manual, publication 1785-UM012, or to the SLC 500 Modular Hardware Style User Manual, publication 1747-UM011, for more information on configuring these controllers for Ethernet communication.

You will also need RSLogix 5 programming software to configure the PLC-5 controller or RSLogix 500 programming software to configure the SLC 5/05 controller.

Follow these steps to enable communication between the GuardPLC controller, acting as an adapter (target), and a PLC-5 or SLC 5/05 controller.

1. Create a GuardPLC adapter Assembly Instance (input or output), including the data type, assembly size, and assembly name. See pages 215 and 216.

TIP	Make sure the Run/Idle header box is unchecked as PCCC messages do not use a Run/Idle header.

2. Configure an EtherNet/IP driver for the PLC-5 or SLC 5/05 controller by using RSLinx software.

3. Add a MSG instruction to the PLC-5 or SLC 5/05 application program logic.

4. Save and download your application.

These steps are described in more detail beginning on page 237.

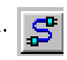
For detailed information on the MSG Instruction, refer to these publications:

- PLC-5 Programmable Controllers Instruction Set Reference Manual, publication 1785-6.1.
- SLC 500 Instruction Set Reference Manual, publication 1747-RM001.

Configure an EtherNet/IP Driver

If you are going to program the PLC-5 or SLC 5/05 controller via the EtherNet/IP network, you must configure an EtherNet/IP driver in RSLinx software to allow your PC to communicate with the PLC-5 or SLC 5/05 controller.

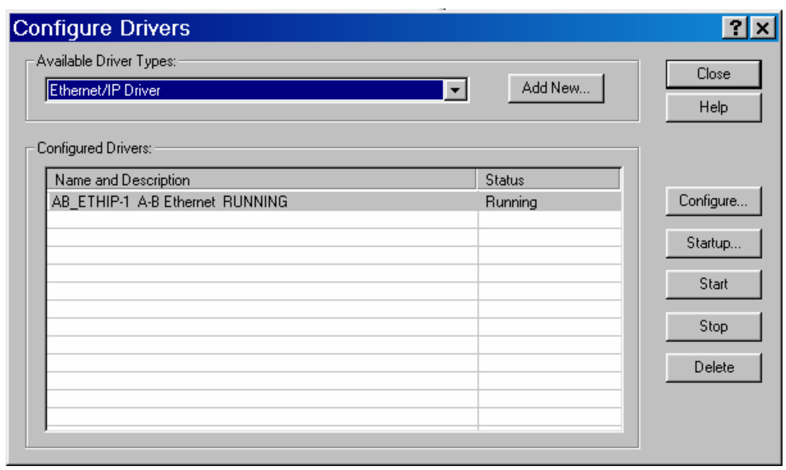
1. Start RSLinx software.

2. Click the Configure Drivers button. 

3. From the Available Driver Types pull-down menu, choose the Ethernet/IP Driver.

4. Click Add New.

5. Enter a name for the new driver and click OK.



Create an EtherNet/IP Project in RSLogix Programming Software

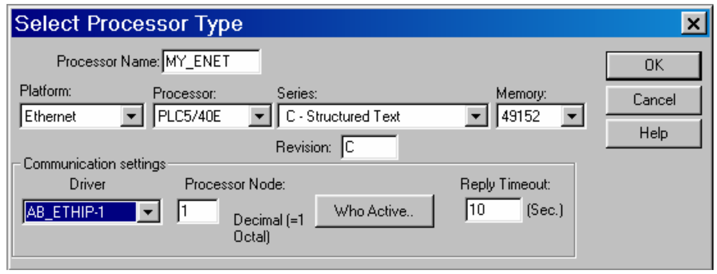
Use RSLogix 5 programming software for PLC-5 controllers and RSLogix 500 programming software for SLC 5/05 controllers. Follow these steps to create an EtherNet/IP project in RSLogix software.

1. Open the appropriate programming software.

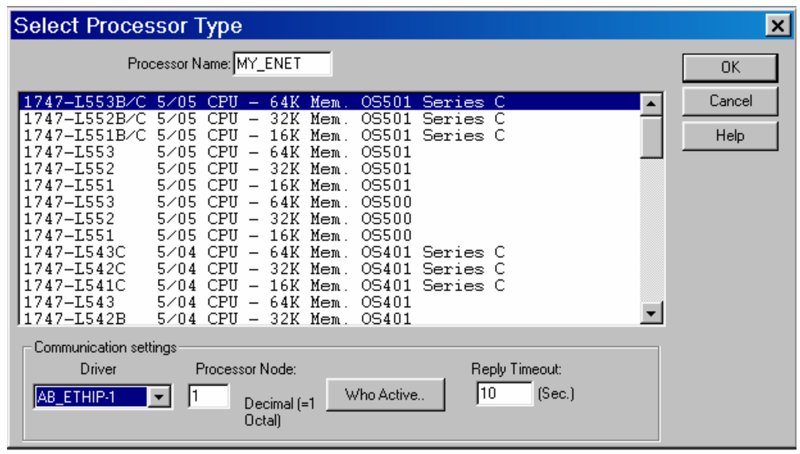
2. From the File menu, choose New.

3. Enter a name for the processor and choose the EtherNet/IP driver as shown below.

PLC-5 Controller

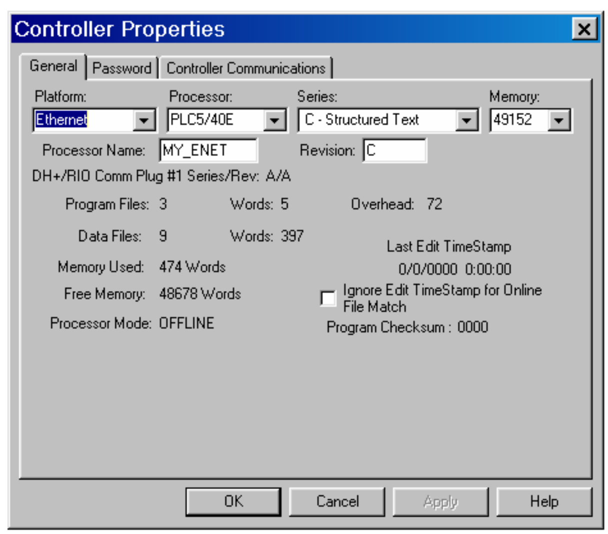


SLC 5/05 Controller

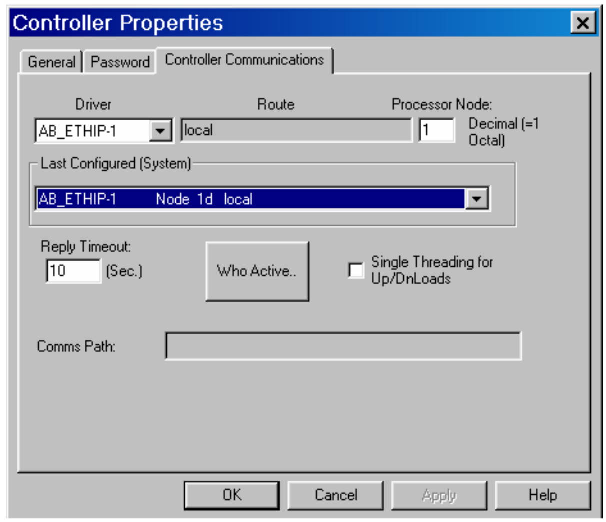


4. If your controller is a PLC-5 controller, configure the controller.

   a. Expand the Project in the project tree, right-click Controller, and choose Properties.



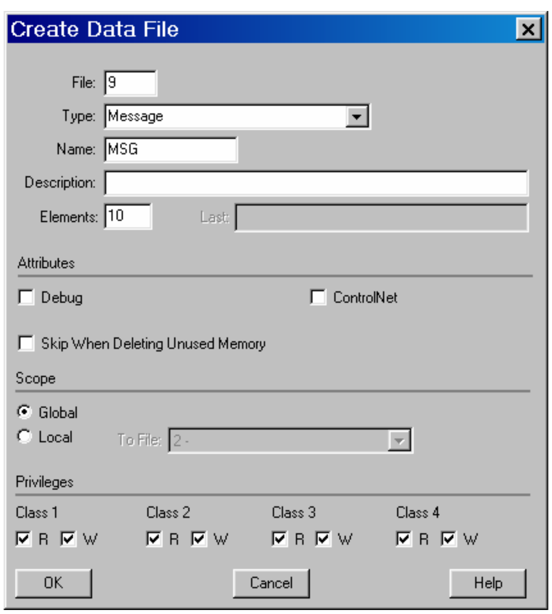
b. On the Controller Communications tab, choose the EtherNet/IP communication driver you configured in RSLinx software and click OK.



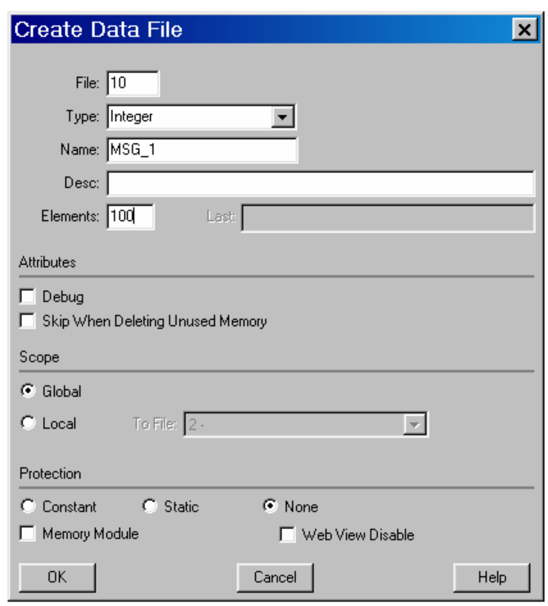
Add a Message Instruction to Your Application Program Logic

1. To allocate a MSG instruction control block, right-click Data Files and choose New > Message.

PLC-5 Controller

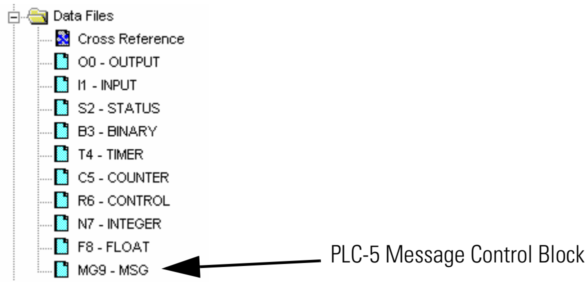


SLC 5/05 Controller



For the SLC 5/05 controller, the number of elements must be at least 93.

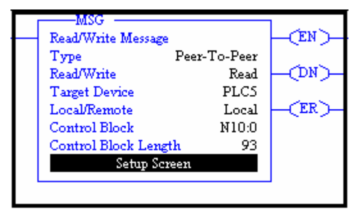
The MSG control block appears in the project tree under Data Files.



2. Insert a MSG instruction rung and assign it to a MSG instruction control block.

PLC-5 Controller

SLC 5/05 Controller



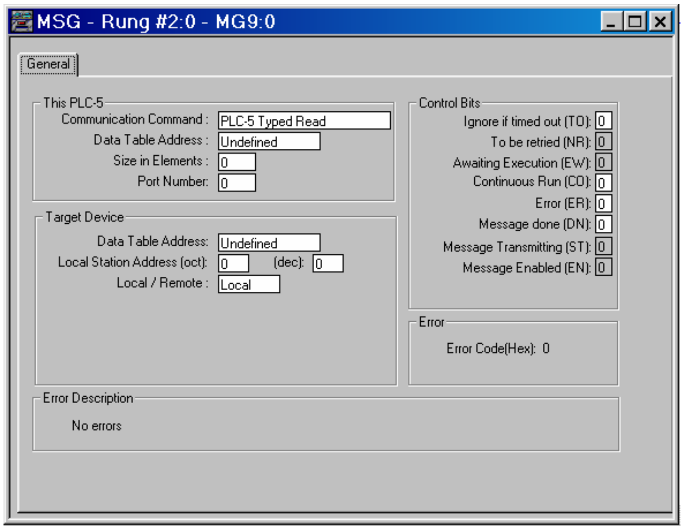
3. For an SLC 5/05 controller, edit the instruction parameters in the as described below.

Parameter	Setting
Read/Write	Choose either Read or Write.
Target Device	PLC-5
Local/Remote	Local
Control Block	Enter an integer file with at least 93 elements.
Control Block Length	93 (This is automatically entered by the programming software.)

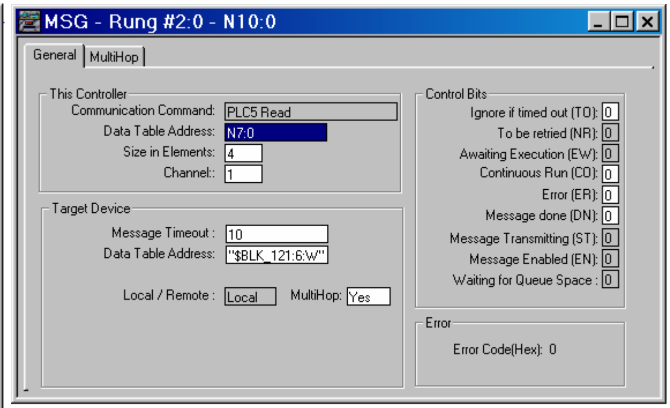
4. Double-click Setup Screen in the MSG instruction to configure the MSG instruction.

5. Configure the This Controller parameters.

PLC-5 Controller



SLC 5/05 Controller



Parameter	PLC-5 Controller Settings	SLC 5/05 Controller Settings
Communication Command	Choose PLC-5 Typed Read or PLC-5 Typed Write	Choose either PLC5 Read or PLC5 Write.
Data Table Address	Enter the source file address for a write or the destination file address for a read.	Enter the source file address for a write or the destination file address for a read.
Size in Elements	The number of items to read or write (1…1000). The actual number of bytes transmitted is based on the data type of the file specified in the Data Table Address.	The number of items to read or write (1…1000). The actual number of bytes transmitted is based on the data type of the file specified in the Data Table Address.
Port Number (for PLC-5 controllers) Channel (for SLC 5/05 controllers)	Enter the Ethernet port number. • The onboard PLC-5E port number is 2. • The EtherNet/IP sidecar Ethernet port number 3 A.	Enter 1 for the EtherNet/IP port.

TIP

You cannot send a write message to an input assembly, for example IN_120.

Input versus output assemblies are from the perspective of the PLC-5 or SLC 5/05 controller, which sends the request to the GuardPLC controller.

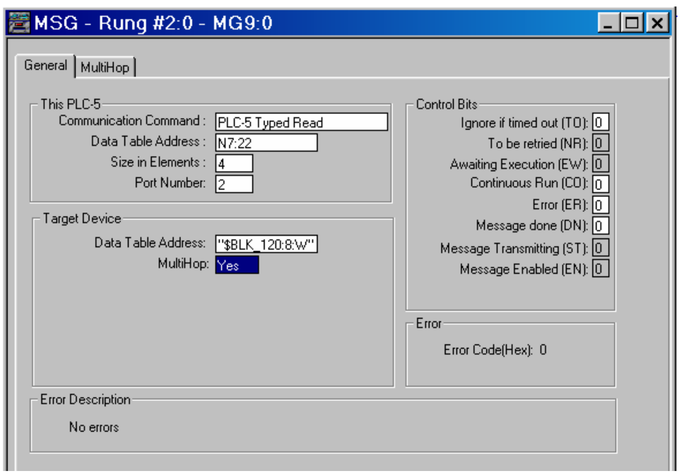
TIP

The GuardPLC controller supports only PLC-5 Typed Read and Typed Write commands. No other PCCC commands work with the GuardPLC controller on the EtherNet/IP network.

6. Configure the Target Device (the GuardPLC controller) parameters.

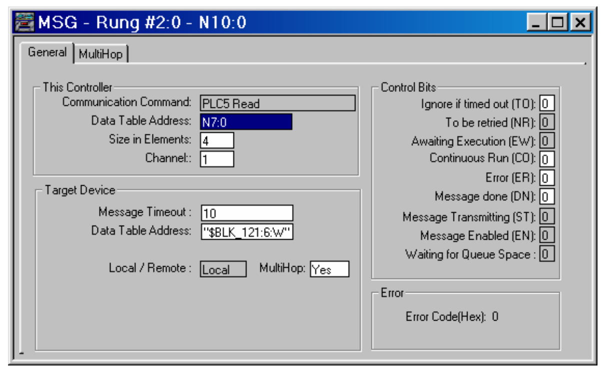
Parameter	PLC-5 Controller Settings	SLC 5/05 Controller Settings
Data Table Address	This is the GuardPLC assembly object. Enter the text name of the GuardPLC assembly proceeded by a $ and enclosed in double quotes. For example, "$BLK_120:8:W".	This is the GuardPLC assembly object. Enter the text name of the GuardPLC assembly proceeded by a $ and enclosed in double quotes. For example, "$BLK_121:6:W".
MultiHop	Choose Yes to configure MultiHop operation. The Local/Remote parameter disappears and the MultiHop tab becomes available.	Choose Yes to configure MultiHop operation. The EtherNet/IP Address field disappears and the MultiHop tab becomes available.

PLC-5 Controller



In the example above, the PLC-5 controller is configured to send a read instruction to the GuardPLC controller. Four 16-bit words of data will be read from a GuardPLC assembly named BLK_120 at an offset of eight 16-bit words. The data will be placed into the PLC-5 controller's integer file number 7 at offset 22.

SLC 5/05 Controller



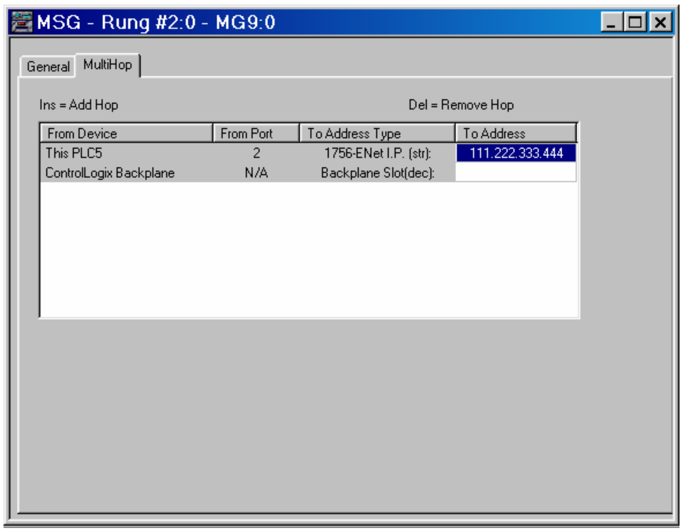
In the example above, the SLC 5/05 controller is configured to send a read instruction to the GuardPLC controller. Four 16-bit words of data will be read from a GuardPLC assembly named BLK_121 at an offset of six 16-bit words. The data will be placed into the SLC 5/05 controller's integer file number 7 at offset 0.

7. Click the MultiHop tab.

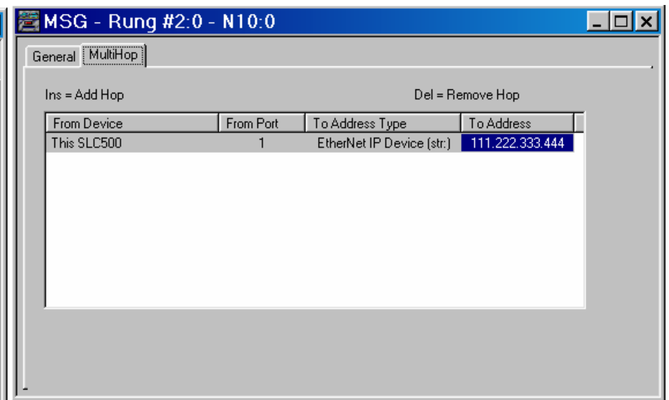
8. Press the Insert key to add the GuardPLC controller hop.

9. Enter the IP address of the GuardPLC controller.

PLC-5 Controller



SLC 5/05 Controller



Use Unconnected CIP Messaging from a PanelView Standard Terminal

Use the Generic CIP message profile to configure the PanelView Standard terminal to exchange data with the GuardPLC controller. Both devices must be connected to the EtherNet/IP network. You will need PanelBuilder32 software, version 3.82.*xx* or later, to configure the PanelView Standard terminal.

Follow these steps to enable the PanelView Standard terminal to message to the GuardPLC controller, acting as an adapter (target).

1. Create a GuardPLC Assembly Instance (input or output), including the data type, assembly size, and assembly name. See pages 215 and 216.

TIP	Make sure the Run/Idle header box is unchecked as unconnected CIP messages do not use a Run/Idle header.

2. Create a new EtherNet/IP application in PanelBuilder32 software.

3. Configure the PanelView terminal for EtherNet/IP communication.

4. To perform read and write operations to the GuardPLC controller's target assemblies, add objects to the PanelView Standard terminal's application. Configure those objects for read or write operation, using tags.

5. Save and download your application.

These steps are described in more detail beginning on page 244.

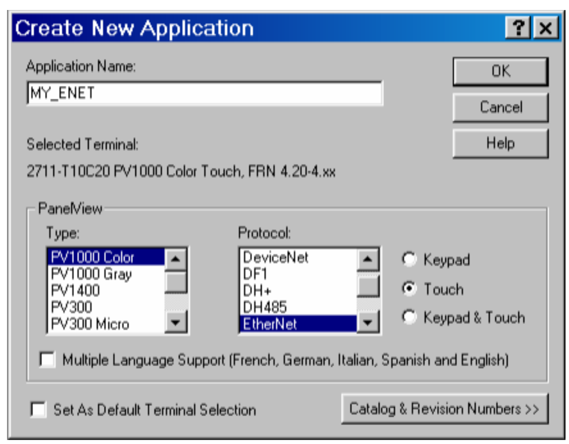
For more information on PanelView Standard terminals and using PanelBuilder32 software, refer to the following:

- PanelView Standard Operator Terminals User Manual, publication 2711-UM014.
- PanelBuilder32 Application Development Software for PanelView Standard Terminals Quick Start, publication 2711-QS003.

Create an EtherNet/IP Application

Follow these steps to create a new EtherNet/IP application in PanelBuilder32 software.

1. Select Create New Application from the PanelBuilder32 start-up screen and click OK.



2. Enter a name for your application.

3. Select your PanelView terminal and EtherNet protocol.

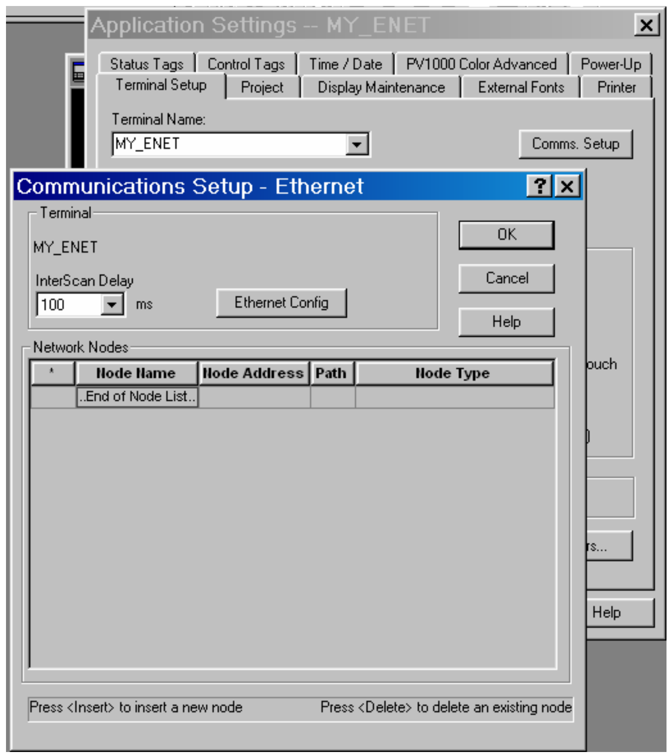
4. Click OK.

Configure the PanelView Terminal for EtherNet/IP Communication

Follow these steps to configure the PanelView terminal.

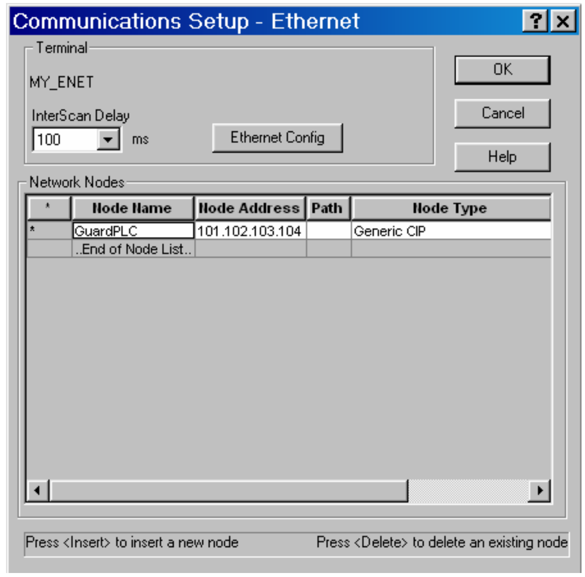
1. Double-click the Comms. Setup button on the Application Settings dialog box.

2. When the Communications Setup - Ethernet dialog box opens, press the Insert key.



3. Choose Generic CIP from the Node Type list.

4. Enter the GuardPLC controller's Node Name and it's EtherNet/IP address.



5. Leave the Path field blank.

6. Click OK.

Configure a Write Operation

The example below configures the PanelView Standard terminal to perform a write operation to set the preset value of a tag located in the GuardPLC controller's target output assembly (OUT_120).

1. From the Objects menu, choose Numeric Entry > Cursor Point.

2. Position the pointer (+) on the application screen, hold down the left mouse button and drag to draw the object on the screen.

