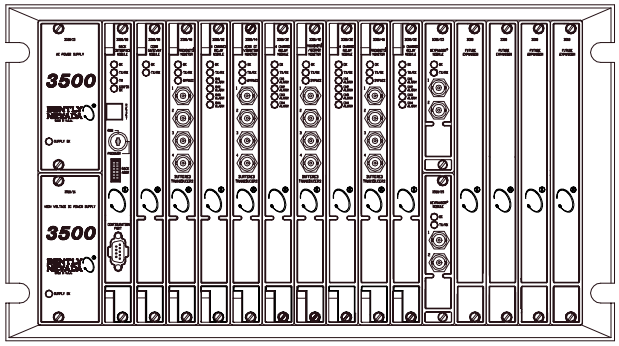
Part number 138629-01
Revision F, May 2001

3500/92 COMMUNICATION MODULE

OPERATION AND MAINTENANCE MANUAL

BENTLY NEVADA®
MADE IN U.S.A.



Bently Nevada Corporation
1631 Bently Parkway South
Minden, Nevada 89423 USA
Telephone (800) 227-5514 or (775) 782-3611
Fax (775) 782-9259

Additional Information

Notice:

This manual does not contain all the information required to operate and maintain the 3500/92 COMMUNICATION MODULE. Refer to the Following manuals for other required information.

3500 Monitoring System Rack Installation and Maintenance Manual (129766-01)

- general description of a standard system
- general description of a Triple Modular redundant (TMR) system
- instructions for installing and removing the module from a 3500 rack
- drawings for all cables used in the 3500 Monitoring System

3500 Monitoring System Rack Configuration and Utilities Guide (129777-01)

- guidelines for using the 3500 Rack Configuration software for setting the operating parameters of the module
- Guidelines for using the 3500 test utilities to verify that the input and output terminals on the module are operating properly

3500 Monitoring system Computer Hardware and Software Manual (128158-01)

- instructions for connecting the rack to 3500 host computer
- procedures for verifying communication
- procedures for installing software
- guidelines for using Data Acquisition / DDE Server and Operator Display Software
- procedures and diagrams for setting up network and remote communications

3500 Field Wiring Diagram Package (130432-01)

- diagrams that show how to hook up a particular transducer
- lists of recommended wiring

Contents

1. Receiving and Handling Instructions

1.1 Receiving Inspection

Visually inspect the module for obvious shipping damage. If shipping damage is apparent, file a claim with the carrier and submit a copy to Bently Nevada Corporation.

1.2 Handling and Storing Considerations

Circuit boards contain devices that are susceptible to damage when exposed to electrostatic charges. Damage caused by obvious mishandling of the board will void the warranty. To avoid damage, observe the following precautions in the order given.

Application Alert
Communication with the external device (DCS, PLC, remote display, etc) will be lost when this module is removed from the rack.

- Do not discharge static electricity onto the circuit board. Avoid tools or procedures that would subject the circuit board to static damage. Some possible causes include ungrounded soldering irons, nonconductive plastics, and similar materials.
- Personnel must be grounded with a suitable grounding strap (such as 3M Velostat No. 2060) before handling or maintaining a printed circuit board.
- Transport and store circuit boards in electrically conductive bags or foil.
- Use extra caution during dry weather. Relative humidity less than 30% tends to multiply the accumulation of static charges on any surface.
- When performed properly, this module may be installed into or removed from the rack while power is applied to the rack. Refer to the Rack Installation and Maintenance Manual (part number 129766-01) for the proper procedure.