   The object is created with six ####### characters as a placeholder for the numeric value. Each # character is a single digit.

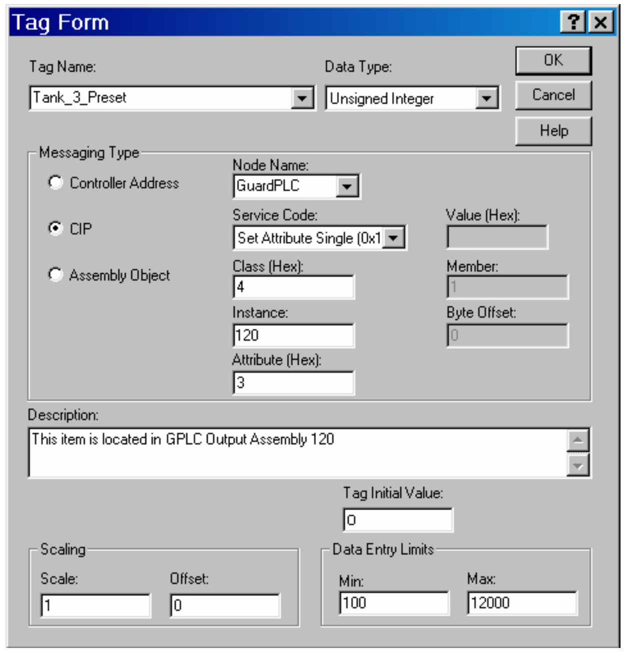
3. Double-click the object to open the Properties dialog box.

4. Check the Touch Cell checkbox.

5. Enter a name for the Write Tag.

6. Click the Edit Tag button to open the Tag Form dialog box.

7. Configure the tag as shown below.



Parameter	Setting
Messaging Type	CIP
Node Name	Enter the name of the GuardPLC controller that will receive the command.
Service Code	Choose Set Attribute Single to indicate that this is a write operation.
Class Code	Enter 4, for an assembly object.
Instance Number	Enter 120 to indicate the GuardPLC target output assembly that was created for the PanelView Standard terminal to write to.
Attribute	Enter 3 to provide access to the assembly object instance data.
Byte Offset	Index into the GuardPLC input assembly x number of bytes, then write the data.

Configure a Read Operation

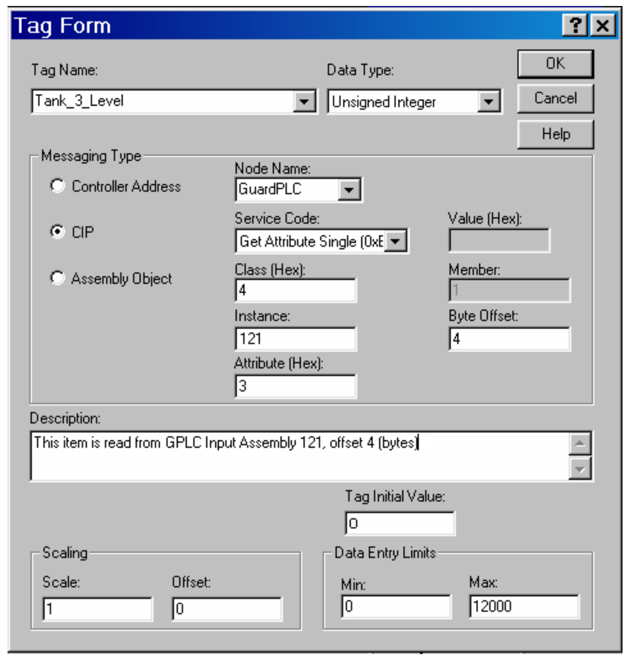
This example configures the PanelView Standard terminal to perform a read operation on the accumulated value of a tag located in the GuardPLC controller's target input assembly (IN_121) at offset 4 bytes.

1. From the Objects menu, choose Numeric Display Data.

2. Position the pointer (+) on the application screen, hold down the left mouse button and drag to draw the object on the screen.

   The object is created with six ####### characters as a placeholder for the numeric value. Each # character is a single digit.

3. Double-click the object to open the Properties dialog box.
4. Enter the desired Field Width and Decimal Point display information.
5. Enter a name for the Read Tag.
6. Click the Edit Tag button to open the Tag Form dialog box.
7. Configure the tag as shown below.



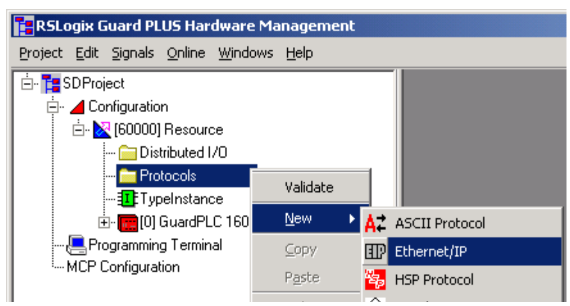
Parameter	Setting
Messaging Type	CIP
Node Name	Enter the name of the GuardPLC controller that will receive the command.
Service Code	Choose Get Attribute Single to indicate that this is a read operation.
Class Code	Enter 4, for an assembly object.
Instance Number	Enter 121 to indicate the GuardPLC target input assembly that was created for the PanelView Standard terminal to read from.
Attribute	Enter 3 to provide access to the assembly object instance data.
Byte Offset	Index into the GuardPLC output assembly x number of bytes, then read the data.

Use the GuardPLC Controller as a Scanner

Introduction

Prepare the GuardPLC Controller for Class 1 Scanner Connections

Make sure the GuardPLC controller resource has the EtherNet/IP protocol added under the Protocols folder in the RSLogix Guard PLUS! Hardware Management project tree. If it does not, see page 203 for instructions on adding EtherNet/IP protocol to the project.

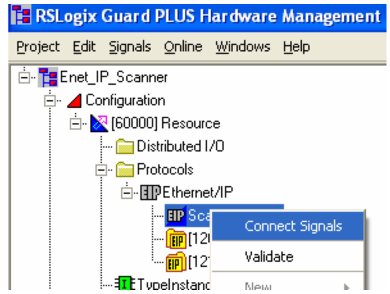


The GuardPLC controller's scanner I/O assembly consists of two buffers: one to store input data and the other to store output data. When a new connection is opened from the GuardPLC controller to an I/O module, the scanner input buffer receives data from the I/O module and the scanner output buffer stores data that is sent to the I/O module.

You must allocate enough space in both of these buffers to store the corresponding data. You do this by creating signals in the Signal Editor and assigning them to the scanner assembly. For detailed information on defining signals by using the Signal Editor, refer to the Using RSLogix Guard PLUS! Software with GuardPLC Controllers Programming Manual, publication 1753-PM001.

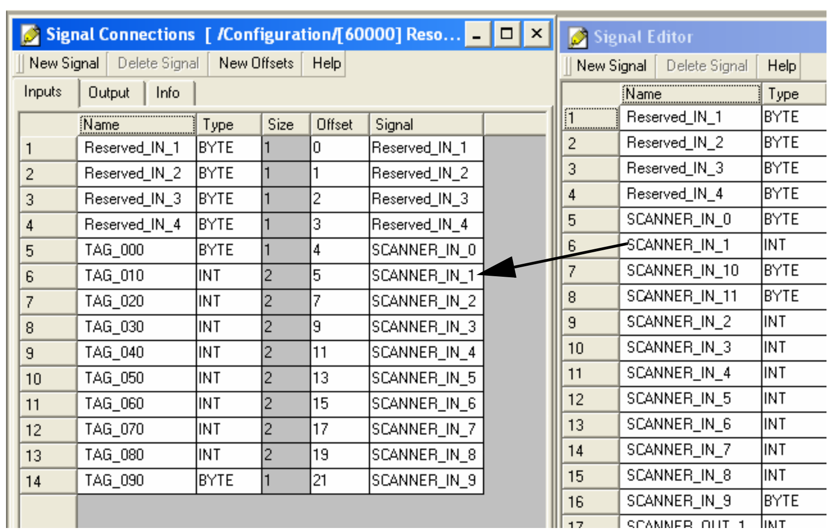
Connect the Scanner Signals

1. Right-click Scanner and choose Connect Signals from the context menu to open the Signal Connections dialog box.



2. Assign signals created in the Signal Editor by dragging them to either the Input or Output tab on the Connect Signals dialog box.

   The Input tab contains all signals to be received from the target. The Output tab contains all signals to be transmitted to the target.

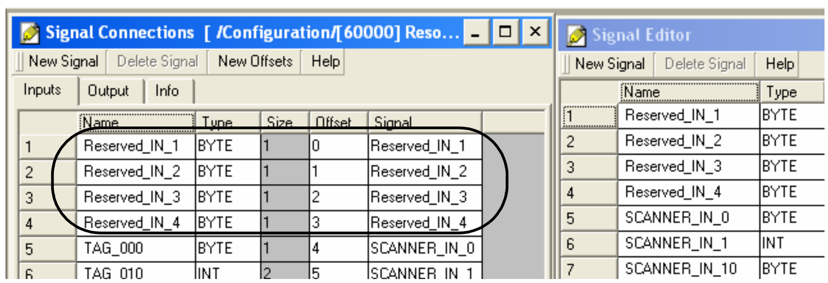


3. After the signals are assigned in the desired order, click New Offsets and RSLogix Guard PLUS! software fills in the offsets based on the type of signals you created.

You must make sure that the Scanner assembly is big enough to establish the scanner connections. For example, when you establish a connection from a GuardPLC controller to the 1794-OB16 FLEX I/O module, up to 3 words of status may come from the FLEX I/O module. One word of output data is sent to the digital output module. This means that the input assembly should be at least 6 bytes in size and the output assembly should be at least 2 bytes.

Also make sure that the data to be written or read does not cross data type boundaries or try to use only a portion of the signal. In the example above, you must assign 1 WORD or 1 INT signal, or 2 BYTE signals to the output assembly and 6 BYTES, or 3 WORDs, or 3 INT signals to the input tab. If any I/O module uses an odd number of bytes, then you must use only BYTE data type signals. For example, the 1734-IB4 module requires 2.5 WORDs or 5 BYTEs for the input assembly. If you use anything other than BYTE signals, the GuardPLC returns an error to RSNetWorx for EtherNet/IP software when you try to save the scanlist.

TIP The GuardPLC controller uses four input bytes for status. To prevent this data from automatically being the first four data signals, add four BYTE signals to the first 4 rows of the Inputs tab. In RSNetWorx for EtherNet/IP software, offset 0 will be TAG_000, as shown below.



Disable Scanner Function on the Controller

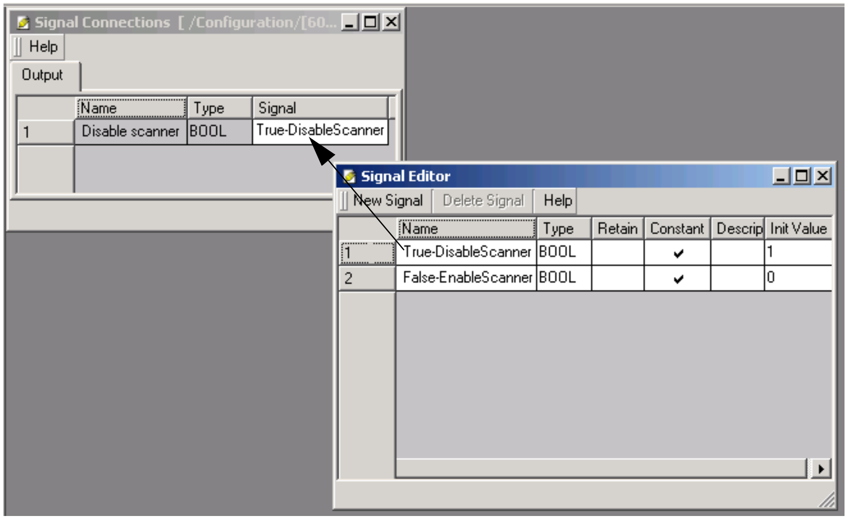
The controller is able to function as a scanner by default. Follow these steps if you need to disable scanner function.

1. Right-click EtherNet/IP in the project tree under the desired Resource and choose Connect Signals to open the Signal Connections dialog box.

2. To open the Signal Editor, from the Signals menu, choose Editor.

3. Create a new signal of type BOOL and an initial value of 1.

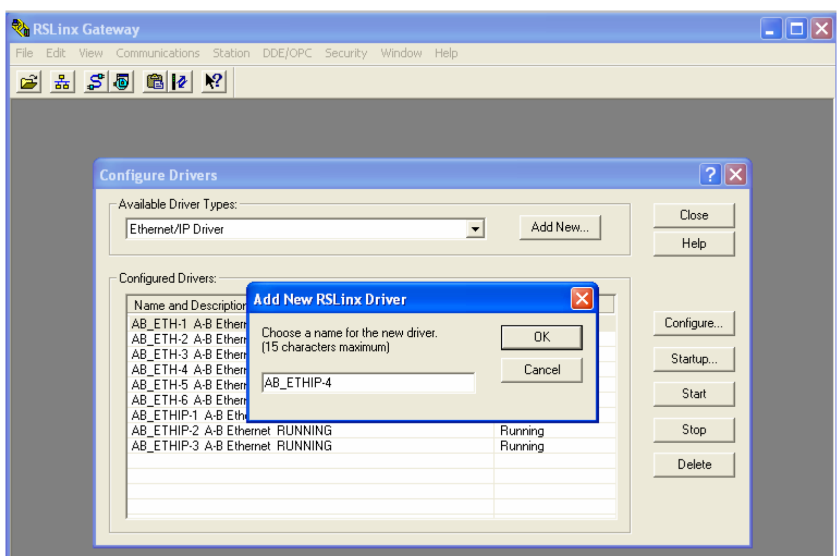
4. Assign the signal to the Disable scanner signal in the signal connections dialog box by dragging and dropping it in the Signal field.



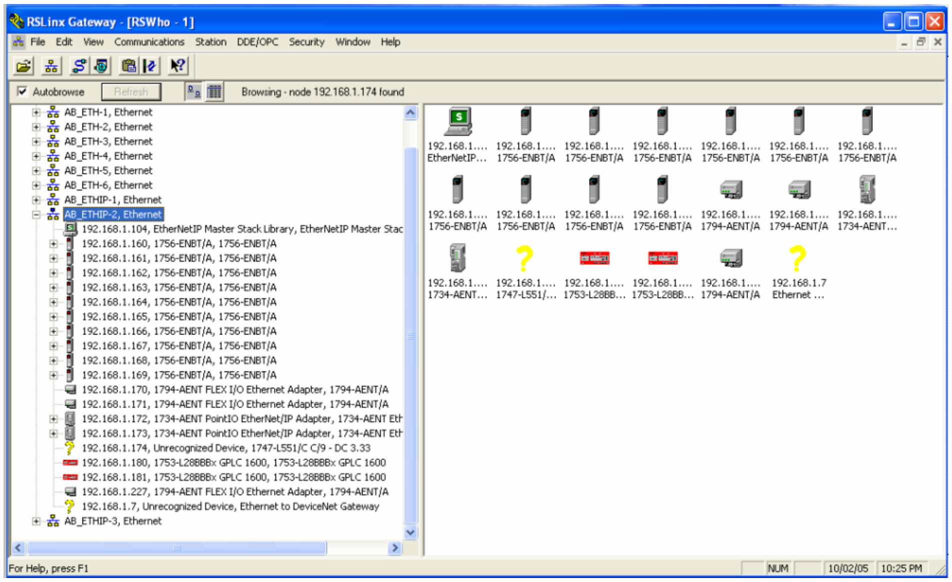
If this signal is TRUE, scanner functionality on the controller is disabled. If this signal is FALSE, scanner functionality is enabled.

Configure the EtherNet/IP Driver

1. Start RSLinx software.
2. Click the Configure Driver button.
3. From the list of Available Driver Types pull-down menu, choose the Ethernet/IP Driver and click Add New.
4. Enter a name for the new driver and click OK.



5. In the Configure Drivers dialog box, leave Browse Local Subnet checked and click OK.



TIP

The controllers will be recognized automatically if they are in the same subnet. If the controller type or name is unidentified, you must install the correct EDS file.

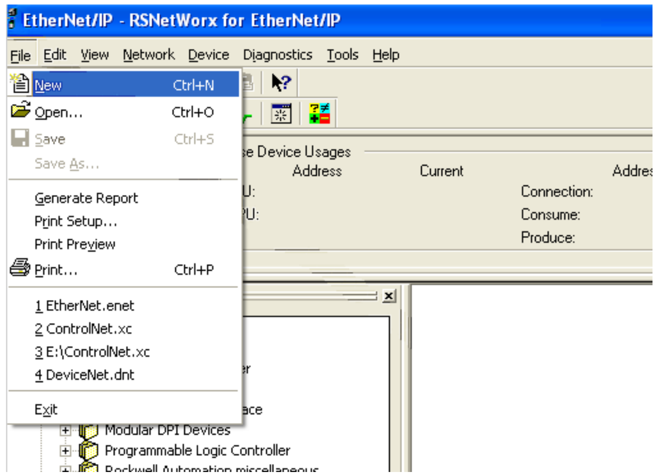
EDS files are available on the RSLogix Guard PLUS! software CD or at http://support.rockwellautomation.com.

Configure Connections in RSNetWorx for EtherNet/IP Software

Before starting RSNetWorx for EtherNet/IP software and configuring the GuardPLC controller's scanlist, make sure the GuardPLC controller is in the STOP/VALID CONFIGURATION state, or RSNetWorx for EtherNet/IP software will generate an error.

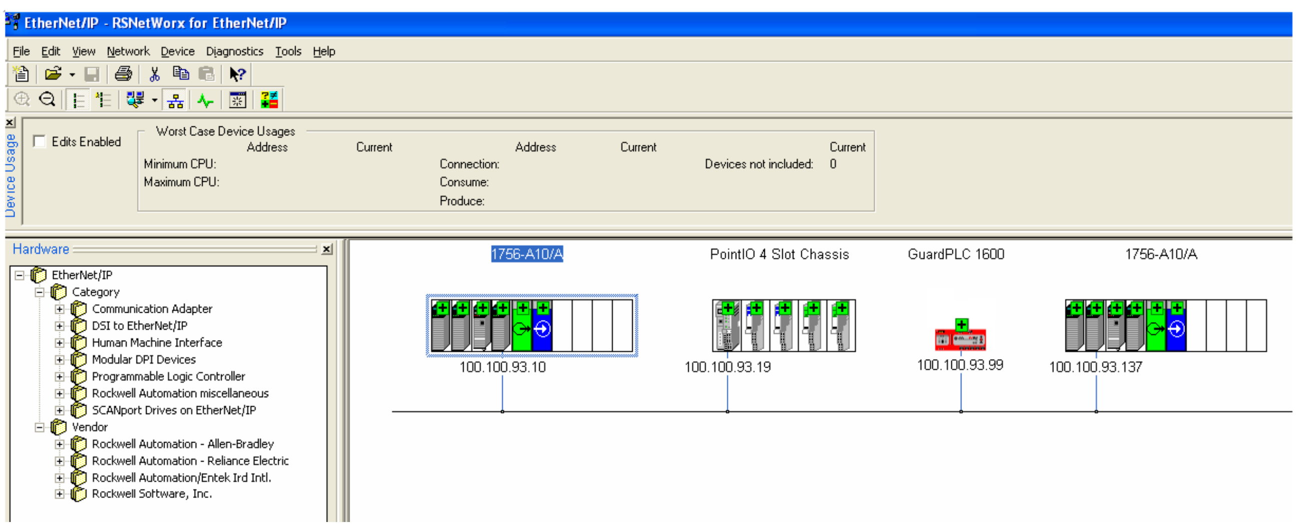
1. Start RSNetWorx for EtherNet/IP software.

2. To create a new configuration, from the File menu, choose New.



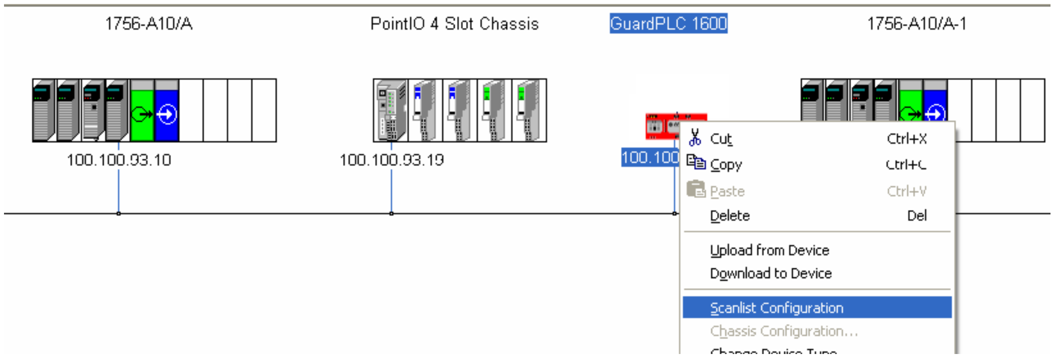
3. To go online, click the online button or, from the Network menu, choose Online.

   Your EtherNet/IP devices appear in the graphic view.

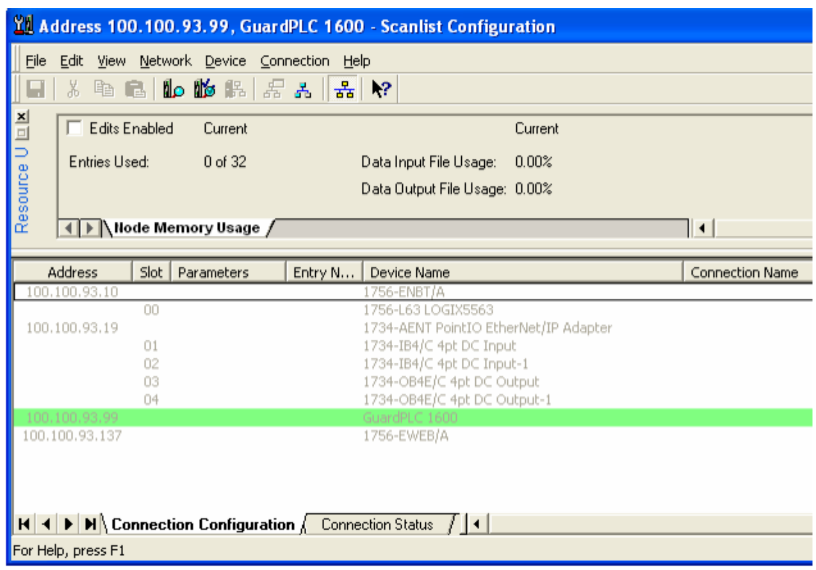


TIP You may see icons overlaying the devices when you first go online. This is normal and only indicates the status of the offline versus the online configuration. Once you complete the configuration, the symbols disappear.

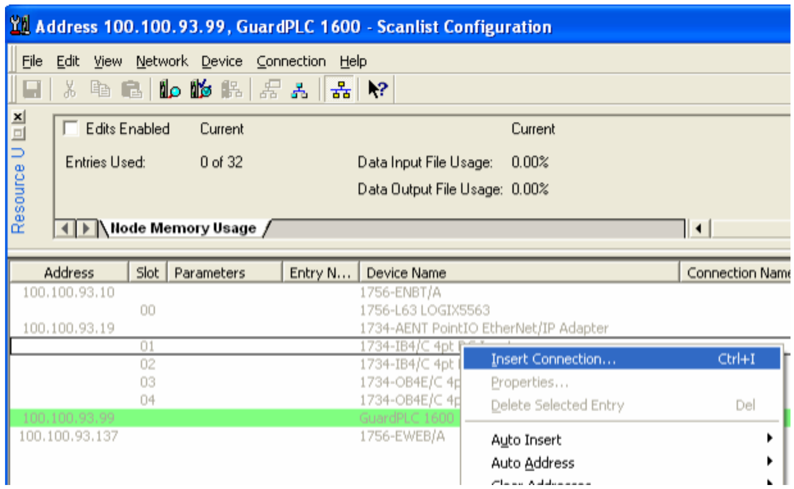
4. Right-click the GuardPLC controller icon in the graphic view and choose Scanlist Configuration to open the Scanlist Configuration dialog box.



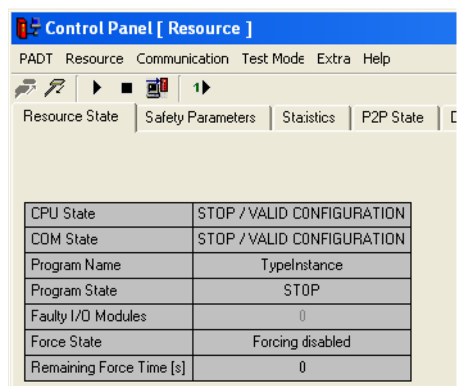
The GuardPLC controller is highlighted in the Scanlist Configuration dialog box to show that it is the scanner in this configuration.



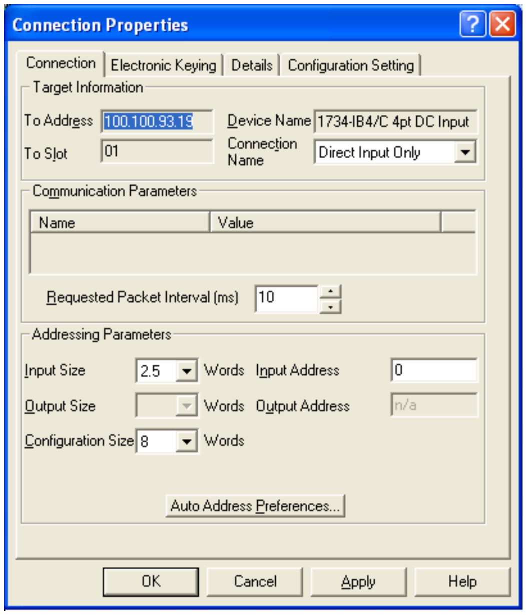
5. Right-click the target I/O module in the Scanlist Configuration dialog box and choose Insert Connection.



TIP If the controller is in the RUN mode, a warning message appears, instructing you to put the scanner into the STOP/VALID CONFIGURATION mode before you attempt to add connections.



6. Configure the Connection Properties for the I/O module, using the Connection tab on the Connection Properties dialog box.



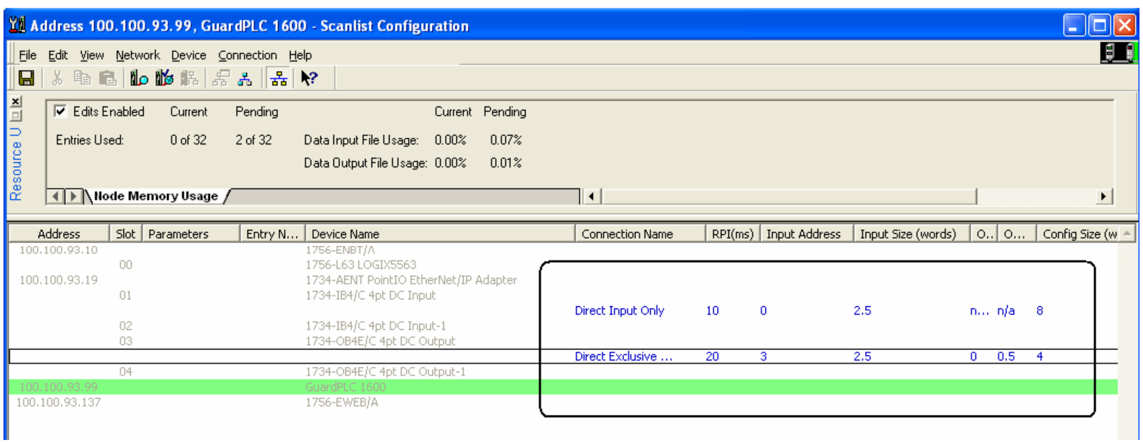
In a produce/consume system, modules multicast data, meaning that multiple modules can receive the same data at the same time from a single module. When you choose Connection Name, in this dialog box, you must choose whether to establish an owner or listen-only relationship with the module. An owner connection is any connection that does not include Listen Only in its Connection Name.

Property	Description	
Connection Name	Some modules do not support all of the possible EtherNet/IP connection types: Exclusive Owner, Input Only, and Listen Only. The Connection Name pulldown menu contains only the connection types supported by the selected module.	
	Exclusive Owner	When the exclusive owner type is used, output assemblies can be written. Only one exclusive owner connection is allowed to connect to a single output assembly. Multiple Exclusive Owner connections can be made to input only modules. Any module that contains output assemblies can have only one Exclusive Owner.
	Input Only	An input only connection lets input assemblies be exported to one or more consumers. Another connection request to the same input connection can be made if the same data size and requested packet rate are specified. All Input Only connections are independent of one another. When one of the connections is closed, the others remain open.
	Listen Only	With listen only connections, input assemblies are sent to one or more consumers. For a listen-only connection to be established, an exclusive owner or input only connection with multicast must already exist. All the subsequent Listen Only connections depend upon the owner connection. When an owner connection is closed, all subsequent Listen Only connections are also closed.
Requested Packet Interval (RPI)	Enter the Requested Packet Interval (RPI) in ms. The RPI specifies the period at which data updates over a connection. The RPI is entered in 1 ms increments. The RPI specified for the GuardPLC controller can be as little as 1 ms. However, the GuardPLC controller will not produce or consume data with a rate less than 2 ms, because this is the tick of the GuardPLC communication module. This limits the minimum RPI to 2 ms.	

Property	Description
Input Size	Input size is the length of the data sent from the I/O module (target) to the GuardPLC controller (scanner). The value in this field is predetermined by the module type and cannot be changed.
Output Size	Output size is the length of the data sent from the GuardPLC controller (scanner) to the I/O module (target). The value in this field is predetermined by the module type and cannot be changed.
Configuration Size	Configuration Size is the size of the configuration data sent with the connection establishment request.
Input Address	The Input Address is the offset in words of the GuardPLC input scanner assembly where the GuardPLC controller will store the input data from the target device. Enter the Input Address.
Output Address	The Output Address is the offset in words of the GuardPLC controller's scanner output assembly buffer where the GuardPLC controller will store its data before sending it to the target device, in this case the FLEX I/O module.

7. Once you have set these properties, click the OK button to apply the changes.

   RSNetWorx for EtherNet/IP software displays these changes in blue under the I/O module entry.

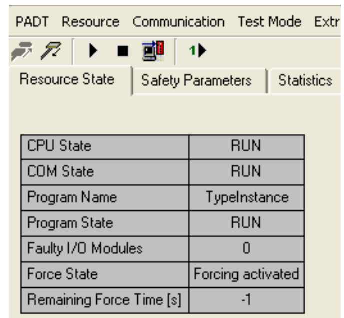


8. Repeat steps 5…7 for all target I/O modules and press the Save button to download the connection configuration to the GuardPLC controller.

TIP If you get a 'Type' error and the save procedure is aborted, it is most likely a data type error with the signals in the RSLogix Guard PLUS! software scanner configuration. Make sure that you have not tried to cross a data type boundary or that you have not used a module with an odd number of bytes with INT or WORD data types.

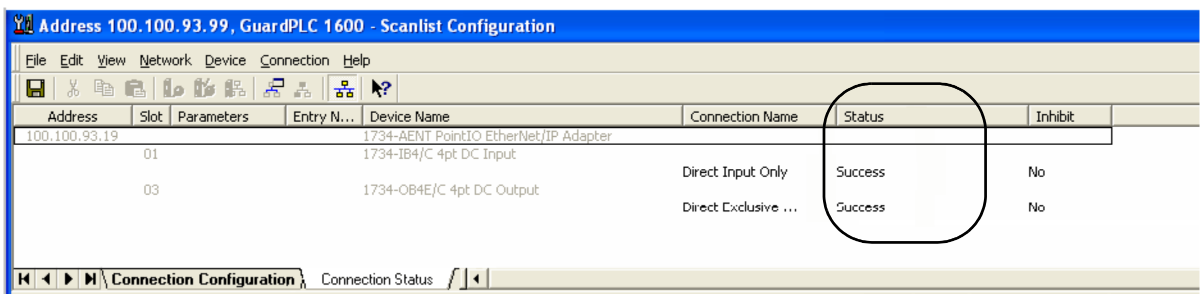
9. In RSLogix Guard PLUS! software, put the GuardPLC controller into RUN mode.

   The configuration is now complete and the I/O modules should be working under the control of the GuardPLC controller.



10 . To view the status of the connection in RSNetWorx for EtherNet/IP software, click the Connection Status tab.

   Every connection in the GuardPLC controller is listed on this screen. Any non-working connections are also listed.

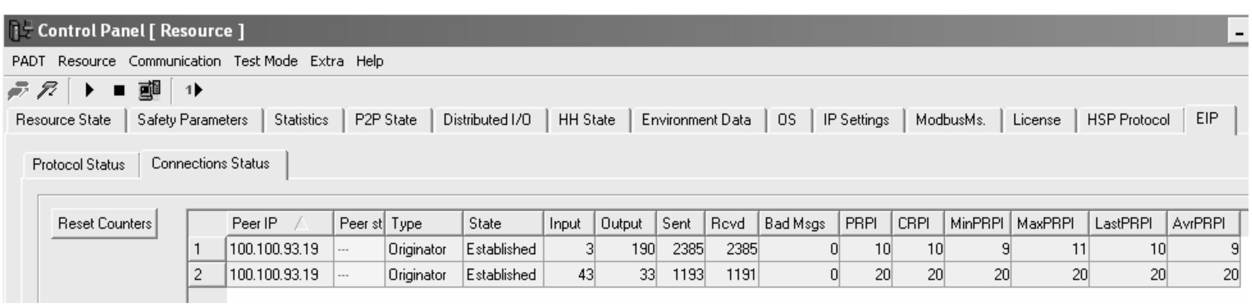


11 . You can also verify the connection status in RSLogix Guard PLUS! software.

   a. Open the Control Panel by choosing Control Panel from the Online menu.

   b. Click the EIP tab.

   c. Click the Connections Status tab.



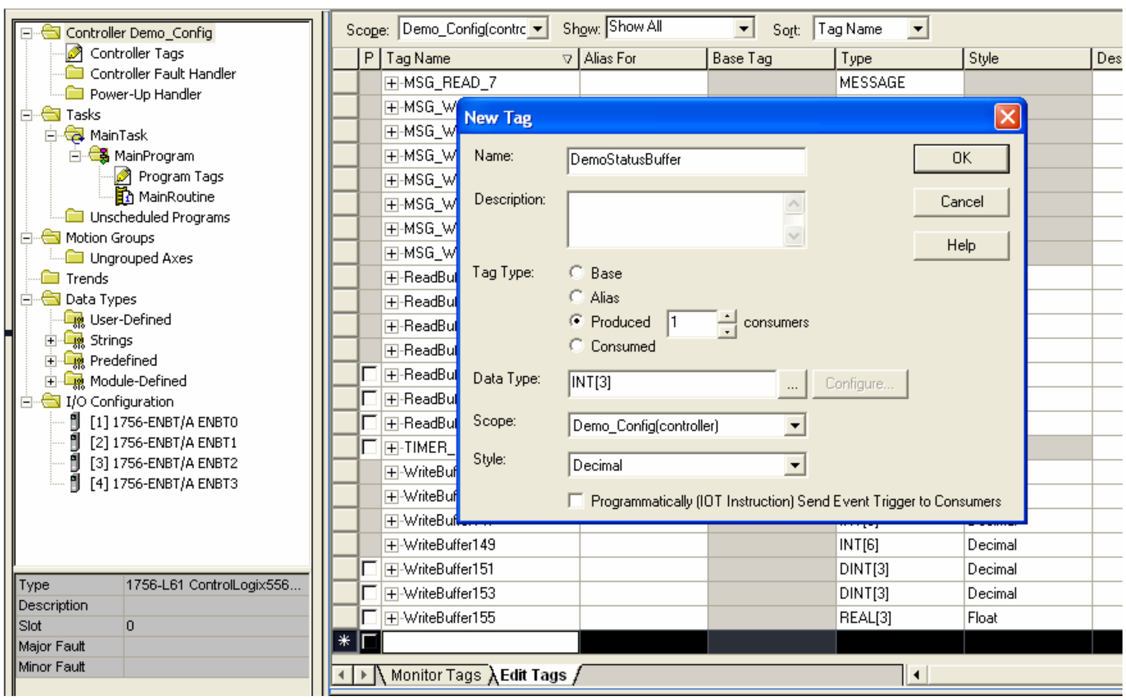
For more information on the Control Panel, see Chapter 14.

Open a Connection to a Logix Controller

The GuardPLC controller can establish a connection to a ControlLogix or CompactLogix controller and read the data over this connection. The data must be stored in the producing data tag in the Logix controller. The data exchange is one-sided, from the Logix controller to the GuardPLC controller. For exchanging data in both directions, see Open a Class 1 Connection from a Logix Controller to the GuardPLC Controller on page 219.

Create a Producing Data Tag

1. Open your RSLogix 5000 project.
2. Click the Edit Tags tab.
3. Right-click an empty line and choose Edit Tag Properties.



4. Enter the tag name.
5. Set the tag type as Produced.

   The Number of Consumers parameter dictates how many scanners should be able to read from this tag at the same time.
6. Enter the Data Type.
7. Click OK to save the changes.

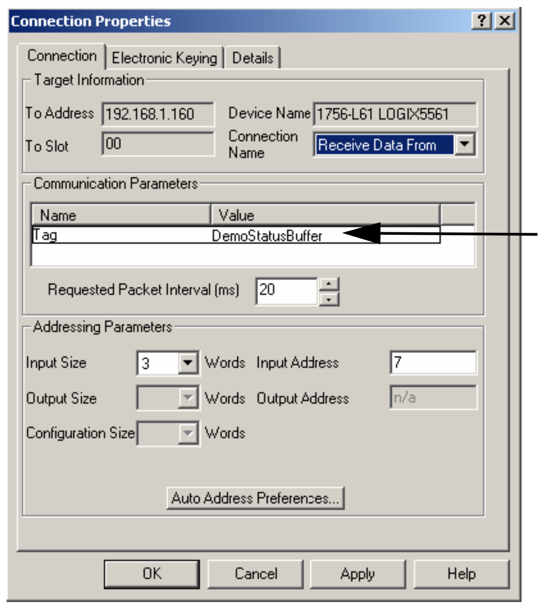
For more information on configuring Logix controllers, refer to Logix5000 Controllers Quick Start, publication 1756-QS001.

Configure Connections from the GuardPLC Controller to the Logix Controller

1. In RSNetWorx for EtherNet/IP software, right-click the GuardPLC scanner controller in the graphic view and choose Scanlist Configuration.

2. Right-click the target Logix controller in the Scanlist Configuration dialog box and choose Insert Connection.

3. In this example, the Connection Name is Receive Data From.



4. Enter the name of the producing tag in the Communication Parameters Value field.

5. Make sure that the Input Size value matches the size of the producing tag.

6. Once you have set these properties, click the OK button to apply the changes.

   RSNetWorx for EtherNet/IP software displays these changes in blue under the I/O module entry.

7. Click Save in RSNetWorx for EtherNet/IP software to download the configuration to the GuardPLC controller.

Save the Connection Configuration in the GuardPLC Controller

Up to this point, only the configuration has been downloaded to the GuardPLC controller. The offline project currently contains only the assigned signal connections.

Once the connection configuration is saved with the RSLogix Guard PLUS! project, you can switch to other projects, reprogram the GuardPLC controller, and be sure that when the configuration is loaded back to the GuardPLC controller, it will use this RSNetWorx configuration to reestablish connections.

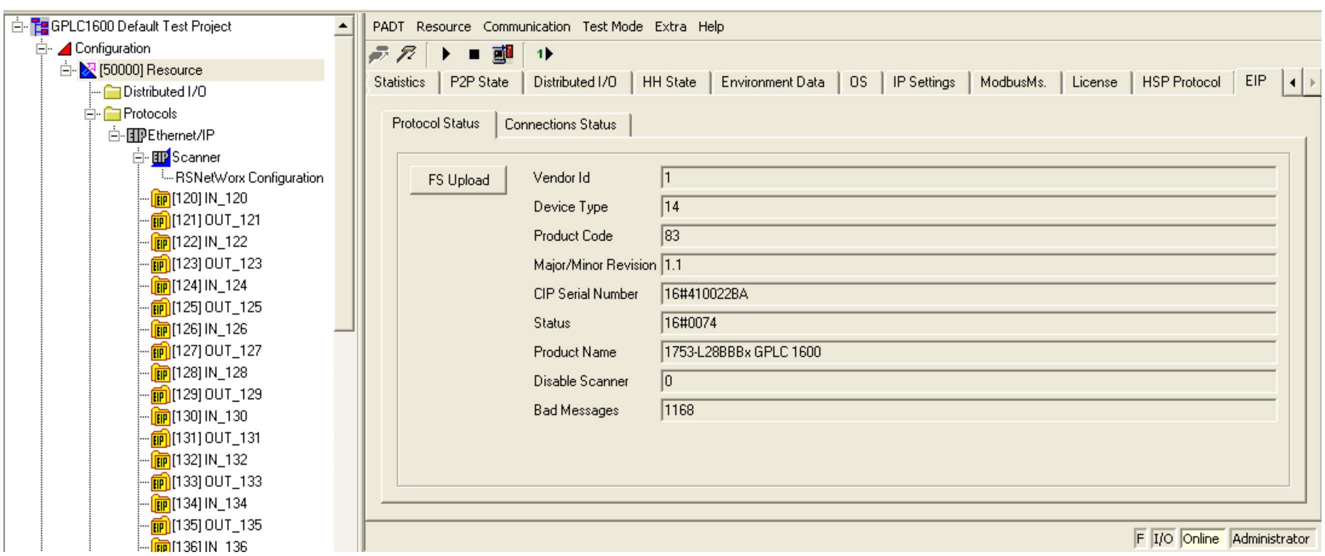
Follow these steps to upload the online configuration to your offline project.

1. Open the Control Panel in RSLogix Guard PLUS! Hardware Management by choosing Control Panel from the Online menu.

2. Click the EIP tab.

3. Press the FS Upload button to upload the connection configuration and add it to the project configuration.

   An RSNetWorx Configuration sub-branch will be added to the project tree under the EtherNet/IP Scanner branch.



4. Right-click the controller Resource in the project tree and choose Code Generation to compile the configuration code.

Remove the Connection Configuration

You can also remove a connection configuration from a project.

1. Click the RSNetWorx Configuration under the EtherNet/IP Scanner branch and press the Delete key.

   RSLogix Guard PLUS! software removes the RSNetWorx Configuration branch.

2. Right-click the controller Resource and choose Code Generation to save the change to the project.

Notes:

Communicate with ASCII Devices

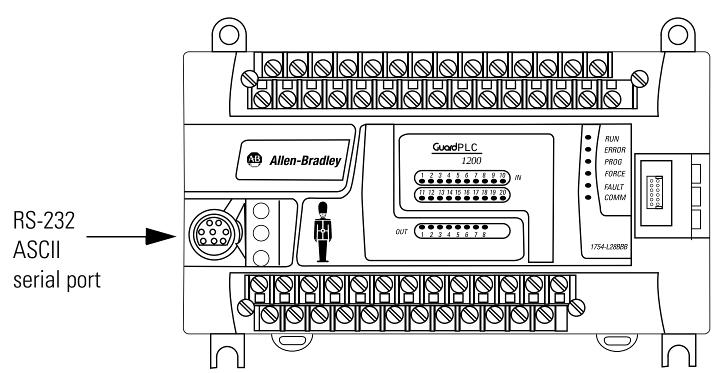
Introduction

Connect the Controller to an ASCII Device

For the sole purpose of sending the status of the signals from the GuardPLC controller to an external device, you can connect an intelligent ASCII device to the GuardPLC controller's serial port. This ASCII connection is one-way from the GuardPLC controller (slave) to the master device. You cannot program the GuardPLC controller or change the values in the GuardPLC controller by using this port.

To use the ASCII function, signals that you wish to send out the serial port must be connected to placeholders in the ASCII-protocol Connect Signals dialog box. These signals are then capable of being sent out the serial port if a command string is properly received from the master. The command string includes a starting address and number of signals to be sent. The GuardPLC controller replies to this command string by sending the values of these signals out the serial port in an ASCII string.

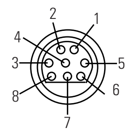
Connect to a GuardPLC 1200 Controller



Use a 1761-CBL-PM02 series C cable to connect to the serial port. The mini-DIN connector attaches to the controller. The other end is a 9-pin

D-shell connector. This mini-DIN connector is not commercially available, so you cannot make this cable.

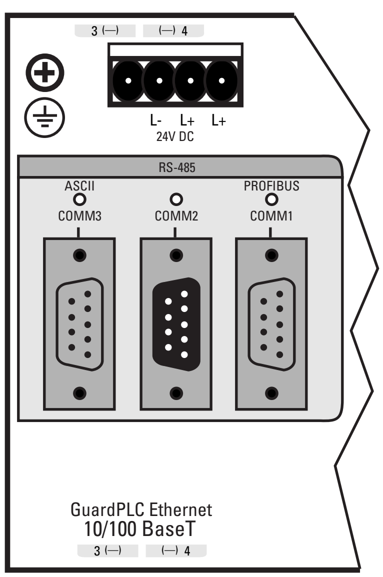
The pin assignment of the ASCII Serial port is shown below.



Pin	Function
1	24V DC
2	ground (GND)
3	request to send (RTS)
4	received data (RxD)
5	received line signal detector (DCD)
6	clear to send (CTS)
7	transmitted data (TxD)
8	ground (GND)
9	not applicable

Connect to a GuardPLC 1600 or 1800 Controller

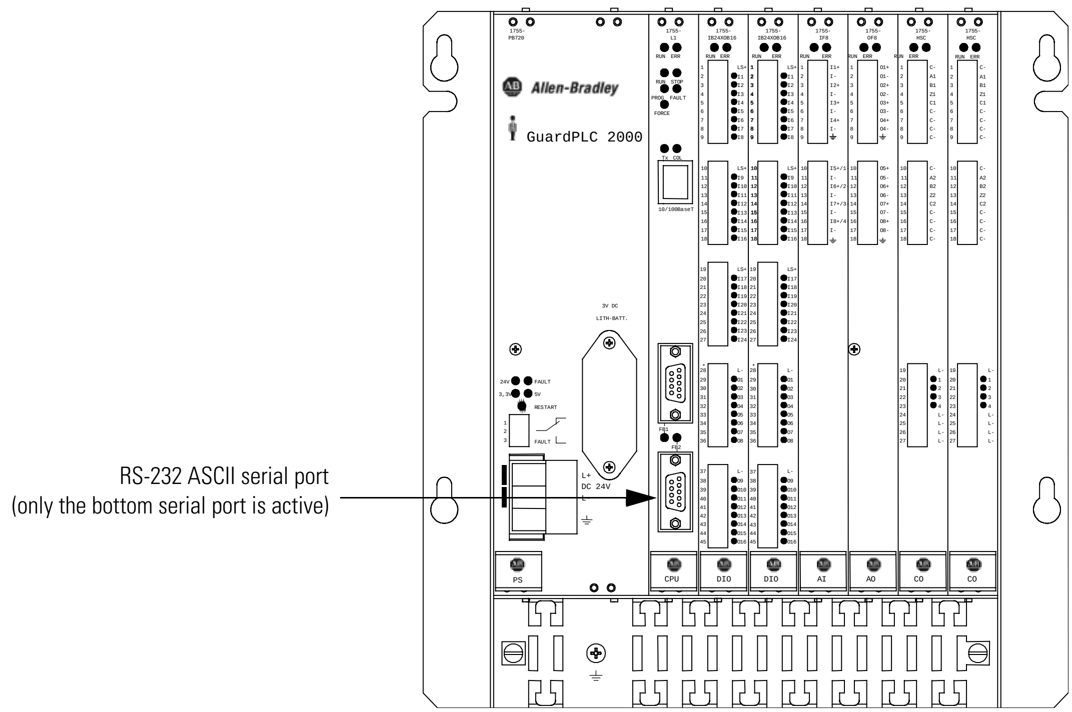
The ASCII COMM3 port location and connector pin assignment are shown below.



Connection	Signal	Function
1	---	---
2	RP	5V, decoupled with diodes
3	RxD/TxD-A	Receive/Transmit data A
4	CNTR-A	Control Signal A
5	DGND	Data reference potential
6	VP	5V, positive pole of supply voltage
7	---	---
8	RxD/TxD-B	Receive/Transmit data B
9	CNTR-B	Control Signal B

IMPORTANT The ASCII port is RS-485. You must use an electrical interface device to connect the controller to an RS-232 device.

Connect to a GuardPLC 2000 Controller



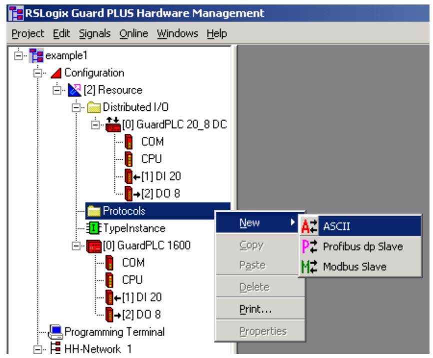
The serial port requires a 9-pin D-shell connector.

Pin	Function
1	none
2	send data
3	receive data
4	none
5	ground
6	none
7	RTS
8	CTS
9	none

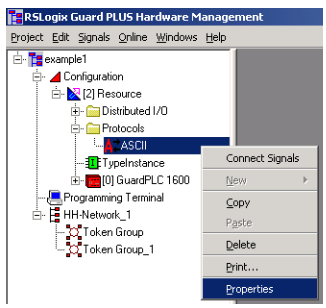
Configure the ASCII Serial Port

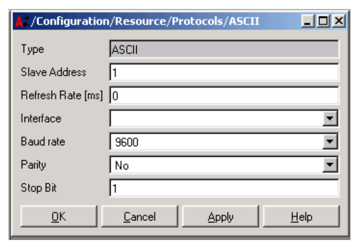
You must either create a new project or open an existing project before you can configure ASCII communication. Once the software opens a project, it automatically displays the Hardware Management window, from which you configure the ASCII port.

1. Right-click Protocols and choose New>ASCII.



2. Right-click the ASCII icon and choose Properties.





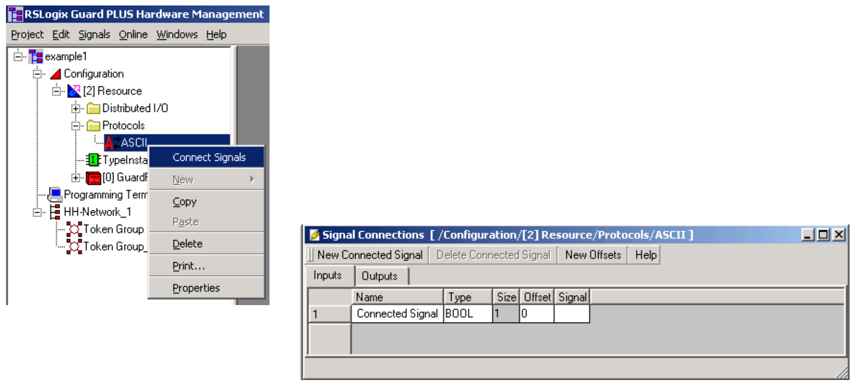
For this field	Specify
Slave Address	the slave address (1…65535) of the controller. The ASCII protocol of the controller supports only a direct point-to-point connection between the master and slave. The controller is always configured as slave. It only transfers process values via the serial interface to the master when it receives the corresponding request from the master.
Refresh Rate	the refresh rate in milliseconds for non-safe communication between the COM and CPU. The default is 0, the fastest refresh rate.
Interface	the field bus interface to be used by the ASCII protocol (comm1, comm2, comm3). Choose comm3 for GuardPLC 1600 or 1800 controllers.
Baud Rate(1)	the data transfer speed in bits/s. Choose from a pull-down menu of predefined values between 300 and 115,200 bps. The default baud rate is 9600 bps.
Parity	the parity for the recognition of transfer errors. Choose No, Odd, or Even. The default is No parity.
Stop Bit	either 1 or 2 stop bits for the serial data transfer. The default is 1 stop bit.

(1) Even if the baud rate is changed from 9600, the power-up string is always sent out at 9600 baud.

Connect Signals

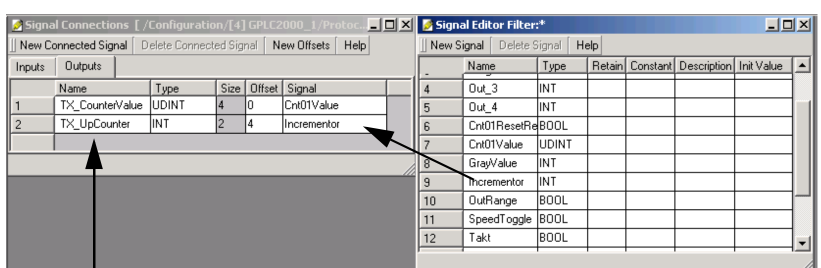
Only ASCII output signals are sent from the controller. You connect signals to the ASCII outputs to determine which signal values you want to send from the controller to the connected ASCII device.

1. Expand Protocols, right-click the ASCII icon and choose Connect Signals.



If you want to	Choose this tab
create a new signal	New Connected Signal
renumber offsets sequentially for all signals	New Offsets
delete the selected signal	Delete Connected Signal

2. Edit the output signals you want to send to the ASCII device.
   - Use the Outputs tab to define output values to send to the ASCII device.
   - Associate each output with a signal from the signal editor by dragging the signal from the Signal Editor to the Signal field on the Outputs tab in the ASCII Signal Connections dialog box.
   - Refer to the Using RSLogix Guard PLUS! Software With GuardPLC Controllers Programming Manual, publication 1753-PM001, for more information on defining signals.



The signal name is used only in printouts.

TIP

The offset in the ASCII output section is numbered based on bytes. In the example, the first signal uses bytes 0, 1, 2, and 3. The second signal uses bytes 4 and 5. However, when you request these signals in the command string (see ASCII Master - Request below), the first signal is always 0, the second signal is always 1, the third signal is always 2, and so forth.

The output section automatically sorts the name field based on alphanumerical order. This does not automatically change the offsets, but if you renumber after sorting, the offsets will change and there is no undo feature. This changes the order in which the signals are sent out the serial port.

Because names are used only in printouts, you may want to enter these names in alphanumeric order to begin with. (For example signal 101, signal 102, signal 103, signal 104, and so forth.)

ASCII Protocol

The controller is a slave ASCII device and expects this protocol from the master device.

ASCII Master - Request

If the ASCII master sends a request, the slave can send a response. The master request has this format (each character is one byte).

Start Sign	Destination	Source	Function Code	Start Address	Number of Variables	End Sign
1 char	2 char	2 char	1 char	5 char	3 char	1 char

Component	Description
Start Sign	identifies the start of a message ^ character
Destination	unique slave address (GuardPLC controller) 01…99
Source	unique master address (requester) 01…99
Function Code	read data R character
Start Address	data start address for characters to read (offset) 00000…65535
Number of Variables	number of variables to read and send back to master 000…999
End Sign	identifies the end of a message & character

For example, this string requests the first two variables from the slave.

Start Sign	Destination	Source	Function Code	Start Address	Number of Variables	End Sign
^	15	01	R	00000	002	&

ASCII Slave - Controller Response

If the controller receives a request from an ASCII master, it responds in this format (each character is one byte).

Start Sign	Destination	Source	Function Code	Start Address	Number of Variables	Number of Characters	Data	End Sign
1 char	2 char	2 char	1 char	5 char	3 char	4 char	maximum 10000 char	1 char

Component	Description
Start Sign	identifies the start of a message ^ character
Destination	unique master address (requester) 01…99
Source	unique slave address (GuardPLC controller) 01…99
Function Code	r character identifies data sent by slave E identifies error with master request
Start Address	data start address for characters to read (offset) 00000…65535
Number of Variables	number of variables to read and send back to master 000…999
Number of Characters	number of characters in the data string (This includes the "/" delimiter but not the "&" termination character.) 0000…9999
Data	data characters
End Sign	needed to recognize the end of a message & character

For example, this string replies to the master request for the first two variables from the slave.

Start Sign	Destination	Source	Function Code	Start Address	Number of Variables	Number of Characters	Data	End Sign
^	01	15	r	00000	002	0005	4/123	&

Every data field in the message is separated with a slash (/). The slash also counts as a character when counting the total number of characters in the data string.

TIP The reply string will have a variable number of characters if non-BOOL are used. For example, 99 is 2 characters, 100 is 3 characters. There is no leading zero.

If the master request was not received properly at the GuardPLC controller, the slave response is the following.

Start Sign	Destination	Source	Function Code	Start Address	Number of Variables	Number of Characters	End Sign
^	01	15	E	00000	000	0000	&

This error response is typically sent when more signals are requested than exist in the ASCII protocol output tab. For example, 10 signals were dragged to the ASCII output section, but 20 signals were requested in the command string.

Data Type Formats

Follow these formats for sending different data types.

Data Type	Format	Example
BOOL	Description: boolean Size: 1 character Range: 1 = true; 0 = false	0 1
SINT	Description: short integer Size: 1…4 characters Range: -128…127	-101 5 127 -128
INT	Description: integer Size: 1…6 characters Range: -32768…32767	-25724 232 -6 248
DINT	Description: double integer Size: 1…11 characters Range: -2147483648…2147483647	-1357679042 257 6200471
USINT	Description: unsigned short integer Size: 1…3 characters Range: 0 …255	123 35 6 255
UINT	Description: unsigned integer Size: 1…5 characters Range: 0 …65535	65535 7 333 597
UDINT	Description: unsigned double integer Size: 1…10 characters Range: 0…4294967295	4294967295 256 334510

Notes:

Communicate with Modbus and Profibus Devices

Introduction

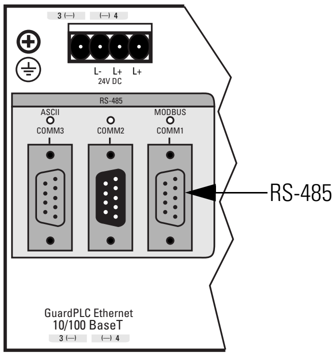
Modbus RTU Slave Protocol

Modbus is available only on GuardPLC 1600 or 1800 controllers. You can connect a Modbus master to the controller's COMM1 port. This Modbus connection is two-way non-safety-related communication between the controller (slave) and the master device. You cannot program the controller by using this port.

The controller is a Modbus RTU slave device and responds only to reads and writes from the master.

To use the Modbus function, signals that you wish to send out/receive into the COMM1 port must be connected to placeholders in the Modbus-protocol Connect Signals dialog box.

Connect the Controller to a Modbus Device



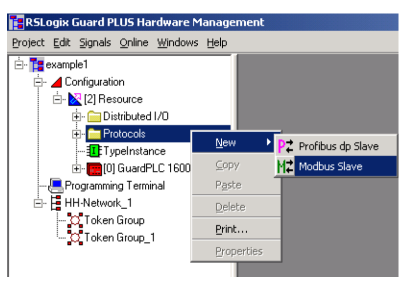
Connection	Signal	Function
1	---	---
2	RP	5V, decoupled with diodes
3	RxD/TxD-A	Receive/Transmit data A
4	CNTR-A	Control Signal A
5	DGND	Data reference potential
6	VP	5V, positive pole of supply voltage
7	---	---
8	RxD/TxD-B	Receive/Transmit data B
9	CNTR-B	Control Signal B

IMPORTANT The Modbus port is RS-485. You must use an electrical interface device to connect the controller to an RS-232 device.

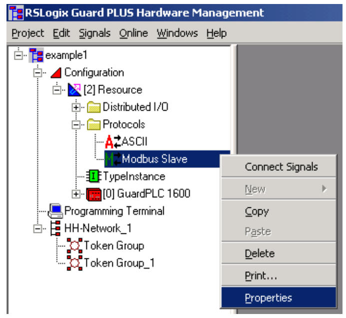
Configure the Modbus Serial Port

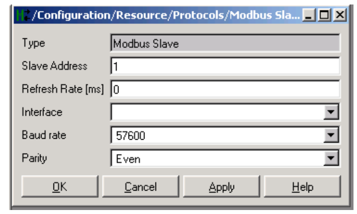
You must either create a new project or open an existing project before you can configure Modbus communication. Once the software opens a project, it automatically displays the Hardware Management window, from which you configure the Modbus port.

1. Right-click Protocols and choose New>Modbus Slave.



2. Expand Protocols, right-click the Modbus Slave icon, and choose Properties.





For this field	Specify
Slave Address	the slave address (1…247) of the controller. The Modbus protocol of the controller supports only a direct point-to-point connection between the master and slave. The controller is always configured as slave. It transfers process values via the serial interface to the master only when it receives the corresponding request from the master.
Interface	the field bus interface to be used by the Modbus Slave protocol (comm1, comm2, comm3). Choose comm1 for GuardPLC 1600 or 1800 controllers.
Refresh Rate	Refresh rate in ms for non-safe communication. The default is 0, the fastest refresh rate.
Baud Rate	the data transfer speed in bits/s. Choose from a pull-down menu of predefined values between 300 and 115,200 bps. The default baud rate is 9600 bps.
Parity	the parity for the recognition of transfer errors. Choose No, Odd, or Even. The default is No parity.
Stop Bit	either 1 or 2 stop bits for the serial data transfer. The default is 1 stop bit.

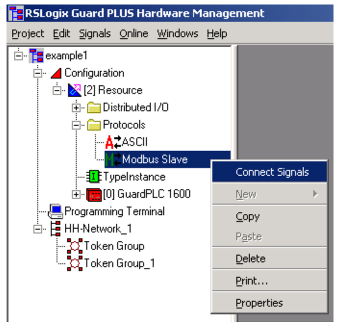
Connect Signals

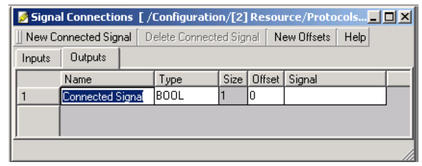
The Modbus RTU Slave protocol lets you read data from the GuardPLC controller and write data to the GuardPLC controller, but none of this data can be used for safety functions.

Inputs are signals sent from the Modbus master to the controller (slave). Outputs are signals sent from the controller (slave) to the master.

Follow these steps to connect signals.

1. Expand Protocols, right-click the Modbus Slave icon, and choose Connect Signals.





If you want to	Click this tab
create a new signal	New Connected Signal
renumber offsets sequentially for all signals	New Offsets
delete the selected signal	Delete Connected Signal

2. Edit the signals you want to receive or send.
   - Use the Inputs tab to determine which values to read into the controller.
   - Use the Outputs tab to define output values to send to the Modbus master. Signals in the output tab must match the order of signal types requested by the Modbus master.
   - Associate each input or output with a signal from the signal editor. You can drag and drop signals from the signal editor to the signal connections dialog box.

The Modbus function calls must match the order in which the signal offsets appear. For example, if you want to read 3 Boolean signals followed by 4 Registers, the first 3 signals must be BOOL and the next 4 must be INT signals.

TIP

The output section automatically sorts the name field based on alphanumerical order. This does not automatically change the offsets, but if you renumber after sorting, the offsets will change and there is no undo feature. This changes the order in which the signals are sent out the serial port.

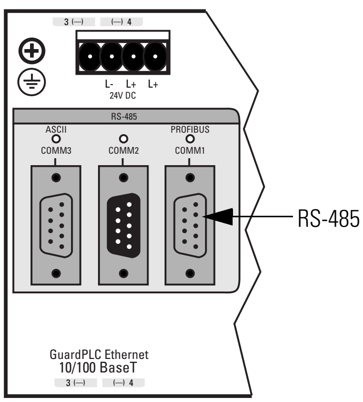
Because names are used only in printouts, you may want to enter these names in alphanumeric order to begin with. (For example signal 101, signal 102, signal 103, signal 104, and so forth.)

Profibus DP Slave Protocol

Profibus DP Slave protocol is available only via the GuardPLC 1600 and 1800 controller's COMM1 port. This connection is two-way non-safety-related communication from the controller (slave) to the master device. You cannot program the controller by using this port.

To use the Profibus DP function, signals that you wish to send out the COMM1 port must be connected to placeholders in the Profibus DP-protocol Connect Signals dialog box.

Connect the Controller to a Profibus DP Device



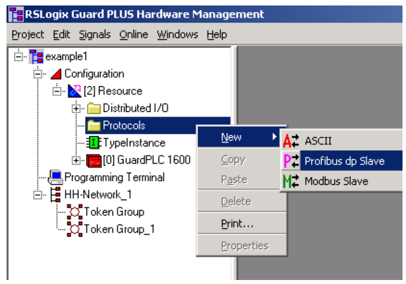
Connection	Signal	Function
1	---	---
2	RP	5V, decoupled with diodes
3	RxD/TxD-A	Receive/Transmit data A
4	CNTR-A	Control Signal A
5	DGND	Data reference potential
6	VP	5V, positive pole of supply voltage
7	---	---
8	RxD/TxD-B	Receive/Transmit data B
9	CNTR-B	Control Signal B

IMPORTANT The Profibus port is RS-485. You must use an electrical interface device to connect the controller to an RS-232 device.

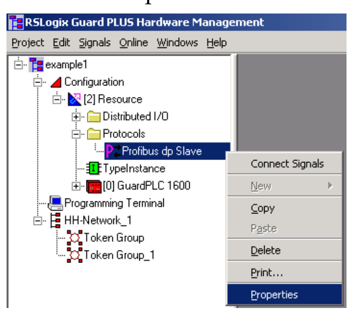
Configure the Profibus DP Serial Port

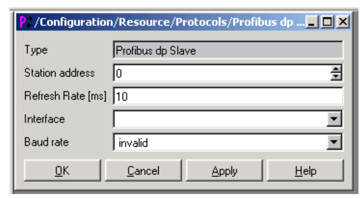
You must either create a new project or open an existing project before you can configure Profibus DP communication. Once the software opens a project, it automatically displays the Hardware Management window, from which you configure the Profibus port.

1. Right-click Protocols and choose New>Profibus dp Slave.



2. Expand Protocols, right-click the Profibus dp Slave icon, and choose Properties.





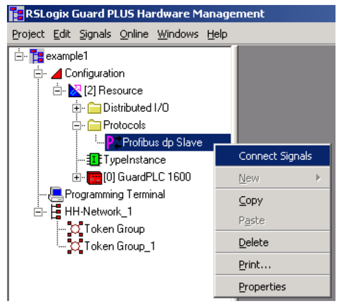
For this field	Specify
Station Address	the address that uniquely identifies the Profibus dp slave on the network. The station address must be less than or equal to 126.
Refresh Rate	Refresh rate in ms for non-safe communication. The default is 0, the fastest refresh rate.
Interface	the field bus interface to be used by the Profibus dp Slave protocol (comm1, comm2, comm3). Choose comm1 for GuardPLC 1600 or 1800 controllers.
Baud Rate	the data transfer speed in bits/s. Choose from a pull-down menu of predefined values between 300 and 115,200 bps. The default baud rate is 9600 bps.

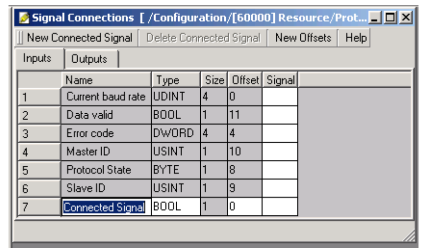
Connect Signals

The Profibus DP Slave protocol lets you read data from the GuardPLC controller and write data to the GuardPLC controller, but none of this data can be used for safety functions.

Inputs are signals sent from the Profibus master to the controller (slave). Outputs are signals sent from the controller (slave) to the master.

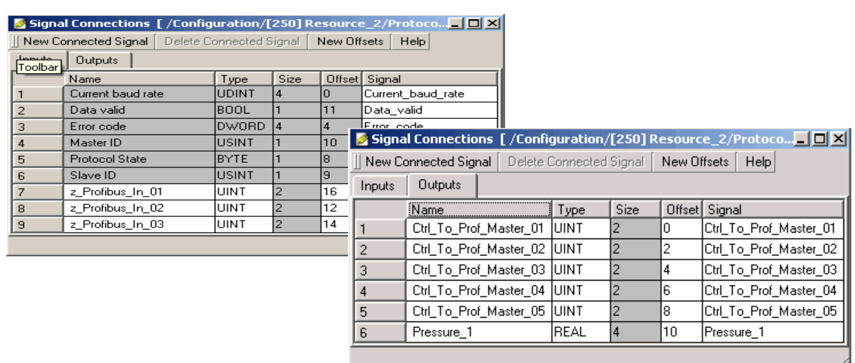
1. Expand Protocols, right-click the Profibus-dp Slave icon, and choose Connect Signals.





If you want to	Click this tab
create a new signal	New Connected Signal
renumber offsets sequentially for all signals	New Offsets
delete the selected signal	Delete Connected Signal

2. Edit the signals you want to receive or send:
   - Use the Inputs tab to determine which values to read into the controller. The Inputs tab contains pre-defined system variables that can be interrogated via the assignment of signals.
   - Use the Outputs tab to define output values to send to the Profibus master.
   - Associate each input or output with a signal from the signal editor. You can drag and drop signals from the signal editor to the signal connections dialog box.



3. Click New Offsets to automatically calculate the offsets for the new signals.

IMPORTANT	Due to the offsets of the system variables, the offset of the first input signal must begin with 12. The offset for the first output signal begins with 0. The Profibus ID for the first input signal is 0.

Configure the Profibus Master

For both the Profibus output and input signals, the Profibus ID of the first signal to communicate, the number of signals, and the number of bytes must be configured in the Profibus Master.

Configuration is accomplished via parameter data read from a GSD file. The parameter data consists of 32 bytes in hexadecimal format, which may be displayed in different ways depending upon the Profibus DP master software.

The GSD file for GuardPLC 1600 and GuardPLC 1800 controllers is available on the RSLogix Guard PLUS! software CD.

For more information on using Profibus protocol, consult the online Help.

Specifications

GuardPLC 1200 Controller

Attribute	1754-L28BBB
Controller	
User Memory	500 KB application code memory 500 KB application data memory
Digital Inputs	
Number of inputs	20 (not electrically isolated from each other, isolated from the backplane)
Nominal input voltage	24V DC
On-state voltage	10V DC…30V DC
On-state current	2 mA @ 10V DC, 13 mA @ 30V DC
Off-state voltage, max	5V DC (max)
Off-state current, max	1.5 mA max (1 mA @ 5V)
Digital Outputs	
Number of outputs	8 (not electrically isolated from each other, isolated from the backplane)
Output voltage range	18.4V…26.8V
Output current	0.5 A per channel (channel 1…6) 2 A per channel (channel 7, 8)
Surge current per channel	1 A for 10 ms @ 1 Hz (channel 1…6) 4 A for 10 ms @ 1 Hz (channel 7, 8)
Minimum current load	2.5 mA per channel
On-state voltage drop, max	2.0V DC @ 500 mA
Off-state leakage current, max	1 mA per channel
Temporary overload	Output switches off until overload is eliminated
Counters	
Number of counters	2
Inputs per counter	3 (Input A, Input B, Z/Gate/Reset)
Counter resolution	24 bit
Input frequency, max	100 kHz in counter modes (input A)
Trigger	Negative edge
Edge steepness	1 V/μs
Duty cycle	50% @ 100 kHz
Input voltages	4.5V…5.5V for 5V input 13V…26.4V for 24V input
Input current	Typ. 15 mA, ≤3 mA

Attribute	1754-L28BBB
Power Supply	
Supply Voltage (L+)	24V DC
Supply voltage range	20.4V DC…28.8V DC (10 ms buffer), ripple ≤ 15%
Power rating, max	8 A (1 A to run the controller, 7 A for inputs and outputs)
Environmental Conditions	
Temperature, operating	0… 60 °C (32…140°F)
Temperature, storage	-40…85 °C (-40…185°F) without back-up battery
Mechanical Dimensions	
Width x height x depth	160 mm x 112 mm x 90 mm (6.3 in. x 4.41 in. x 3.54 in.)
Weight	680 g (1.5 lb)
Certifications (when product is marked)	
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada
CE	European Union 89/336/EEC EMC Directive, compliant with: • EN 61000-6-4; Industrial Emissions • EN 50082-2; Industrial Immunity • EN 61326; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN61131-2; Programmable Controllers (Clause 8, Zone A, B, & C)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Functional Safety	Certified by TÜV

GuardPLC 1600 Controller

Attribute	1753-L28BBBM and 1753-L28BBBP
Controller	
User memory, max	250 KB user program memory 250 KB application data memory
Watchdog time, min	10 ms
Safety time, min	20 ms
Current consumption	8 A max (with max load) 0.5 A idle current (just running the controller)
Operating voltage	24V DC, -15%…+20%, w_{ss} ≤ 15% (from a power supply with protective separation conforming to IEC 61131-2 requirements)
GuardPLC Ethernet interfaces	4 x RJ-45, 10/100BaseT (with 100 Mbps) with integrated switch
Protection	IP20

Attribute	1753-L28BBBM and 1753-L28BBBP
Digital Inputs	
Number of inputs	20 (not electrically isolated)
Voltage, on-state	15V … 30V DC
Current consumption, on-state	≥ 2 mA @ 15V 7.5 mA @ 30V
Voltage, off-state, max	5V DC
Current consumption, off-state, max	1.5 mA (1 mA @ 5V)
Switching point, typical	7.5V
Supply	5 x 20V / 100 mA @ 24V short-circuit proof
Digital Outputs	
Number of Outputs	8 (not electrically isolated)
Output voltage range	18.4V … 26.8V
Output current	Channels 1…3 and 5…7: 0.5 A @ 60 °C (140 °F) Channels 4 and 8: 1 A @ 60 °C (140 °F); 2A @ 50 °C (122 °C)
Surge current per channel	1 A for 10ms @ 1 Hz (Channels 1…3 and 5…7) 4 A for 10ms @ 1 Hz (Channels 4 and 8)
Current load, min	2 mA per channel
On-state voltage drop, max	2.0V DC @ 2 A
Off-state leakage current, max	1 mA @ 2V
Environmental Conditions	
Temperature, operating	0…60 °C (32…140 °F)
Temperature, storage	-40…85 °C (-40…185 °F)
Mechanical Dimensions	
Width	257 mm (10.1 in.) including housing screws
Height	114 mm (4.49 in.) including latch
Depth	66 mm (2.60 in.) including grounding bolt
Weight	1.2 kg (2.64 lb)

Attribute	1753-L28BBBM and 1753-L28BBBP
Certifications (when product is marked)	
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada
CE	European Union 89/336/EEC EMC Directive, compliant with: • EN 61000-6-4; Industrial Emissions • EN 50082-2; Industrial Immunity • EN 61326; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN61131-2; Programmable Controllers (Clause 8, Zone A, B, & C)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Functional Safety	Certified by TÜV

GuardPLC 1800 Controller

Attribute	1753-L32BBBM-8A and 1753-L32BBBP-8A
Controller	
User memory, max	250 KB user program memory 250 KB application data memory
Watchdog time, min	10 ms
Safety time, min	20 ms
Current consumption	9 A max (with max load) 0.75 A idle current (just running the controller)
Operating voltage	24V DC, -15%…20%, $w_{ss} \leq 15\%$ (from a power supply with protective separation conforming to IEC 61131-2 requirements)
Protection	IP 20
Digital Inputs	
Number of inputs	24 (not electrically isolated)
Voltage, on-state	15V…30V DC
Current consumption, on-state, approx.	3.5 mA @ 24V DC 4.5 mA @ 30V DC
Voltage, off-state, max	5V DC
Current consumption, off-state, max	1.5 mA (1 mA @ 5V DC)
Input resistance	< 7 kΩ
Overvoltage protection	-10V, +35V
Line length, max	300 m (984 ft.)
Supply	20V / 100 mA, short-circuit proof

Attribute	1753-L32BBBM-8A and 1753-L32BBBP-8A
Digital Outputs	
Number of outputs	8 (not electrically isolated)
Output voltage range	≥ L+ minus 2V
Output current	Channels 1…3 and 5…7: 0.5 A @ 60 °C (140 °F) Channels 4 and 8: 1 A @ 60 °C (140 °F); 2 A @ 50 °C (122 °C)
Surge current per channel	1 A for 10 ms @ 1 Hz (Channels 1…3 and 5…7) 4 A for 10 ms @ 1 Hz (Channels 4 and 8)
Current load, min	2 mA per channel
Internal voltage drop, max	2.0V DC @ 2 A
Off-state leakage current, max	1 mA @ 2V
Total output current, max	7 A
Counters	
Number of counters	2 (not electrically isolated)
Inputs	3 per counter (A, B, Z)
Input voltages	5V and 24V DC High signal (5V DC): 4V…6V High signal (24V DC): 13V…33V Low signal (5V DC): 0V…0.5V Low signal (24V DC): -3V…5V
Input currents	1.4 mA @ 5V DC 6.5 mA @ 24V DC
Input impedance	3.7 kΩ
Counter resolution	24-bit
Input frequency, max	100 kHz
Triggered	on negative edge
Edge steepness	1 V/μs
Pulse duty factor	1:1
Analog Inputs	
Number of inputs	8 (unipolar, not electrically isolated)
External shunt (for current measurement)	500 Ω for 0…20 mA
Input values related to L-	Nominal Value: 0…10V DC or 0… 20 mA with 500 Ω shunt Service Value: -0.1…11.5V DC or -0.4…23 mA with 500 Ω shunt
Input impedance	1 MΩ
Internal resistance of the signal source	≤500 Ω
Overvoltage protection	+15V, -4V
Resolution (A/D converter)	12-bit
Accuracy	0.1% @ 25 °C (77 °F) 0.5% @ 60 °C (140 °F)

Attribute	1753-L32BBBM-8A and 1753-L32BBBP-8A
Transmitter supplies	25.37 … 28.24V / ≤46 mA, short-circuit proof
Safety accuracy	± 2%
Environmental Conditions	
Temperature, operating	0…60 °C (32 …140 °F)
Temperature, storage	-40…85 °C (-40…185 °F)
Mechanical Dimensions	
Width	257 mm (10.1 in.) including housing screws
Height	114 mm (4.49 in.) including latch
Depth	66 mm (2.60 in.) including grounding screw 80 mm (3.15 in.) including shield plate
Weight	1.2 kg (2.64 lb)
Certifications (when product is marked)	
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada
CE	European Union 89/336/EEC EMC Directive, compliant with: • EN 61000-6-4; Industrial Emissions • EN 50082-2; Industrial Immunity • EN 61326; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN61131-2; Programmable Controllers (Clause 8, Zone A, B, & C)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Functional Safety	Certified by TÜV

Distributed I/O

1753-IB16 Input Module

Attribute	1753-IB16
General	
GuardPLC Ethernet interfaces	2 x RJ-45, 10/100BaseT (with 100 Mbps) with integrated switch
Operating voltage	24V DC, -15% … +20%, w_{SS} 15% from a power supply with protective separation, conforming to IEC 61131-2 requirements
Response time	≥ 10 ms
Current consumption	0.8 A max (with max load) (0.4 A idle current)

Attribute	**1753-IB16**
Digital Inputs	
Number of inputs	16 (not electrically isolated)
1 Signal	Voltage: 15V … 30V DC, Current consumption: ≥ 2 mA @ 15V
0 Signal	Voltage, max: 5V DC Current consumption, max: 1.5 mA (1 mA @ 5V)
Switching point	typically 7.5V
Switching time	typically 250 µs
Sensor supply	4 x 19.2V / 40 mA @ 24V short-circuit proof
Pulse Test Sources	
Number of pulse test sources	4 (not electrically isolated)
Output voltage range	approximately 24V
Output current	60 mA
Current load, min	none
Response to overload	4 x ≥ 19.2V, short circuit current 60 mA @ 24V
Environmental Conditions	
Temperature, operating	0…60 °C (32…140 °F)
Temperature, storage	-40…85 °C (-40…185 °F)
Mechanical Dimensions	
Width	152 mm (5.99 in.) including housing screws
Height	114 mm (4.49 in.) including latch
Depth	66 mm (2.60 in.) including grounding bolt
Weight	0.7 kg (1.54 lb)
Certifications (when product is marked)	
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada
CE	European Union 89/336/EEC EMC Directive, compliant with: • EN 61000-6-4; Industrial Emissions • EN 50082-2; Industrial Immunity • EN 61326; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN61131-2; Programmable Controllers (Clause 8, Zone A, B, & C)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Functional Safety	Certified by TÜV

1753 Combination I/O Modules

Attribute	1753-IB8XOB8	1753-IB16XOB8	1753-IB20XOB8
General			
GuardPLC Ethernet interfaces	2 x RJ-45, 10/100BaseT (with 100 Mbps) with integrated switch		
Operating voltage	24V DC, -15% … +20%, w_{ss} 15% from a power supply with protective separation, conforming to IEC 61131-2 requirements		
Response time	≥ 10 ms		
Battery backup	none		
Current consumption	8 A max (with max load), idle current 0.4 A @24V	10 A max (with max load),idle current 0.4 A @24V	8 A max (with max load), idle current 0.4 A @24V
Wiring category	category 2 on communication ports, signal ports, and power ports		
Wire size	I/O – 1.5 mm^2 (16 AWG) … 0.14 mm^2 (26 AWG) solid or stranded copper wire rated at 75 °C (167 °F) or greater with 3/64 inch (1.2 mm) insulation max Power – 2.5 mm^2 (14 AWG) … 0.34 mm^2 (22 AWG) solid or stranded copper wire rated at 75 °C (167 °F) or greater with 3/64 inch (1.2 mm) insulation max		
Terminal block torque	0.51 Nm (4.5 in-lb)		
Digital Inputs			
Number of inputs	8 (not electrically isolated)	16 (not electrically isolated)	20 (not electrically isolated)
1 Signal	Voltage: 15V…30V DC, Current consumption: ≥ 2 mA @ 15V		
0 Signal	Voltage, max: 5V DC; Current consumption, max: 1.5 mA (1.0 mA @ 5V)		
Switching point	typically 7.5V		
Sensor supply	2 x 20V / 100 mA @ 24V short-circuit proof	4 x 24V DC/ 40 mA short-circuit proof, buffered for 20 ms 2 x 24V DC/1 A short-circuit-proof, not buffered	5 x 20V / 100 mA @ 24V short-circuit proof
Digital Outputs			
Number of outputs	8 positive-switching 2 negative-switching (not electrically isolated)	8 positive-switching 8 negative-switching (not electrically isolated)	8 (not electrically isolated)
Output voltage range	≥ L+ minus 2V	≥ L+ minus 2V	≥ L+ minus 2V
Output current	channels 1…3 and 5…7: 0.5 A @ 60 °C (140 °F) channels 4 and 8: 1 A @ 60 °C (140 °F), 2 A @ 40 °C (104 °F)	channels 2, 4, 5 and 7: 0.5 A @ 60 °C (140 °F) channels 1 and 8: 1 A @ 60 °C (140 °F); 2 A @ 40 °C (104 °F) channels 3 and 6: 1 A @ 60 °C (140 °F)	channels 1…3 and 5…7: 0.5 A @ 60 °C (140 °F) channels 4 and 8: 1 A @60 °C (140 °F), 2 A @ 50 °C (122 °F)
Surge current per channel	—	—	1 A for 10 ms @ 1 Hz (Channels 1 … 3 and 5 … 7) 4 A for 10 ms @ 1 Hz (Channels 4 and 8)
Current load, min	2 mA per channel		

Attribute	**1753-IB8XOB8**	**1753-IB16XOB8**	**1753-IB20XOB8**
Internal voltage drop, max	2V @ 2 A		
Leakage current (with 0 signal)	maximum 1 mA @ 2V		
Total output current, max	7 A	8 A	7 A
Response to overload	shut down of the concerned output with cyclic reconnecting		
Pulse Test Sources			
Number of pulse test sources	2 (not electrically isolated)	2 (not electrically isolated)	Not applicable
Output voltage range	L+ minus 4V		Not applicable
Output current	60 mA		Not applicable
Current load, min	none		Not applicable
Switching time	≤100 µs		
Response to overload	4 x ≥ 19.2V, short circuit current 60 mA @ 24V	2 x ≥ 19.2V, short circuit current 60 mA @ 24V	Not applicable
Environmental Conditions			
Temperature, operating	0…60 °C (32…140 °F)		
Temperature, storage	-40…85 °C (-40… 185 °F)		
Mechanical Dimensions			
Width	15mm (in.) including housing screws	205 mm (in.) including housing screws	207 mm (8.16 in.) including housing screws
Height	114 mm (4.49 in.) including latch		
Depth	66 mm (2.60 in.) including grounding bolt	88 mm (in.) including grounding bolt	66 mm (2.60 in.) including grounding bolt
Weight	1.0 kg (2.2 lb)	1.3 kg (2.9 lb)	1.0 kg (2.2 lb)
Certifications (when product is marked)			
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada		
CE	European Union 89/336/EEC EMC Directive, compliant with: • EN 61000-6-4; Industrial Emissions • EN 61000-6-2; Industrial Immunity		
C-Tick	Australian Radiocommunication Act, compliant with: AS/NZS CISPR 11; Industrial Emissions		
Functional Safety	Certified by TÜV		

1753-IF8XOF4 Analog Combination Module

Attribute	1753-IF8XOF4
GuardPLC Ethernet interfaces	2 x RJ-45, 10/100BaseT (with 100 Mbps) with integrated switch
Operating voltage	24V DC, -15%… +20%, w_{ss} 15% from a power supply with protective separation, conforming to IEC 61131-2 requirements
Response time	≥ 20 ms
Battery backup	none
Current consumption	0.8 A max (with max load), idle current 0.4 A @24V
Wiring category	category 2 on communication ports, signal ports, and power ports
Wire size	I/O – 1.5 mm^2 (16 AWG)…0.14 mm^2 (26 AWG) solid or stranded copper wire rated at 75 °C (167 °F) or greater with 3/64 inch (1.2 mm) insulation max Power – 2.5 mm^2 (14 AWG)…0.34 mm^2 (22 AWG) solid or stranded copper wire rated at 75 °C (167 °F) or greater with 3/64 inch (1.2 mm) insulation max
Terminal block torque	0.51 Nm (4.5 in-lb)
Analog Inputs	
Number of inputs	8 (not electrically isolated)
Input signal range, nom	Voltage: 0…10V DC Current: 0…20 mA(1)
Input signal range, service	Voltage: -0.1…11V DC Current: -0.4…23 mA(1)
Shunt resistor, external	500 Ω (for current input)
Impedance, analog input	>2 MΩ
Analog input signal, source impedance	≤500 Ω
Input resolution	12 bits
Effective resolution	9 bits @ 10V
Sensor supply	selectable 26V/8.2V 200 mA, short-circuit-proof
Accuracy	0.5%
Safety accuracy	2%
Calibration error zero point	±1%
Calibration error terminal point	±0.4%
Channel error	±0.5%
Temperature error zero point	±0.5%/10 K
Temperature error terminal point	±0.5%/10 K
Linearity error	±0.5%
Long-term drift	±0.5%

Analog Outputs	
Number of outputs	4 (not electrically isolated) non-safety with common safety switch off
Output signal range	4…20 mA nominal 0…20 mA full range
resolution of software	12 bits
Impedance, current output	600 Ω max
Calibration error zero point	±1%
Calibration error terminal point	±1%
Channel error	±1%
Temperature error zero point	±1%/10 K
Temperature error terminal point	±1%/10 K
Linearity error	±1%
Environmental Conditions	
Temperature, operating	0…60 °C (32…140 °F)
Temperature, storage	-40…85 °C (-40…185 °F) without back-up battery
Mechanical Dimensions	
Width	207 mm (8.16 in.) including housing screws
Height	114 mm (4.49 in.) including latch
Depth	97 mm (3.82 in.) including grounding bolt
Weight	0.95 kg (2.09 lb)
Certifications (when product is marked)	
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada
CE	European Union 89/336/EEC EMC Directive, compliant with: • EN 61000-6-4; Industrial Emissions • EN 61000-6-2; Industrial Immunity
C-Tick	Australian Radiocommunication Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Functional Safety	Certified by TÜV

(1) with external shunt resistor

1753-OW8 Relay Output Module

Attribute	**1753-OW8**
Response Time	≥ 10 ms
GuardPLC Ethernet Interfaces	2 x RJ-45, 10/100BaseT (with 100 Mbps) with integrated switch
Operating voltage	24V DC, -15%…20%, w_{ss} ≤15% from a power supply with protective separation conforming to IEC 61131-2 requirements
Current consumption	0.6 A max (with max load)
Isolation voltage	No isolation between circuits
Wiring category[1]	category 2 on communication ports, signal ports, and power ports
Wire size	I/O – 1.5 mm^2 (16 AWG)…0.14 mm^2 (26 AWG) solid or stranded copper wire rated at 75 °C (167 °F) or greater with 3/64 inch (1.2 mm) insulation max Power – 2.5 mm^2 (14 AWG) …0.34 mm^2 (22 AWG) solid or stranded copper wire rated at 75 °C (167 °F) or greater with 3/64 inch (1.2 mm) insulation max
Terminal block torque	0.51 Nm (4.5 in-lb)
Fuse (external)	10 A (slow blow)
Battery backup	none
Relay Outputs	
Number of outputs	8 normally open contacts
Switching voltage	≥ 5V, ≤250V AC/250V DC
Switching current	UL: 24V DC @ 1 A resistive load, 250V AC @ 6 A general purpose
	TÜV: • up to 240VA (for V AC) • up to 30V DC @ 90 W • up to 70V DC @ 35 W • up to 127V DC @ 30 W
Turn-on time	approx. 30 ms
Turn-off time	approx. 10 ms
Bounce time	approx. 15 ms
Service life, mechanical	≥10^6 switching cycles
Service life, electrical	≥2.5 x 10^5 switching cycles with resisitive full load and I_e0.1 switching cycles per second
Environmental Conditions	
Temperature, operating	0...60 °C (32...140 °F)
Temperature, storage	-40...85 °C (-40...185 °F)
Vibration	1 g @ 10…150 Hz

Shock, operating	15 g
Relative humidity	10 … 95% noncondensing
Emissions	Group 1, Class A
ESD immunity	6 kV contact discharges 8 kV air discharges
Radiated RF immunity	10V/m with 1kHz sine-wave 80% AM from 80 MHz…2000 MHz
EFT/B immunity	±2 kV @ 5 kHz on power ports ±1 kV @ 5 kHz on signal ports ±1 kV @ 5 kHz on communication ports
Surge transient immunity	±500V line-line (DM) and ±500V line-earth (CM) on DC power ports ±1 kV line-earth (CM) on signal ports ±1 kV line-earth (CM) on communication ports
Conducted RF immunity	10Vrms with 1 kHz sine-wave 80% AM from 150 kHz…80 MHz
Enclosure type rating	meets IP20
Mechanical Dimensions	
Width	207 mm (8.14 in.) including housing screws
Height	114 mm (4.49 in.) including latch
Depth	86 mm (3.38 in.) including grounding bolt
Weight	1.3 kg (3.47 lb)
Certifications (when product is marked)	
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada
CE	European Union 89/336/EEC EMC Directive, compliant with: • EN 61000-6.2; Industrial Immunity • EN 61000-6-4; Industrial Emissions European Union 73/23/EEC LVDDirective, compliant with: • EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunication Act, compliant with: • AS/NZS CISPR 11; Industrial Emissions
Functional Safety	Certified by TÜV

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

1753-OB16 Output Module

Attribute	**1753-OB16**
General	
GuardPLC Ethernet interfaces	2 x RJ-45, 10/100Base T (with 100 Mbps) with integrated switch
Operating voltage	24V DC, -15% … +20%, w_{ss} 15% from a power supply with protective separation, conforming to IEC 61131-2 requirements
Response time	≥ 10 ms
Battery backup	none
Current consumption	approximately 0.2 A per group (idle current)
Digital Outputs	
Number of outputs	16 (not electrically isolated)
Output Voltage Range	≥ L+ minus 2V
Output current	maximum 1 A @ 60 °C (140 °F), maximum 2 A @40 °C (104 °F)
Surge current per channel	4 A for 10 ms @ 1 Hz
Current load, min	2 mA per channel
Current per group (admissible total current)	max 8 A per group (max 16 A per module)
Lamp load, max	10 W (for output 1 A), 25 W (for output 2 A)
Inductive load, max	500 mH
Internal voltage drop, max	2V @ 2 A
Leakage current, max (with 0 signal)	1 mA @ 2V
Response to overload	shut down of concerned output with cyclic reconnecting
Environmental Conditions	
Temperature, operating	0…60 °C (32…140 °F)
Temperature, storage	-40…85 °C (-40…185 °F)
Mechanical Dimensions	
Width	207 mm (8.16 in.) including housing screws
Height	114 mm (4.49 in.) including latch
Depth	66 mm (2.60 in.) including grounding bolt
Weight	0.85 kg (1.87 lb)

Attribute	1753-OB16
Certifications (when product is marked)	
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada
CE	European Union 89/336/EEC EMC Directive, compliant with: • EN 61000-6-4; Industrial Emissions • EN 50082-2; Industrial Immunity • EN 61326; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN61131-2; Programmable Controllers (Clause 8, Zone A, B, & C)
C-Tick	Australian Radiocommunication Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Functional Safety	Certified by TÜV

GuardPLC 2000 Controller

Attribute	1755-L1
User memory	500 KB application code memory 500 KB application data memory
Operating voltages	3.3V DC 5V DC
Current consumptions	3.3V / 1.5 A 5V / 0.1 A 24V DC / 1.0 A
Front connectors	1 Ethernet connector for RSLogix Guard PLUS! software 2 ASCII connectors (RS-232)
Temperature, operating	0…60 °C (32…140 °F)
Temperature, storage	-40…85 °C (-40 …185 °F)
Weight	280 g (0.62 lb)

Attribute	1755-L1
Certifications (when product is marked)	
UL	UL Listed Industrial Control Equipment
CE	European Union 89/336/EEC EMC Directive, compliant with: • EN 61000-6-4; Industrial Emissions • EN 50082-2; Industrial Immunity • EN 61326; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN61131-2; Programmable Controllers (Clause 8, Zone A, B, & C)
C-Tick	Australian Radiocommunication Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Functional Safety	Certified by TÜV

GuardPLC 2000 Distributed I/O Modules

1755-IB24XOB16 Digital I/O Module

Attribute	1755-IB24XOB16
Digital Inputs	
Quantity of inputs	24
Nominal input voltage (1 signal)	24V DC (10…30V)
Off-state input voltage, max (0 signal)	5V DC
On-state current	2 mA @ 10V, 13 mA @ 30V (3 groups of 8, each group limited to 100 mA)
Off-state current	1.5 mA @ 5V
Digital Outputs	
Quantity of outputs	16
Output voltage range	operating voltage minus 2V (depending on load)
Output current (30 °C)	2 A per channel, overload protected, 8 A max per module

Attribute	1755-IB24XOB16
General Specifications	
Current consumption	0.3 A / 3.3V DC 0.5 A / 24V DC (Idle current to run module)
Operating voltage	24V DC, -15 … +20%, ripple ≤ 15%
Temperature, operating	0…60 °C (32…140 °F)
Temperature, storage	-40…85 °C (-40…185 °F)
Weight	260 g (0.57 lb)
Certifications (when product is marked)	
UL	UL Listed Industrial Control Equipment
CE	European Union 89/336/EEC EMC Directive, compliant with: • EN 61000-6-4; Industrial Emissions • EN 50082-2; Industrial Immunity • EN 61326; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN61131-2; Programmable Controllers (Clause 8, Zone A, B, & C)
C-Tick	Australian Radiocommunication Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Functional Safety	Certified by TÜV

1755-IF8 Analog Input Module

Attribute	1755-IF8
Number of inputs	8 single-ended or 4 differential
Input values	rated values: 0…±10V DC or 0…20 mA (with shunt) user values: 0…±10.25V DC or 0…20.5 mA (with shunt)
External shunt (for current input)	500 Ω
Overvoltage protection	30V (±15V DC)
Resolution	12 bit
Input impedance	1 MΩ (DC)
Input signal / source impedance	≤500 Ω
Accuracy	0.1% @ 25 °C (77 °F) 0.5% @ 60 °C (140 °F)
Operating voltage	24V DC -15…20% ripple ≤15%

Attribute	1755-IF8
Maximum common mode voltage to I-	±13V DC
Current consumption	150 mA / 3.3V DC 400 mA / 24V DC
Temperature, operating	0…60 °C (32…140 °F)
Temperature, storage	-40…85 °C (-40…185 °F)
Weight	240 g (0.53 lb)
Certifications (when product is marked)	
UL	UL Listed Industrial Control Equipment
CE	European Union 89/336/EEC EMC Directive, compliant with: • EN 61000-6-4; Industrial Emissions • EN 50082-2; Industrial Immunity • EN 61326; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity EN61131-2; Programmable Controllers (Clause 8, Zone A, B, & C)
C-Tick	Australian Radiocommunication Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Functional Safety	Certified by TÜV

1755-OF8 Analog Output Module

Attribute	1755-OF8
Quantity of outputs	8
Output values, max	0…±10V or 0…20 mA
Overvoltage protection	24V
Source value	UINT
Load impedance	load ≤ 600 Ω (current) limit resistance > 5 kΩ (voltage)
Accuracy	0.3% @ 25 °C (77 °F) 0.5% @ 60 °C (140 °F)
Safety relevant accuracy	1%
Operating voltage	24V DC -15…20% ripple ≤ 15%
Current consumption	150 mA / 3.3V DC 400 mA / 24V DC
Temperature, operating	0…60 °C (32…140 °F)
Temperature, storage	-40…85 °C (-40…185 °F)

Attribute	1755-OF8
Weight	280 g (0.53 lb)
Certifications (when product is marked)	
UL	UL Listed Industrial Control Equipment
CE	European Union 89/336/EEC EMC Directive, compliant with: • EN 61000-6-4; Industrial Emissions • EN 50082-2; Industrial Immunity • EN 61326; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity EN61131-2; Programmable Controllers (Clause 8, Zone A, B, & C)
C-Tick	Australian Radiocommunication Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Functional Safety	Certified by TÜV

1755-HSC High Speed Counter Module

Attribute	**1755-HSC**
Number of counters	2
Input voltage	5V or 24V
Input current	≤3 mA
Input signal frequency	0…1 MHz
Trigger	with falling edge
Edge steepness	1V/µs
Input cables	≤500 m @ 100 kHz, shielded, twisted
Input resistance	3.7 kΩ
Resolution	24 bit (value range 0… 6,777,215)
Accuracy of time basis	0.2%
Quantity of outputs	4 digital
Output load	≤0.5A, voltage drop: ≤3V
Output load in summary	≤2 A ≥ 18V
Operating Voltage	24V DC, -15…20%, ripple ≤15%
Current consumption	0.1 A / 24V DC without load 0.8 A (3.3V DC), 0.1 A (5V DC)
Temperature, operating	0…60 °C (32…140 °F)
Temperature, storage	-40…85 °C (-40…85 °F)
Weight	260 g (0.57 lb)
Certifications (when product is marked)	
UL	UL Listed Industrial Control Equipment
CE	European Union 89/336/EEC EMC Directive, compliant with: • EN 61000-6-4; Industrial Emissions • EN 50082-2; Industrial Immunity • EN 61326; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity EN61131-2; Programmable Controllers (Clause 8, Zone A, B, & C)
C-Tick	Australian Radiocommunication Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Functional Safety	Certified by TÜV

GuardPLC 2000 Power Supply

Attribute	1755-PB720
Supply voltage	24V DC
Supply voltage range	20.4V DC…28.8V DC (10 ms buffer), ripple ≤15%
External fusing	30 A(1) / IEC (This module has no overcurrent protection.)
Outputs	3.3V DC/10 A, 5V DC/2 A
Temperature, operating	0…60 °C (32…140 °F)
Temperature, storage	-40…60 °C (-40…140 °F) with battery -40…85 °C (-40…185 °F) without battery
Weight	820 g (1.80 lb)
Certifications (when product is marked)	
UL	UL Listed Industrial Control Equipment
CE	European Union 89/336/EEC EMC Directive, compliant with: • EN 61000-6-4; Industrial Emissions • EN 50082-2; Industrial Immunity • EN 61326; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity EN61131-2; Programmable Controllers (Clause 8, Zone A, B, & C)
C-Tick	Australian Radiocommunication Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Functional Safety	Certified by TÜV

(1) The power supply can supply up to 30 A for I/O modules. Use an appropriate fuse for your system's power requirements.

Notes:

System Signal Variables

Introduction

Programming Controller Data

The controller supports system variables that you can configure.

The system variables are defined as:

- **SAFE**: the controller can use this information in safety-related functions.
- **NON-SAFE**additional information that safety functions must not rely on.

These are the system variables.

System Variable	Unit/Value	Read/Write	Description(1)
Contact Assembly 1 Contact Assembly 2 Contact Assembly 3 Contact Assembly 4	true false	Write	On true, the contact closes; on false the contact does not close. Only available for a GuardPLC 2000 controller. [BOOL] **NON-SAFE**
Cooling Fan State	0, 1, 2	Read	0 = normal 1 = fans OK 2 = fan error Only available for a GuardPLC 2000 controller. [BYTE] **NON-SAFE**
Cycle Time	milliseconds	Read	Duration of the last cycle [UDINT] **SAFE**
Date Time Seconds Date Time Milliseconds	seconds milliseconds	Read	Time passed since 1970. An automatic switchover from summer to winter time is not supported. [UDINT] **NON-SAFE**
Emergency Stop 1 Emergency Stop 2 Emergency Stop 3 Emergency Stop 4	true false	Write	True triggers Emergency Off [BOOL] **SAFE** Use these signals to force all inputs and outputs to the zero/OFF state from within the user program.

<table>
<tr><th>System Variable</th><th>Unit/Value</th><th>Read/Write</th><th colspan="2">Description[1]</th></tr>
<tr><td>Force Time</td><td>milliseconds</td><td>Read</td><td colspan="2">Remaining running time during forcing; 0 if Force is inactive.
[DINT]
NON-SAFE</td></tr>
<tr><td>Power Supply</td><td>0-255</td><td>Read</td><td>GuardPLC 1200 and GuardPLC 2000 Controllers
0 = normal
1 = error of input power supply 24 VDC
2 = error of battery
4 = module error of power supply 5 V
8 = module error of power supply 3.3 V
16 = 5 V undervoltage
32 = 5 V overvoltage
64 = 3.3 V undervoltage
128 = 3.3 V overvoltage
255 = status does not exist
[BYTE]
NON-SAFE</td><td>GuardPLC 1600 and GuardPLC 1800 Controllers
0 = normal
1 = 24 VDC undervoltage
4 = 5 V undervoltage
8 = 3.3 V undervoltage
16 = 3.3 V overvoltage
[BYTE]
NON-SAFE</td></tr>
<tr><td>System Tick High
System Tick Low</td><td>milliseconds</td><td>Read</td><td colspan="2">Ring counter with 64 bits, incremented in millisecond steps. [UDINT]
SAFE</td></tr>
<tr><td>Temperature State</td><td>0, 1, 2, 3, 255</td><td>Read</td><td colspan="2">0 = normal
1 = high
2 = faulty
3 = very high
255 = status does not exist
[BYTE]
NON-SAFE (but for additional switch-off)</td></tr>
</table>

(1) Binary values are ORed.

I/O Variables

Depending upon the type of controller, the various GuardPLC controllers support variables for digital and analog I/O parameters that you can configure or monitor.

Digital I/O Module Variables (AB-DIO) for GuardPLC 1200 and 2000 Controllers

The GuardPLC 1200 and 2000 controllers support these digital I/O parameters.

I/O Data	Read/Write	Description	
Board.SRS	Read	System.Rack.Slot	
Board.Type	Read	Module type	
		0x00E1	digital I/O module for GuardPLC 1200 controllers
		0xFE01	digital I/O module for GuardPLC 2000 controllers
		0xFFFF	missing module in GuardPLC 2000 chassis
Board.State(1)	Read	Error mask for the module	
		0x000	I/O processing may be running with errors
		0x001	No I/O processing (CPU not in RUN)
		0x002	No I/O processing during start-up tests
		0x004	Manufacturing interface running
		0x010	No I/O processing due to faulty parameterization
		0x020	No I/O processing due to exceeded fault rate
		0x040	No I/O processing because configured module is not plugged in

I/O Data	Read/Write	Description	
DO.State(1)	Read	Error mask for all digital outputs	
		0x0000	No errors detected
		0x0001	Error of the DO section of the module
		0x0002	Within the multiple error occurrence time: safety switch 1 faulty
		0x0004	Within the multiple error occurrence time: safety switch 2 faulty
		0x0008	Within the multiple error occurrence time: test sample tests faulty
		0x0010	Within the multiple error occurrence time: readback channels faulty
		0x0020	Within the multiple error occurrence time: active switch-off faulty
		0x0100	Within the safety time: CS signals faulty
		0x0200	All outputs switched off; total current too high
		0x0400	Within the safety time: temperature limit 1 exceeded
		0x0800	Within the safety: temperature limit 2 exceeded
		0x01000	Within the safety time: auxiliary voltage monitoring: undervoltage
		0x02000	Within the multiple error occurrence time: status of the safety switches
DO[0x].State(1)(2)	Read	Error mask for digital output channels	
		0x00	No error detected; outputs driven as expected
		0x01	Error in digital output module; outputs not driven
		0x02	Output switched off due to overcurrent; outputs not driven
		0x04	Error during readback of the digital output; outputs not driven
DO[0x].Value(1)	Write	Output value of digital output channels	
		0	Output de-energized
		1	Output activated
DI.State	Write	Error mask for all digital inputs	
		0x0000	No error detected
		0x0001	Error of the DI section of the module
		0x0002	Within the safety time: test sample test faulty
DI[xy].State(3)	Read	Error mask of digital input channels	
		0x00	No error detected
		0x01	Error in the digital input module; input value set to 0
DI[xy].Value(2)	Read	Input values of digital input channels	
		0	Input not activated
		1	Input activated

(1) Values are ORed.
(2) 0x = output channel 01…16 for GuardPLC 2000 controller and 01…08 for GuardPLC 1200, 1600, and 1800 controllers.
(3) xy = input channel 01…24 for GuardPLC 2000 and GuardPLC 1800 controllers and 01… 20 for GuardPLC 1200 and 1600 controllers.

Analog Input Module Variables (AB-AI) for GuardPLC 2000 Controller

The GuardPLC 2000 controller supports these analog input parameters.

I/O Data	Read/Write	Description	
AI.Mode	Write	Mode for all channels of the analog input module	
		0	unipolar (single-ended)
		1	differential
AI.State	Read	Error mask for all analog inputs	
		0x0000	No errors detected
		0x0001	Error of the module
		0x0008	Within the safety time: data bus walking bit error
		0x0010	Within the safety time: coefficient table check error
		0x0020	Within the safety time: supply voltages error
		0x0040	Error on A/D conversion (DRDY_HIGH)
		0x0080	Within the multiple error occurrence time: error in multiplexer crosslink
		0x0100	Within the multiple error occurrence time: data bus walking bit error
		0x0200	Within the multiple error occurrence time: multiplexer address error
		0x0400	Within the multiple error occurrence time: supply voltages error
		0x0800	Within the multiple error occurrence time: error in characteristic curve (Unipolar mode)
		0x1000	Within the multiple error occurrence time: limit values/zero point error (Unipolar mode)
		0x2000	Within the multiple error occurrence time: error in characteristic curve (Differential mode)
		0x4000	Within the multiple error occurrence time: limit values/zero point error (Differential mode)
		0x8000	Error in A/D conversion (DRDY_LOW)

I/O Data	Read/Write	Description	
AI[0x].State[1]	Read	Error mask for analog input channels	
		0x00	No error detected
		0x01	Error in analog input channel
		0x02	Invalid measurement values
		0x04	A/D converters faulty
		0x08	Measurement values are not within the safety accuracy
		0x10	Measurement value overflow
		0x20	Channel not in use
		0x40	Addressing error of the two A/D converters
AI[0x].Used	Write	Configuration of analog input channel	
		0	not used
		1	used
AI[0x].Value[1]	Read	Analog value of input channel (WORD) -10V…10V = -1000…1000	
Board.SRS	Read	System.Rack.Slot	
Board.Type	Read	Module type	
		0xFD02	analog input module for GuardPLC 2000 controller
		0xFFFF	missing module in GuardPLC 2000 chassis
Board.State	Read	Error mask for the module	
		0x000	I/O processing may be running with errors
		0x001	No I/O processing (CPU not in RUN)
		0x002	No I/O processing during start-up tests
		0x004	Manufacturing interface running
		0x010	No I/O processing due to faulty parameterization
		0x020	No I/O processing due to exceeded fault rate
		0x040	No I/O processing because configured module is not plugged in

(1) 0x = input channel 01…08.

Analog Output Module Variables (AB-AO) for GuardPLC 2000 Controller

The GuardPLC 2000 controller supports these analog output parameters

I/O Data	Read/Write	Description	
AO.State	Read	Error mask for all analog outputs	
		0x0000	No errors detected
		0x0001	Error of the module
		0x0002	Within the safety time: co-efficient table check error
		0x0004	No communication with the module due to controller error
AO[0x].Mode	Write	Mode of analog output channel	
		0	voltage
		1	current
AO[0x].State[1]	Read	Error mask for analog output channels	
		0x0000 0001	CPU detected error on AB-AO module
		0x0000 0002	CPU detected faulty monotony counter
		0x0000 0004	CPU detected error in safe addressing
		0x0000 0008	CPU detected faulty CRC
		0x0000 0010	CPU detected error in watchdog time of the AB-AO onboard microprocessor
		0x0000 0020	CPU cannot communicate with the AB-AO onboard microprocessor
		0x0000 0040	CPU detected that the present operating mode (current/voltage) is different from the initialized operating mode
		0x0001 0000	AB-AO onboard microprocessor detected read back error
		0x0004 0000	AB-AO onboard microprocessor detected wrong supply voltage
		0x0008 0000	Within the multiple error occurrence time: AB-AO onboard microprocessor detected faulty safety switch
		0x0080 0000	AB-AO onboard microprocessor detected both safety switches as faulty
		0x0200 0000	AB-AO onboard microprocessor INITIALIZE
		0x1000 0000	AB-AO onboard microprocessor detected error because of module over temperature
		0x2000 0000	AB-AO onboard microprocessor detected module over temperature
		0x8000 0000	CPU detected error on redundant AB-AO onboard microprocessor channel
AO[0x].Used	Write	Configuration of analog output channel	
		0	not used
		1	used

I/O Data	Read/Write	Description	
AO[0x].Value(1)	Write	Output value of analog output channels Voltage mode: -10V…10V = -1000…1000 Current mode: 0 mA…20 mA = 0…1000 for values between -1000… 0, the output current is 0 mA	
Board.SRS	Read	System.Rack.Slot	
Board.Type	Read	Module type	
		0xFB04	analog output module for GuardPLC 2000 controller
		0xFFFF	missing module in GuardPLC 2000 chassis
Board.State	Read	Error mask for the module	
		0x000	I/O processing may be running with errors
		0x001	No I/O processing (CPU not in RUN)
		0x002	No I/O processing during start-up tests
		0x004	Manufacturing interface running
		0x010	No I/O processing due to faulty parameterization
		0x020	No I/O processing due to exceeded fault rate
		0x040	No I/O processing because configured module is not plugged in

(1) 0x = output channels 01…08.

High-Speed Counter Variables For GuardPLC 1200 and 2000 Controllers

The GuardPLC 1200 and GuardPLC 2000 controllers support these variables for counter I/O parameters.

I/O Data	Read/Write	Description	
Board.SRS	Read	System.Rack.Slot	
Board.Type	Read	Module type	
		0x0003	counter module for GuardPLC 1200 controller
		0xFC03	counter module for GuardPLC 2000 controller
		0xFFFF	missing module in GuardPLC 2000 chassis

I/O Data	Read/Write	Description	
Board.State	Read	Error mask for the module	
		0x000	I/O processing may be running with errors
		0x001	No I/O processing (CPU not in RUN)
		0x002	No I/O processing during start-up tests
		0x004	Manufacturing interface running
		0x010	No I/O processing due to faulty parameterization
		0x020	No I/O processing due to exceeded fault rate
		0x040	No I/O processing because configured module is not plugged in
Cnt.State	Read	Error mask of both counters	
		0x0000	No errors detected
		0x0001	Error of the counter section of the module
		0x0002	Error while comparing the time base
		0x0004	Addressing error while reading the time base
		0x0008	Parameterization of the time base corrupted
		0x0010	Addressing error while reading the counts
		0x0020	Parameterization of counter corrupted
		0x0040	Addressing error while reading the Gray codes
		0x0080	Within the multiple error occurrence time: test sample test faulty
		0x0100	Error of the module
Cnt[0x].Value(1)	Read	Counts of counter 1 or 2 (cyclic 24-bit) 24 bits for pulse counter 4 bits for Gray code for GuardPLC 2000 controllers; 3 bits for Gray code for GuardPLC 1200 controllers	
Cnt[0x].5/24V Mode(1)	Read/Write	5V or 24V mode of counter 1 or 2 The write values must have initial values or constants.	
		0	5V
		1	24V
Cnt[0x].Auto Advance Sense(1)	Read/Write	Automatic recognition of direction of counting for counter 1 or 2	
		0	Manual setting of direction of counting
		1	Automatic recognition of direction of counting
Cnt[0x].Direction(1)	Read/Write	Direction of counting for counter 1 or 2 (only when Automatic Counter Advance Sense = false)	
		0	Up
		1	Down
Cnt[0x].Dummy1	Read/Write	reserved memory space for future use	
Cnt[0x].Dummy2	Read/Write	reserved memory space for future use	

I/O Data	Read/Write	Description	
Cnt[0x].GrayCode[1]	Read/Write	Gray code mode of counter 1 or 2	
		0	Pulse
		1	Gray
Cnt[0x].Halt[1]	Read/Write	currently not used	
Cnt[0x].Reset[1]	Read/Write	Reset for counter 1 or 2	
		0	Resetting of counter
		1	No resetting of counter
Cnt[0x].State[1]	Read	Error mask of counter 1 or 2	
		0x01	Error in counter unit
		0x02	Error while comparing the counts
		0x04	Error while comparing the time stamps
		0x08	Error resetting counter
Cnt[0x].Time Overflow[1]	Read	Overflow indicator of time stamp of counter 1 or 2	
		true	24 bits overflow since last cycle
		false	No 24 bits overflow since last cycle
Cnt[0x].Time Stamp[1]	Read	Time stamp for Cnt[0x].Value (cyclic 24-bit) 24 bits, time resolution 1μs	
Cnt[0x].Value Overflow[1]	Read	Overflow indicator of counter 1 or 2	
		true	24 bits overflow since last cycle (only when Automatic Counter Advance Sense = false)
		false	No 24 bits overflow since last cycle
DO.State	Read	Error mask for all counter outputs	
		0x0001	Error of the DO section of the module
		0x0002	Within the multiple error occurrence time: safety switch 1 faulty
		0x0004	Within the multiple error occurrence time: safety switch 2 faulty
		0x0008	Within the multiple error occurrence time: test sample tests faulty
		0x0010	Within the multiple error occurrence time: readback channels faulty
		0x0020	Within the multiple error occurrence time: active switch-off faulty
		0x0100	Within the safety time: CS signals faulty
		0x0200	All outputs switched off; total current too high
		0x0400	Within the safety time: temperature limit 1 exceeded
		0x0800	Within the safety time: temperature limit 2 exceeded
		0x01000	Within the safety time: auxiliary voltage monitoring: undervoltage
		0x02000	Within the multiple error occurrence time: status of the safety switches

I/O Data	Read/Write	Description	
DO[0y].State[2]	Read	Error mask for counter outputs 1…4	
		0x01	Error in output channel
		0x02	Output channel switched off due to overcurrent
		0x04	Error during readback of the output channel
		0x08	Faulty initialization after counter reset
DO[0x].Value[2]	Write	Output value of counter outputs 1…4 (These 4 outputs cannot be driven by counter presets. They are driven by user software only.)	
		0	Output de-energized
		1	Output activated

(1) 0x = counter 01 or 02.
(2) 0y = outputs 01, 02, 03, or 04

Module Variables for GuardPLC 1600 and 1800 Controllers and Distributed I/O

The GuardPLC 1600 and 1800 controllers and distributed I/O support these module parameters.

I/O Data	Read/Write	Description	
Module.SRS	Read	Slot number (System.Rack.Slot)	
Module.Type	Read	Module type	
		0x00A5	Digital input module (DI20) for GuardPLC 1600 controllers
			Digital input module (DI20) for 1753-IB20XOB8
			Digital input module (DI8) for 1753-IB8XOB8
		0x00E2	Digital input module (DI16) for 1753-IB16XOB8
		0x002D	Digital input module (DI16) for 1753-IB16
		0x005A	Digital output module (DO16) for 1753-OB16
		0x003C	Digital relay output module (DO8) 1753-OW8
		0x00B4	Digital output module (DO8) for GuardPLC 1600/1800 controllers, and 1753-IB20XOB8
		0x005B	Digital output module (DO8) for 1753-IB8XOB8
		0x00C4	Digital output module (DO8) for 1753-IB16XOB8

I/O Data	Read/Write	Description	
Module.Error.Code	Read	Error mask for the module	
		0x0000	I/O processing may be running with errors
		0x0001	No I/O processing (CPU not in RUN)
		0x0002	No I/O processing during start-up tests
		0x0004	Manufacturing interface running
		0x0010	No I/O processing due to incorrect configuration
		0x0020	No I/O processing due to exceeded fault rate
		0x0040/80	No I/O processing because configured module is not plugged in

Digital Input Module Variables for GuardPLC 1600 Controllers and Distributed I/O

The GuardPLC 1600 controllers and distributed I/O support these digital input parameters.

I/O Data	Read/Write	Description	
DI.Error Code Supply (1753-IB16XOB8 only)	Read	0x0001	Error in the total module DI supply.
DI[xx].Error Code Supply (1753-IB16XOB8 only)	Read	Error mask of all digital inputs	
		0x01	Error in DI supply of the module.
		0x02	Supply is switched off due to overcurrent.
		0x04	Error in reading back the supply.
DI.Error Code	Read	Error mask for all digital inputs	
		0x0001	Error in digital input range
		0x0002	FTZ test of test pattern failed
DI[xx].Error Code(1)	Read	Error mask of all digital input channels	
		0x01	Error in digital input module
		0x10	Short-circuit of the channel
		0x80	Line interrupt between pulse output (DO) and pulse input (DI)
DI[xx].Value(1)	Write	Input value of digital input channels	
		0	Input not set
		1	Input set

I/O Data	Read/Write	Description	
DI.Number of Pulse Channel	Write	Number of pulse outputs (feed outputs)	
		0	No output channel provided for line monitoring
		1	Output channel 1 provided for line monitoring
		2	Output channels 1 and 2 provided for line monitoring
		3	Output channels 1, 2, and 3 provided for line monitoring
		4	Output channels 1…4 provided for line monitoring
		5	Output channels 1…5 provided for line monitoring
		6	Output channels 1 …6 provided for line monitoring
		7	Output channels 1…7 provided for line monitoring
		8	Output channels 1…8 provided for line monitoring
DI Supply[xx] 1753-IB16XOB8 only)	Write	Activation of the single DI supply	
		0	Transmitter supply (1 A) is switched off (default: supply current 40 mA)
		1	Transmitter supply (1 A) is switched on
DI.Pulse Slot	Write	Pulse module slot (LC)	
DI.Pulse Channel	Write	Source channel of pulse feed	
		0	Input channel
		1	Pulse from first DO channel
		2	Pulse from second DO channel
		3	Pulse from third DO channel
		4	Pulse from fourth DO channel
		5	Pulse from fifth DO channel
		6	Pulse from sixth DO channel
		7	Pulse from seventh DO channel
		8	Pulse from eighth DO channel
DI.LC Delay (GuardPLC 1600 and 1800 Controllers and 1753-IB16 and 1753-IB20XOB8 modules) DI Pulse Delay (1753-IB8XOB8 and 1753-IB16XOB8)	Write	Waiting time for pulse output (short-circuit-proof)	

(1) xx = the affected input channel of the controller or module.

Digital Output Module Variables for GuardPLC 1600/1800 Controllers, 1753-IB20XOB8 Modules, and 1753-OB16 Modules

The GuardPLC 1600 and GuardPLC 1800 controllers, 1753-IB20XOB8 modules, and 1753-OB16 modules support these digital output parameters.

I/O Data	Read/Write	Description	
DO.Error Code	Read	Error mask for all digital outputs	
		0x0001	Error in digital output range
		0x0002	MEZ test of test pattern failed
		0x0004	MEZ test, auxiliary supply failed
		0x0010	FTZ test of test pattern failed
		0x0020	FTZ test of test pattern of the output switch failed.
		0x0040	FTZ test of the test pattern of the output switch (disconnection test of outputs) failed.
DO[xx].Error Code(1)	Read	Error mask of all digital output channels	
		0x01	Error in digital output module
		0x02	Output switched off due to overload
		0x04	Error when reading back the activation of the digital outputs
		0x08	Error when reading back the status of the digital outputs

(1) xx = affected output channel of the controller or module.

Digital Output Parameters for 1753-IB8XOB8 Modules

In addition to the output parameters in the table on page 318, the GuardPLC 1753-IB8XOB8 module features these digital output parameters.

I/O Data L+ Switching Outputs	I/O Data L- Switching Outputs	Read/ Write	Description	
DO1.Error Code	DO2.Error Code	Read	Error mask for all digital outputs	
			0x0001	Error in digital output range
			0x0002	MEZ test of safety shutdown failed
			0x0004	MEZ test, auxiliary supply failed
			0x0008	FTZ test of test pattern failed
			0x0010	MEZ test of test pattern of the output switch failed
			0x0020	MEZ test of test pattern of the output switch (disconnection test of outputs) failed
			0x0040	MEZ test, active disconnection via watchdog failed
			0x0200	All outputs switched off, total current exceeded
			0x0400	FTZ test: 1. Temperature threshold exceeded
			0x0800	FTZ test: 2. Temperature threshold exceeded
			0x1000	FTZ test: Monitoring of auxiliary supply 1: Undervoltage
DO1[xx].Error Code(1)	DO2[xx].Error Code(1)	Read	Error mask of all digital output channels	
			0x01	Error in digital output module
			0x02	Output switched off due to overload
			0x04	Error when reading back the activation of the digital outputs
			0x08	Error when reading back the status of the digital outputs
			0x40	external short-circuit or short-circuit of EMC protection yield to an error
			0x80	channel is switched off due to an error in the corresponding DO channel
DO1[xx].Value	DO2[xx].Value	Write	Output value of the digital output channels	
			0	The output is not set, no current
			1	The output is set

I/O Data		Read/ Write	Description	
L+ Switching Outputs	L- Switching Outputs			
—	DO2[xx].2 Pole used	Write	Configures the channel for 2 pole operation.	
			0	channel DO2[xx] is not used for 2-pole operation.
			1	channel DO2[01] is used for 2-pole operation with channel DO1[04], or channel DO2[02] is used for 2-pole operation with channel DO1[08]
—	Switch-on delay	Write	Sets switch-on delay for 2-pole tests, due to lamp load, inductive and capacitive load	

(1) xx = affected output channel of the controller or module.

Digital Output Parameters for 1753-IB16XOB8 Modules

In addition to the output parameters in the table on page 318, the GuardPLC 1753-IB16XOB8 module features these digital output parameters.

I/O Data	Read/Write	Description	
DO.Error Code	Read	Error mask for all digital outputs	
		0x0001	Error in digital output range
		0x0002	MEZ test of safety shutdown failed
		0x0004	MEZ test, auxiliary supply failed
		0x0008	FTZ test of test pattern failed
		0x0010	MEZ test of test pattern of the output switch failed
		0x0020	MEZ test of test pattern of the output switch (disconnection test of outputs) failed
		0x0040	MEZ test, active disconnection via watchdog failed
		0x0080	FTZ test of the period monitoring causes an error.
		0x0100	FTZ read back of the period monitoring causes an error
		0x0200	All outputs switched off, total current exceeded
		0x0400	FTZ test: 1. Temperature threshold exceeded
		0x0800	FTZ test: 2. Temperature threshold exceeded
		0x1000	FTZ test: Monitoring of auxiliary supply 1: Undervoltage
		0x2000	FTZ test: Monitoring of auxiliary supply 2: Undervoltage
		0x4000	Flip-flop of the supply monitoring (18V) causes undervoltage
		0x8000	MEZ test of the period monitoring causes an error

I/O Data	Read/Write	Description	
DO[xx].+Error Code(1) DO[xx].-Error Code	Read	Error code of digital outputs DO+ Error code of digital outputs DO-	
		0x0001	Error in the digital output module
		0x0002	Output switched off due to overload
		0x0004	Error reading back the activation of digital outputs
		0x0008	Error reading back status of the digital outputs
		0x0010	Short-circuit
		0x0020	Channel is switched off due to an error in the corresponding DO channel
		0x0040	Zener diode at the output is not alloyed
		0x0080	Line break
		0x0100	MEZ test of the output switches in the DO+ line caused an error
		0x0200	MEZ test of the output switches in the DO- line caused an error
		0x0400	MEZ test of the L- test switch caused an error
		0x0800	External L+ supply at DO+
DO.LSLB period(2)	Write	Period during which line monitoring is carried out. Values in one second increments from 1…100 s.	
DO.LSLB time	Write	Time for Line Short Line Break (LSLB) monitoring. Values in one millisecond increments from 0 …50 ms. The default is 0 ms.	
DO[xx].2-pole	Write	Configures the module for 2-pole operation	
		0	1-pole operation
		1	2-pole operation
DO[xx].+Value	Write	Output value for DO channels (DO+) 1-pole (Value:0 or 1) 2-pole, identical to DO- (Value: 0 or 1)	
DO[xx].-Value	Write	Output value for DO channels (DO-) 1-pole (Value:0 or 1) 2-pole, identical to DO+ (Value: 0 or 1	
DO[xx].LSLB monitoring	Write	Configures line control	
		0	no LSLB (line control)
		1	set for LSLB (line control)
DO[xx]LS monitoring with reduced voltage	Write	Configures line control with reduced voltage	
		0	normal signal voltage level
		1	reduced signal voltage level
DO[xx][xx].in pairs	Write	Configures line control with channel pairs	
		Pair 1	channel 1 [01] and channel 2 [02
		Pair 2	channel 3 [03] and channel 4 [04
		Pair 3	channel 5 [05] and channel 6 [06
		Pair 4	channel 7 [07] and channel 8 [08]

(1) xx = affected output channel of the controller or module.
(2) LSLB = Line Short Line Break

Digital Relay Output Parameters for 1753-OW8 Modules

The 1753-OW8 module supports these digital output parameters.

I/O Data	Read/Write	Description	
DO.Error Code	Read	Error mask for all digital outputs	
		0x0001	Module error
		0x0002	MEZ test, safety switch 1 failed
		0x0004	MEZ test, safety switch 2 failed
		0x0008	FTZ test of test pattern failed
		0x0010	MEZ test of test of readback channels failed
		0x0020	MEZ test, active disconnection failed
		0x0040	Error with initialization: relays
		0x0080	FTZ test: error of relay voltage
		0x0100	FTZ test of chip select (cs) signals failed
		0x0400	FTZ test: 1. Temperature threshold exceeded
		0x0800	FTZ test: 2. Temperature threshold exceeded
		0x1000	MEZ test: status of safety switch 1
		0x2000	MEZ test: status of safety switches
		0x4000	MEZ test: active disconnection by watchdog failed
DO[xx].Error Code(1)	Read	Error code of digital output channels	
		0x01	Error in the digital output module
		0x04	Error reading back the digital outputs
		0x10	Error reading back relay [x].1 (The channel is permanently deactivated.)
		0x20	Error reading back relay [x].2 (The channel is permanently deactivated.)
		0x80	Channel cannot be activated after deactivation by: • user program • forcing • channel/module failure
DO[xx].Value	Write	Output value for DO channels	
		0	Output not powered.
		1	Output activated.

(1) xx = affected output channel of the controller or module.

Analog Input Signals for 1753-IF8XOF4 Modules

The 1753-IF8XOF4 module supports these analog input signals.

I/O Data	Read/Write	Description	
Module.SRS	Read	Slot number (System.Rack.Slot)	
Module.Type	Read	Module type: 0x001E	
Module.Error.Code	Read	Error mask for the module	
		0x0000	I/O processing may be running with errors
		0x0001	No I/O processing (CPU not in RUN)
		0x0002	No I/O processing during start-up tests
		0x0004	Manufacturing interface running
		0x0010	No I/O processing due to incorrect configuration
		0x0020	No I/O processing due to exceeded fault rate
		0x0040/80	No I/O processing because configured module is not plugged in
AI.Error Code	Read	Error mask for all analog inputs	
		0x0001	Module error
		0x0004	MEZ test, time monitoring of conversion
		0x0008	FTZ test: walking bit of data bus faulty
		0x0010	FTZ test: Operating voltages faulty
		0x0020	MEZ test, active disconnection failed
		0x0040	A/D conversion faulty
		0x0080	MEZ test: cross links of MUX faulty
		0x0100	MEZ test: walking bit of data bus faulty
		0x0200	MEZ test: multiplexer addresses faulty
		0x0400	MEZ test: operating voltages faulty
		0x0800	MEZ test: measuring system (characteristic) faulty (unipolar)
		0x1000	MEZ test: measuring system (final values, zero point) faulty (unipolar)
		0x8000	A/D conversion faulty (DRDY_HIGH)

I/O Data	Read/Write	Description	
AI[xx].Error Code(1)	Read	Error code of analog input channels	
		0x01	Error in the analog input module
		0x02	Limit value underflow/overflow
		0x04	A/D converter faulty; measuring values not valid
		0x08	Measured value not within safety accuracy
		0x10	Measured value overflow
		0x20	Channel not in operation
		0x40	Address error of both A/D converters
AI[xx].Value	Read	Analog value of each channel [INT] from 0…2000 (0V…10V). The validity depends on the AI[xx].Error Code.	
AI[xx].Used	Write	Configures the channel for operation	
		0	Channel is not in operation.
		1	Channel is operating.
AI[xx].Transmitter Used	Write	Configures the channel for transmitter supply	
		0	Transmitter supply is not used.
		1	Transmitter supply is used.
Transmitter Voltage[01]	Write	Configures switchover of the transmitter supply per group	
		1	8.2V
		2	26.0V
Transmitter.Error Code	Read	Error codes of the transmitter unit	
		0x0001	Error in the transmitter supply
		0x0400	FTZ test 1: temperature threshold exceeded
		0x0800	FTZ test 2: temperature threshold exceeded
Transmitter[01].Error Code	Read	Error codes of each transmitter group	
		0x01	Module error of transmitter supply
		0x02	Overcurrent of transmitter supply
		0x04	Undervoltage of transmitter supply
		0x08	Overvoltage of transmitter supply
AI[xx].Underflow	Read	Underflow AI[xx].Value according to AI[xx].Limit LOW. The validity depends upon the AI[xx].Error Code.	
AI[xx].Overflow	Read	Overflow AI[xx].Value according to AI[xx].Limit HIGH. The validity depends upon the AI[xx].Error Code.	
AI[xx].Limit LOW	Write	Upper limit of voltage range 0-signal AI[xx].Underflow	
AI[xx].Limit HIGH	Write	Lower limit of voltage range 0-signal AI[xx].Overflow	

(1) xx = affected output channel of the controller or module.

Analog Output Signals for 1753-IF8XOF4 Modules

The 1753-IF8XOF4 module supports these analog output signals.

I/O Data	Read/Write	Description	
Module.SRS	Read	Slot number (System.Rack.Slot)	
Module.Type	Read	Module type: 0x	
Module.Error.Code0069	Read	Error mask for the module	
		0x0000	I/O processing may be running with errors
		0x0001	No I/O processing (CPU not in RUN)
		0x0002	No I/O processing during start-up tests
		0x0004	Manufacturing interface running
		0x0010	No I/O processing due to incorrect configuration
		0x0020	No I/O processing due to exceeded fault rate
		0x0040/80	No I/O processing because configured module is not plugged in
AO.Error Code	Read	Error mask for all analog inputs	
		0x0001	Module error
		0x0002	MEZ test: safety switch 1 failed
		0x0004	MEZ test: safety switch 2 failed
		0x0008	FTZ test: of test pattern failed
		0x0010	FTZ test: error checking coefficients
		0x0400	FTZ test: 1. Temperature threshold exceeded.
		0x0800	FTZ test: 2. Temperature threshold exceeded.
		0x2000	MEZ test: status of safety switches
		0x4000	MEZ test: active disconnection by watchdog failed
AO[xx].Error Code[(1)]	Read	Error code of analog input channels	
		0x01	Error in the analog output unit
		0x80	AO[xx].Value not in the specified range.
AO[xx].Value	Write	Output value of AO channels: Current characteristic: 0…2000 (0 mA…20 mA) Current characteristic: -2000…0 (0 mA) Values are tested for plausibility before standardization. Current characteristic: • Values < 0: standardization with 0 • Values < sampling point LOW: standardization with sampling point LOW • Values > sampling point HIGH: standardization with sampling point HIGH **IMPORTANT:** Outputs must not be used as safety-related outputs!	
AO[xx].Used	Write	Configures the channel for operation	
		0	Channel is not in operation.
		1	Channel is operating.

(1) xx = affected output channel of the controller or module.

Counter Module Variables for GuardPLC 1800 Controllers

The GuardPLC 1800 controllers support these counter parameters.

I/O Data	Read/Write	Description	
Module.SRS	Read	Slot number (System.Rack.Slot)	
Module.Type	Read	Module type	
		0x0003	high speed counter module for GuardPLC 1800 controllers
Module.Error.Code	Read	Error mask for the module	
		0x0000	I/O processing may be running with errors
		0x0001	No I/O processing (CPU not in RUN)
		0x0002	No I/O processing during start-up tests
		0x0004	Manufacturing interface running
		0x0010	No I/O processing due to incorrect configuration
		0x0020	No I/O processing due to exceeded fault rate
		0x0040	No I/O processing because configured module is not plugged in
Cnt.Error Code	Read	Error mask of counter module	
		0x0001	Error in module
		0x0002	Error comparing the time base
		0x0004	Address error reading the time base
		0x0008	Parameters for the time base are faulty
		0x0010	Address error reading the counter content
		0x0020	Configuration of counter damaged
		0x0040	Address error reading the Gray Code
		0x0080	FTZ test of the test pattern failed
		0x0100	FTZ test, error checking the coefficients
Cnt[0x].Error Code(1)	Read	Error mask of counter channels 1 and 2	
		0x01	Error in counter module
		0x02	Error comparing contents of counters
		0x04	Error comparing the timestamps of the counters
		0x08	Error setting the parameters (reset)
Cnt[0x].Value(1)	Read	Content of counters: 24-bit for pulse counter, 3-bit for Gray Code	
Cnt[0x].Timestamp(1)	Read	Time stamp for *Cnt[0x].Value* 24-bit, time resolution 1µs	
Cnt[0x].Value Overflow(1)	Read	Counter overflow indication	
		True	24-bit overflow since last measurement (only if *Cnt[0x].Auto Advance Sense* = False)
		False	No overflow since last cycle

I/O Data	Read/Write	Description	
Cnt[0x].Time Overflow[1]	Read	Overflow indication for the time stamp of the counters	
		True	24-bit overflow since last measurement
		False	No 24-bit overflow since last measurement
Cnt[0x].Direction[1]	Read/Write	Counting direction of the counter (only if *Cnt[0x].Auto Advance Sense* = False)	
		True	upward (increment)
		False	downward (decrement)
Cnt[0x].Auto Advance Sense[1]	Read/Write	Automatic counter direction recognition	
		True	Automatic recognition on
		False	Manual setting of counter direction
Cnt[0x].Reset[1]	Read/Write	Reset counter	
		True	No reset
		False	Reset
Cnt[0x].5/24V Mode[1]	Read/Write	Counter input 5V or 24V	
		True	24V
		False	5V
Cnt[0x].Gray Code[1]	Read/Write	Decoder or pulse operation	
		True	Gray Code decoder
		False	Pulse operation

(1) 0x = counter 01 or 02.

Digital (Analog) Input Variables for the GuardPLC 1800 Controller

The digital inputs on the GuardPLC 1800 controller are actually analog inputs with these configurable parameters.

I/O Data	Read/Write	Description	
Module.SRS	Read	Slot number (System.Rack.Slot)	
Module.Type	Read	Module type	
		0x00D2	Digital input module (MI24/8 FS:1000) for GuardPLC 1800 controllers
		0x0096	Digital input module (MI24/8 FS:2000) for GuardPLC 1800 controllers
Module.Error.Code	Read	Error mask for the module	
		0x0000	I/O processing may be running with errors
		0x0001	No I/O processing (CPU not in RUN)
		0x0002	No I/O processing during start-up tests
		0x0004	Manufacturing interface running
		0x0010	No I/O processing due to incorrect configuration
		0x0020	No I/O processing due to exceeded fault rate
		0x0040	No I/O processing because configured module is not plugged in
AI.Error Code	Read	Error mask for all digital (analog) inputs	
		0x0001	Error in input range
		0x0008	FTZ test: walking bit of data bus faulty
		0x0010	FTZ test: error checking coefficients
		0x0020	FTZ test: operating voltages faulty
		0x0040	A/D conversion faulty (DRDY_LOW)
		0x0080	MEZ test: cross links of MUX faulty
		0x0100	MEZ test: walking bit of data bus faulty
		0x0200	MEZ test: multiplexer addresses faulty
		0x0400	MEZ test: operating voltages faulty
		0x0800	MEZ test: measuring system (characteristic) faulty (unipolar)
		0x1000	MEZ test: measuring system (final values, zero point) faulty (unipolar)
		0x8000	A/D conversion faulty (DRDY_HIGH)

I/O Data	Read/Write	Description	
AI[xx].Error Code DI[xx].Error Code	Read Read	Error mask for analog input channels (1…8) Error mask for digital input channels (9…32)	
		0x01	Error in input module
		0x02	Measured values invalid
		0x04	A/D converter faulty
		0x08	Measured value not within the safety accuracy
		0x10	Measured value overflow
		0x20	Channel not in operation
		0x40	Address error of both A/D converters
		0x80	Configuration of hysteresis faulty
AI[xx].Value Analog DI[xx].Value Analog	Read Read	Analog value of AI channels (1…8) [WORD] from 0…1000 The validity is dependent on the error mask. Analog value of the DI channels (9…32) [WORD] from 0…3000 The validity is dependent on the error mask.	
DI[xx].Value Bool	Read	Digital value of DI channels (9…32) [BOOL] according to hysteresis The validity is dependent on the error mask.	
AI[xx].Hysteresis LOW	Write	Upper limit of the 0-signal voltage range *DI[xx].Value Bool*	
AI[xx].Hysteresis HIGH	Write	Lower limit of the 1-signal voltage range *DI[xx].Value Bool*	
AI[xx].Used DI[xx].Used	Write Write	Configuration for indicating utilization of channels 1…8 Configuration for indicating utilization of channels 9…32	

Notes:

Wiring Examples

Introduction

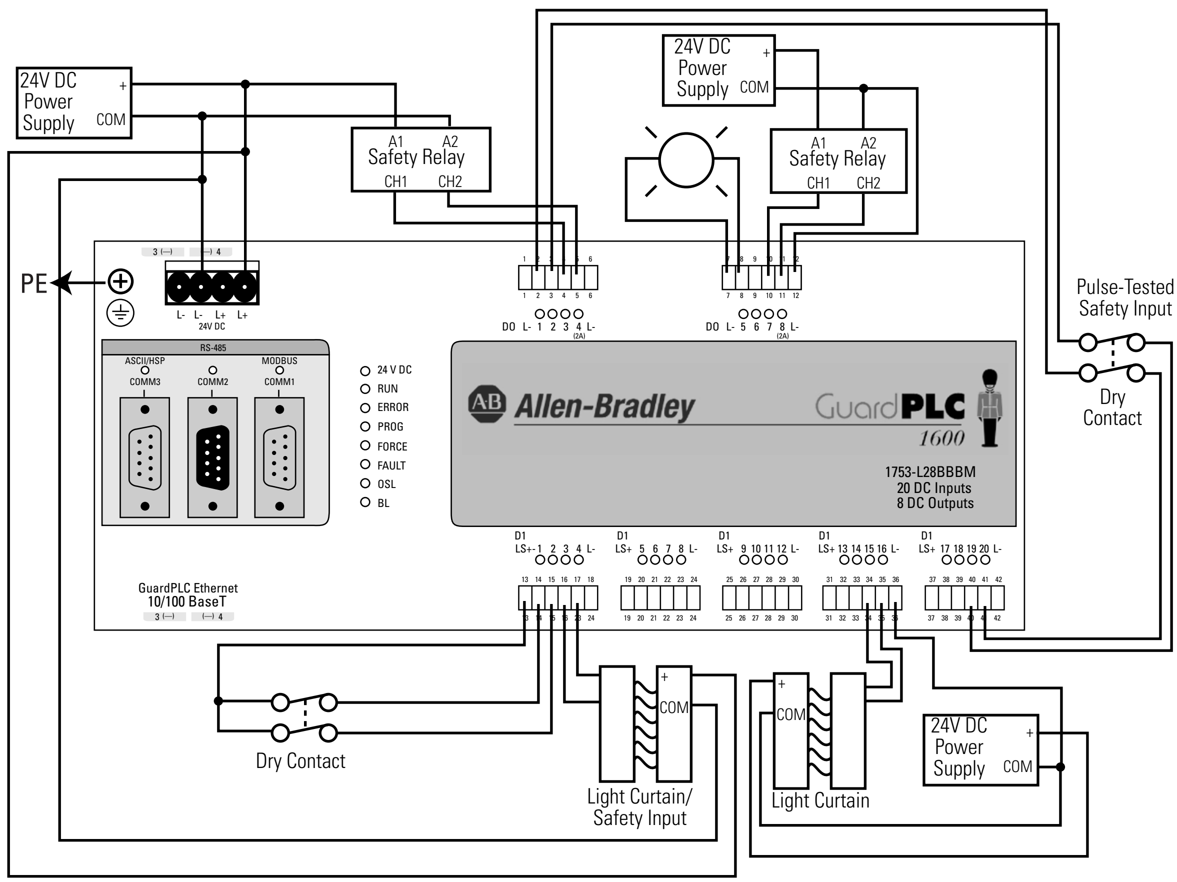
IMPORTANT

The wiring diagrams in this appendix detail only the wiring necessary to sense/control the I/O devices.

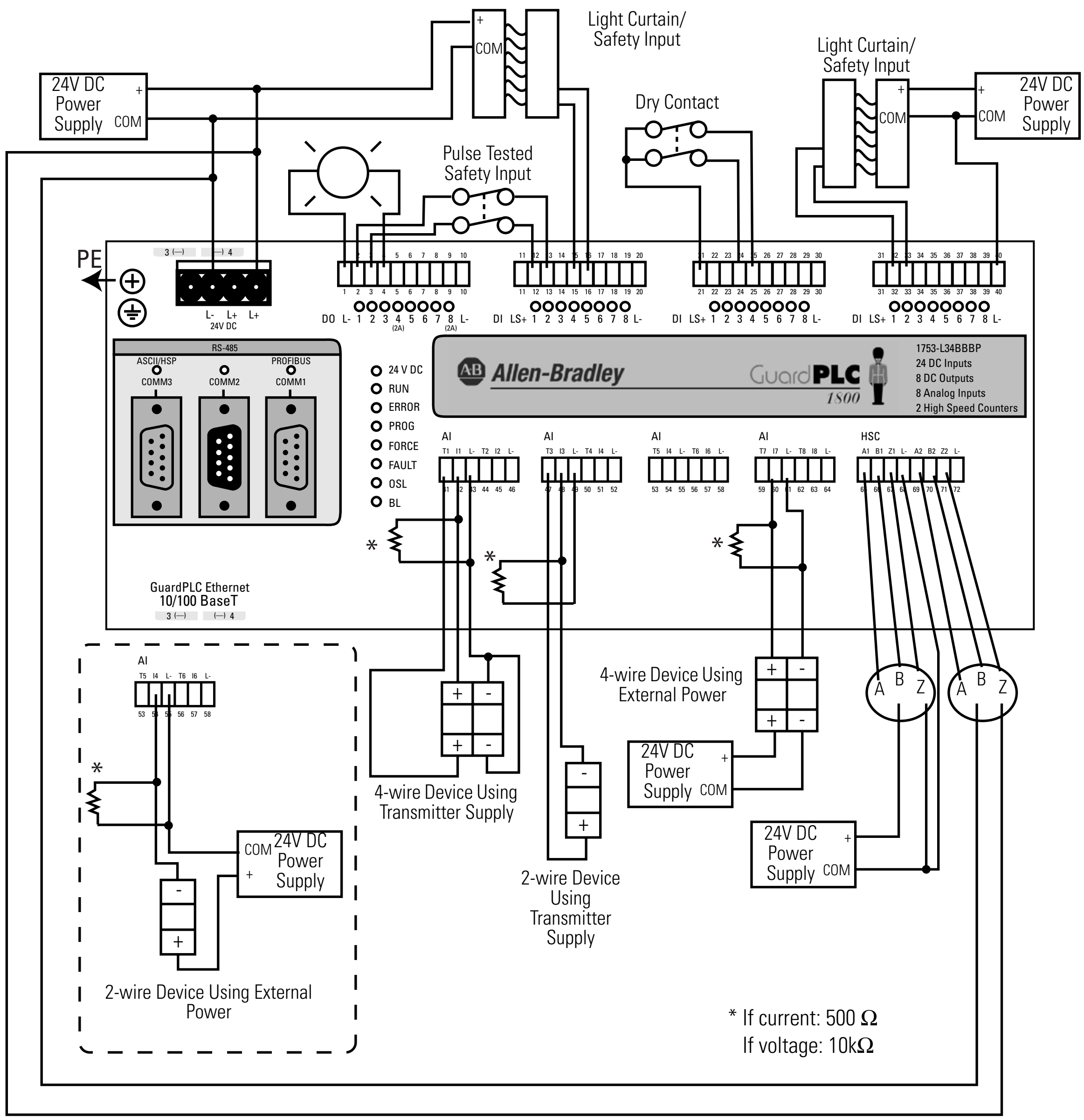
They do not show all of the wiring necessary to achieve Cat. 3 or Cat. 4 safety circuits.

For example, monitoring feedback signals is not illustrated.

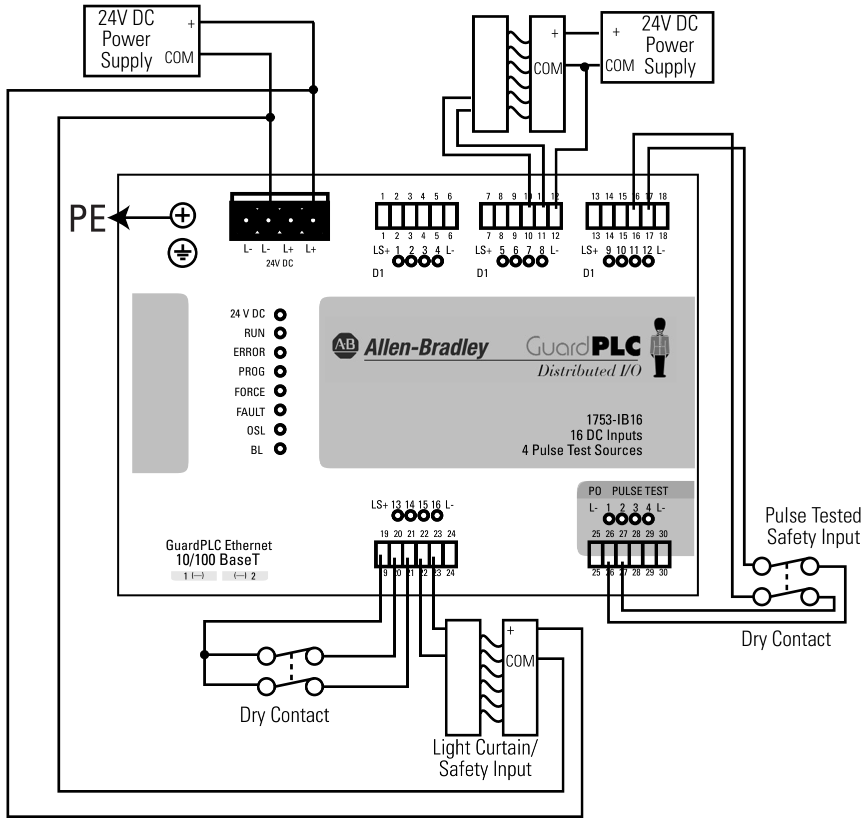
GuardPLC 1600 Controller



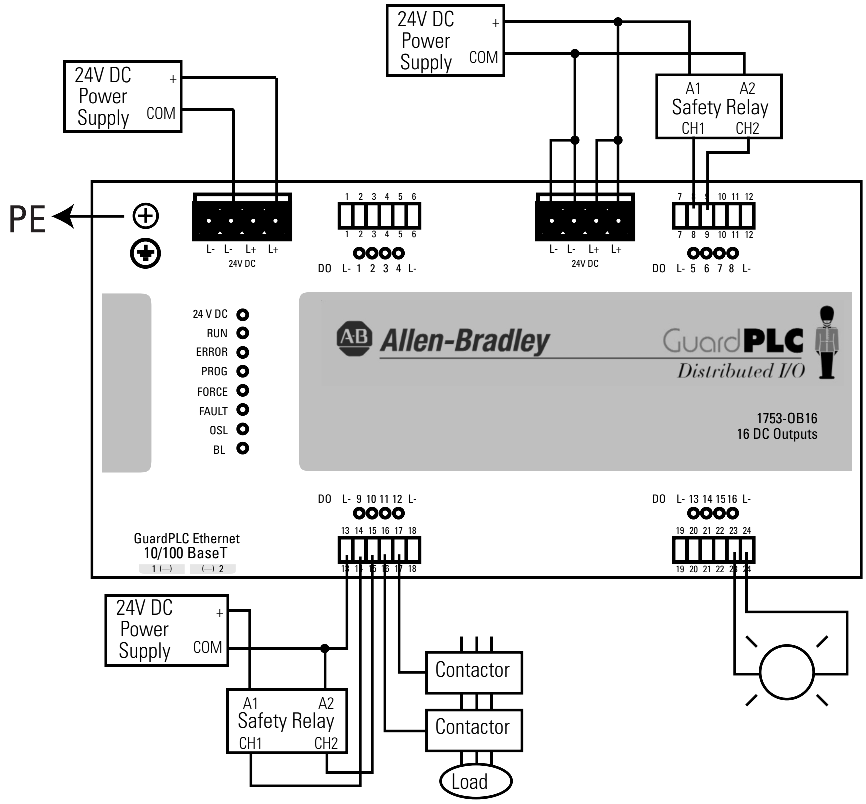
GuardPLC 1800 Controller



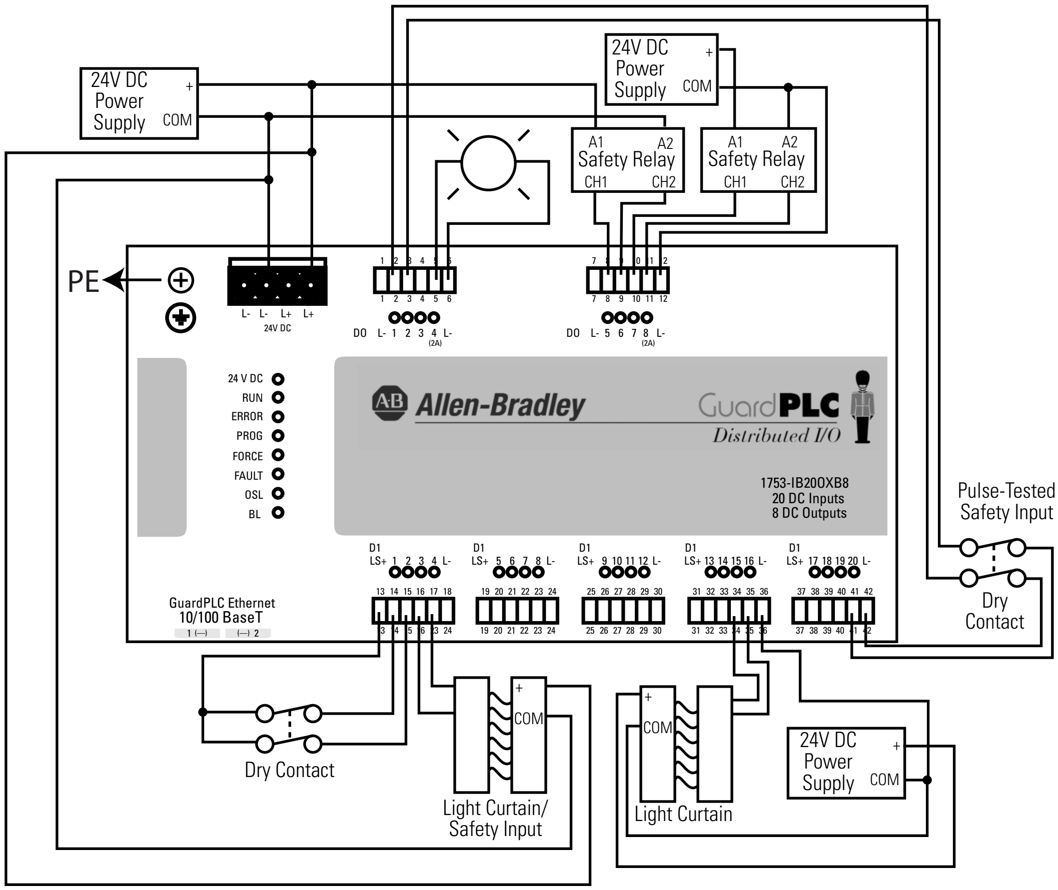
1753-IB16 Modules



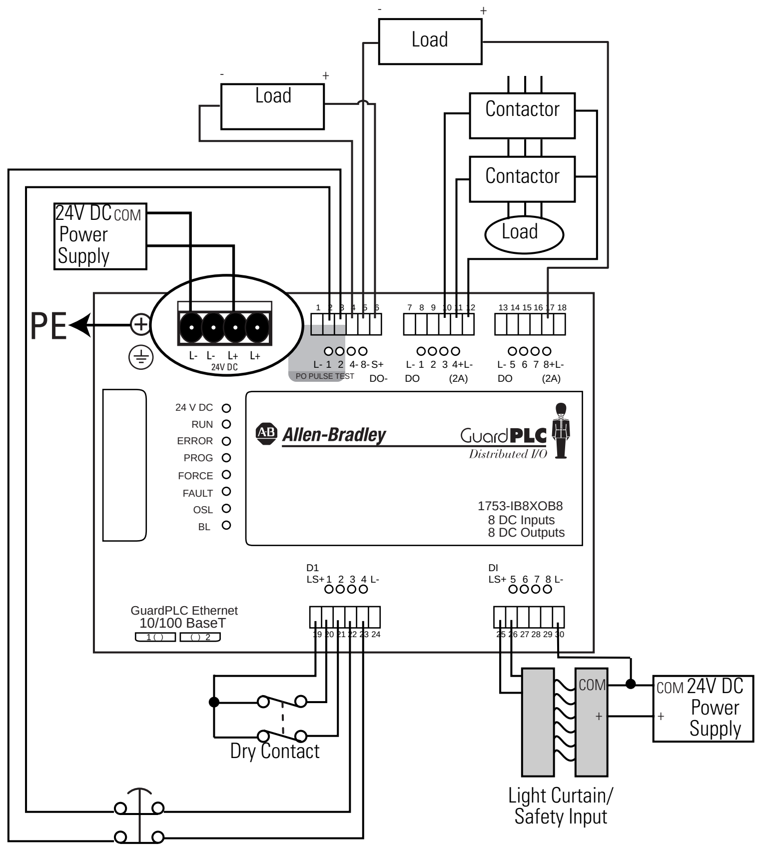
1753-OB16 Modules



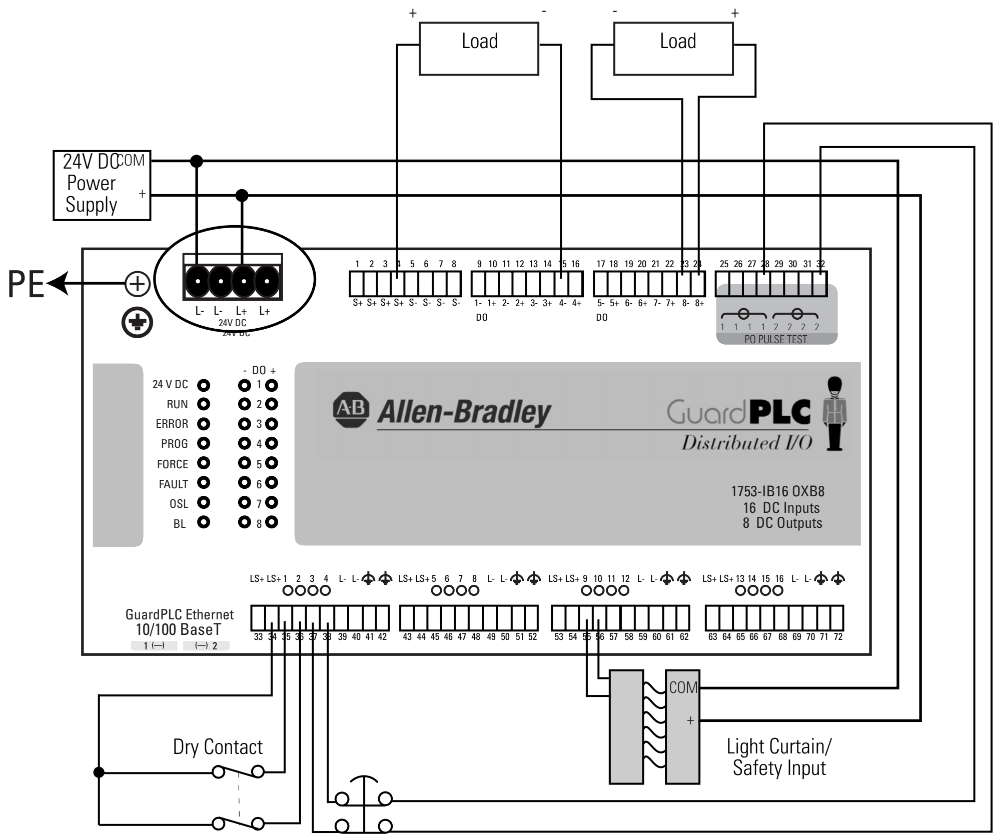
1753-IB20XOB8 Module



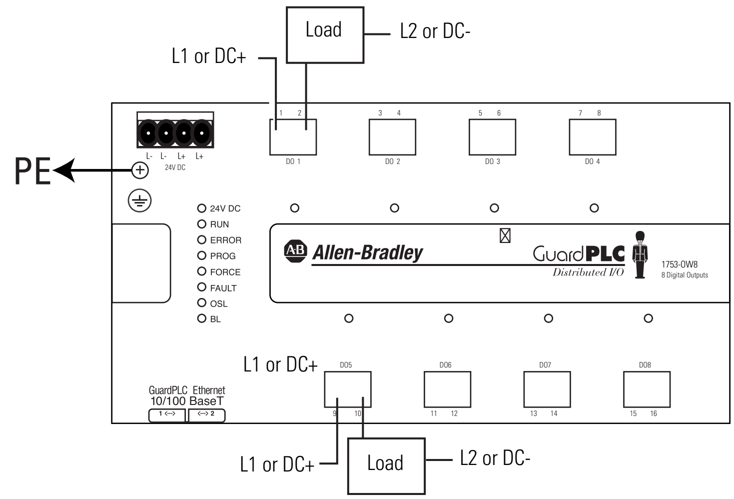
1753-IB8XOB8 Modules



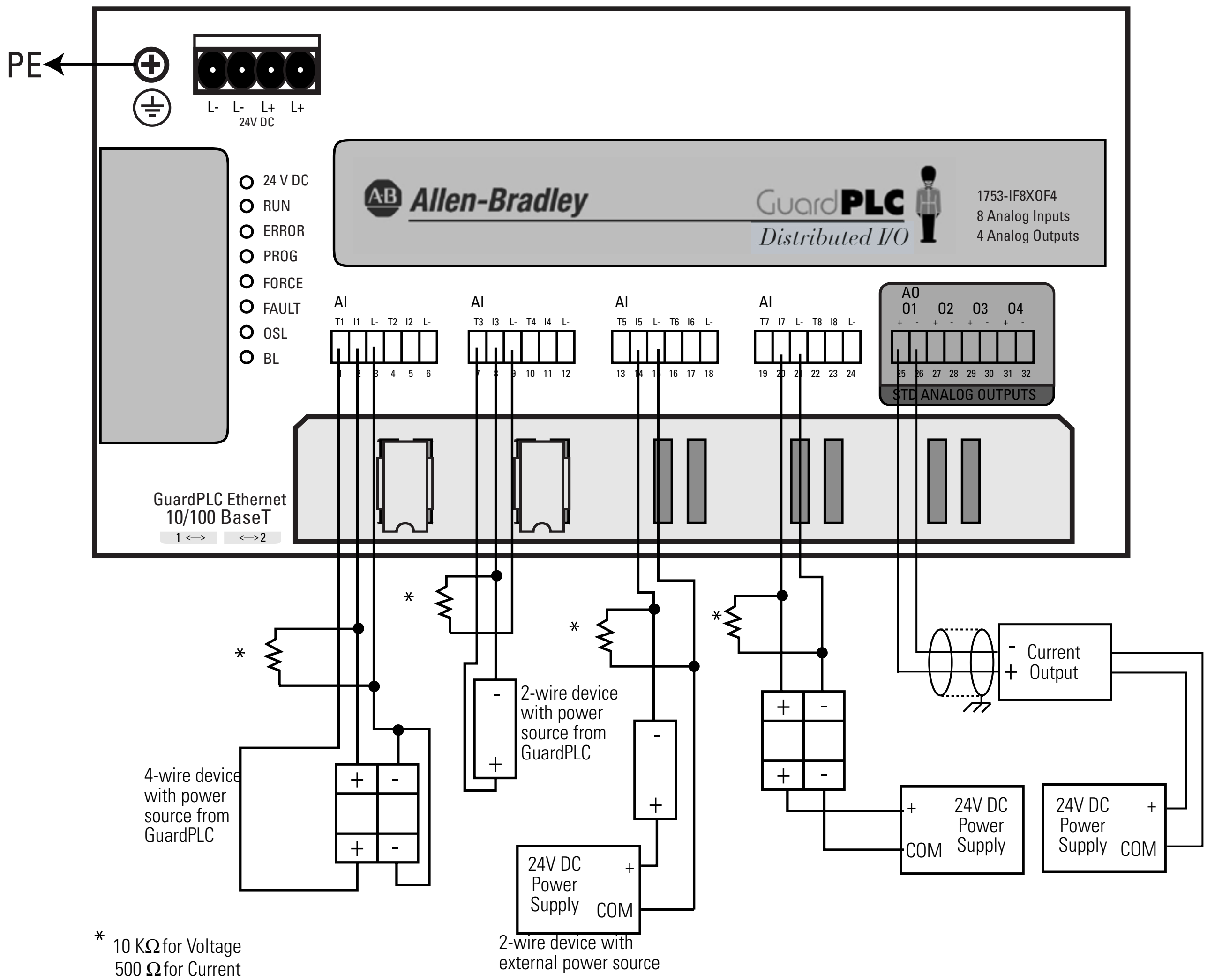
1753-IB16XOB8 Modules



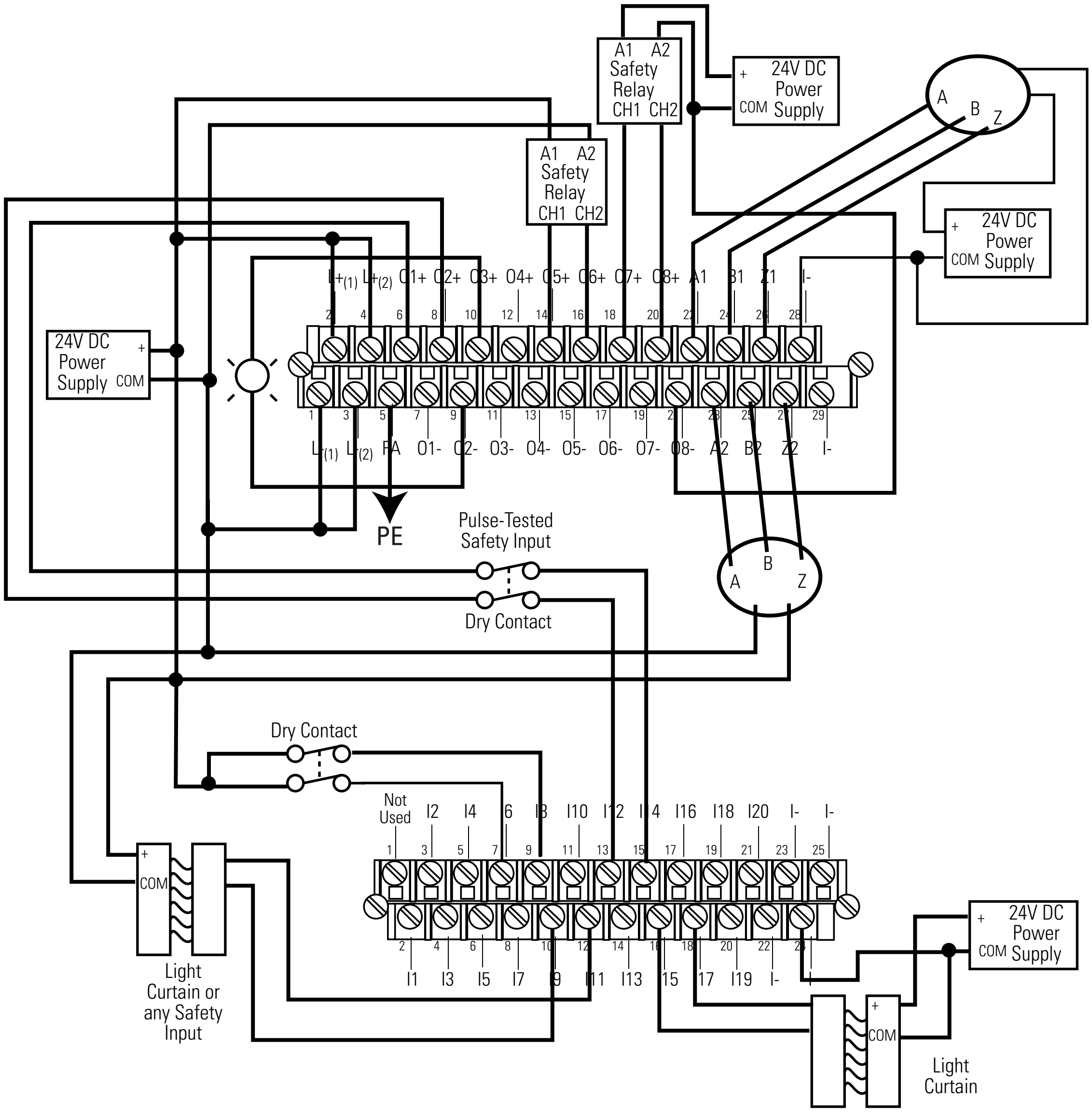
1753-OW8 Modules



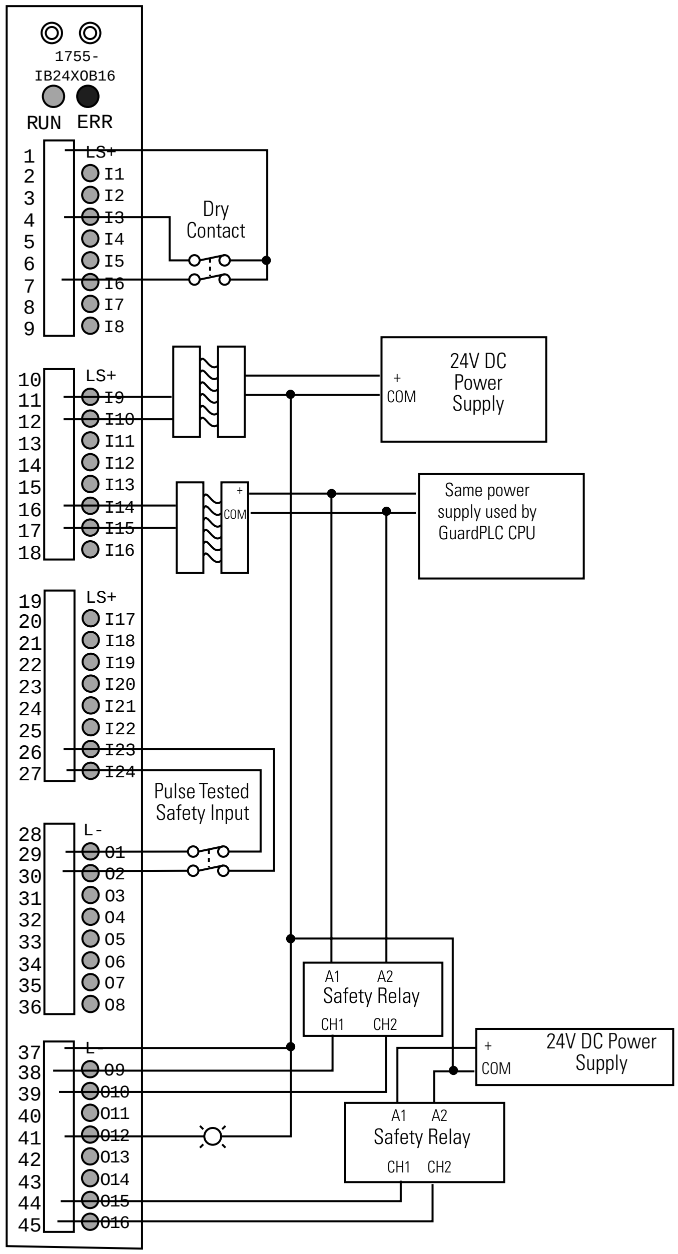
1753-IF8XOF4 Modules



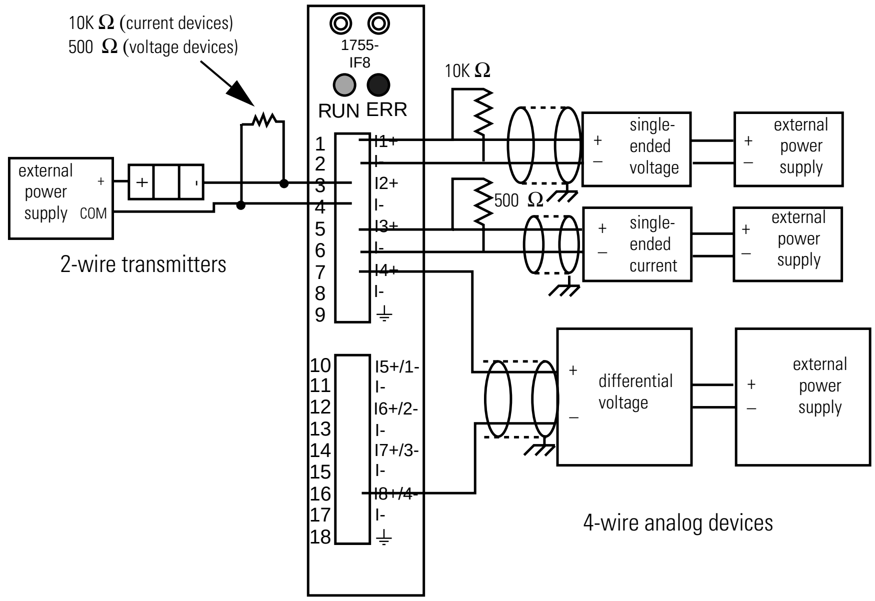
GuardPLC 1200 Controller



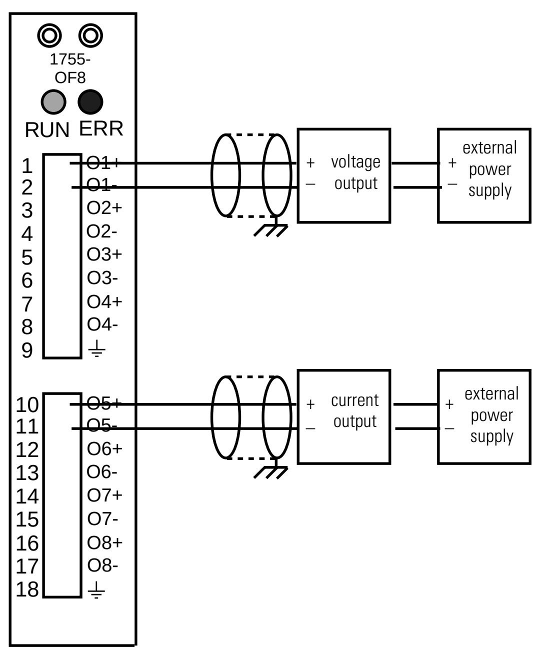
1755-IB24XO16 Digital Input/Output Modules



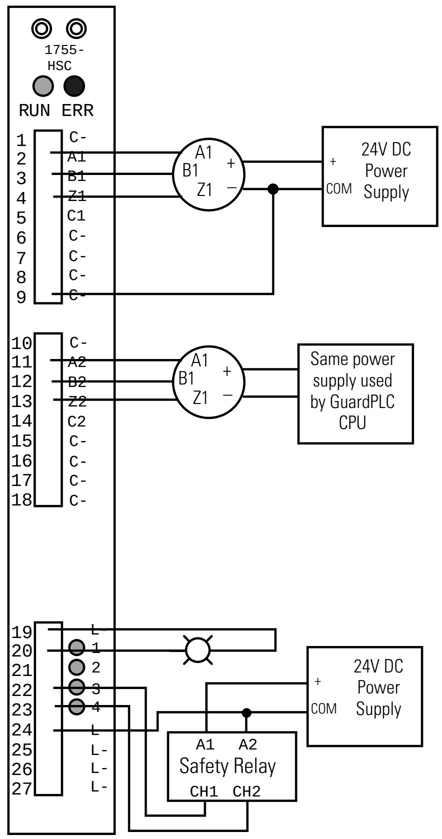
1755-IF8 Analog Input Modules



1755-OF8 Analog Output Modules



1755-HSC High Speed Counter Module



Replacing the Back-up Battery

The following procedures apply only to GuardPLC 1200 controllers and GuardPLC 2000 power supplies. Other GuardPLC controllers and I/O modules are not equipped with back-up batteries.

ATTENTION ⚠	A risk of fire or chemical burn exists if the battery is not handled properly. Do not crush, puncture, disassemble, or short external contacts, or expose the battery to temperatures higher than 60 °C (140 °F). For safety information on the handling and disposal of lithium batteries, refer to Guidelines for Handling Lithium Batteries, publication AG-5.4.

Preventing Electrostatic Discharge

Only qualified personnel with knowledge of ESD protective measures may replace the back-up battery.

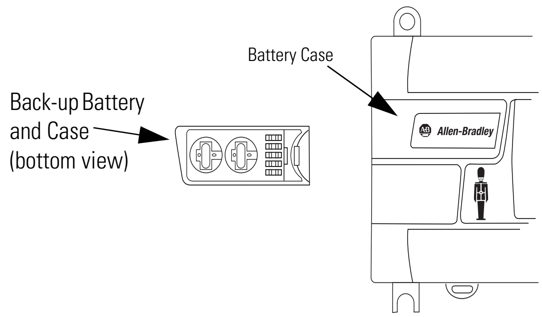
ATTENTION ⚠	Electrostatic discharge can damage integrated circuits or semiconductors. Follow these guidelines when you handle the module: • Touch a grounded object to discharge static potential. • Wear an approved wrist-strap grounding device. • Do not touch connectors or pins on component boards. • Do not touch circuit components inside the equipment. • Use a static-safe workstation, if available. • Store equipment in appropriate static-safe packaging when not in use.

GuardPLC 1200 Controllers

Replace the back-up battery on your GuardPLC 1200 controller every two years. The battery case is located on the left-hand side of the cabinet (see drawing below). The battery must be replaced together with the case.

Replacements are available from Rockwell Automation under part number 1754-BAT.

Follow these steps to replace the battery.



ATTENTION Make sure that the GuardPLC 1200 controller is powered on. Replacing the back-up battery while the controller is de-energized causes a reset. All data including the clock settings will be lost.

1. Press the left side of the battery case toward the controller and pull the left side of the battery case toward you to remove the battery case.

2. Insert a new battery case making sure that the case is correctly aligned and the pins inside the GuardPLC 1200 controller are not bent.

3. Press on the left edge of the case so that the pins seat in the connector, then press on both sides of the case until the battery snaps into place.

GuardPLC 2000 Power Supply

Replace the back-up battery every four years. Replacement batteries are available from Rockwell Automation (1755-BAT).

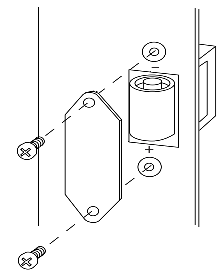
Follow these steps to replace the battery.

ATTENTION	Make sure that the GuardPLC 2000 controller is powered on. Replacing the back-up battery while the controller is off causes a reset. All data including the clock settings will be lost.

1. Remove the lid by removing the two screws.

2. Use a flat-head screwdriver to remove the battery from its compartment.

3. Insert a new battery, following the polarity shown on the compartment.



IMPORTANT	Make sure that the contact pins inside the battery compartment are not damaged.

Battery Disposal

Dispose of the used battery in accordance with local regulations.

ATTENTION	Do not incinerate or dispose of lithium batteries in general trash collection. They may explode or rupture violently. Follow all local regulations for disposal of these materials. You are legally responsible for hazards created during disposal of your battery.

GuardPLC 1200 controllers and GuardPLC 2000 power supplies contain a sealed lithium battery which may need to be replaced during the life of the product.

At the end of its life, the battery contained in this product should be collected separately from any unsorted municipal waste.

The collection and recycling of batteries helps protect the environment and contributes to the conservation of natural resources as valuable materials are recovered.

Notes:

Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support/, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/support/.

Installation Assistance

If you experience an anomoly within the first 24 hours of installation, review the information that's contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/support/americas/phone_en.html, or contact your local Rockwell Automation representative.

New Product Satisfaction Return

Rockwell Automation tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication RA-DU002, available at http://www.rockwellautomation.com/literature/.

www.rockwellautomation.com

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GuardPLC Controller Systems

User Manual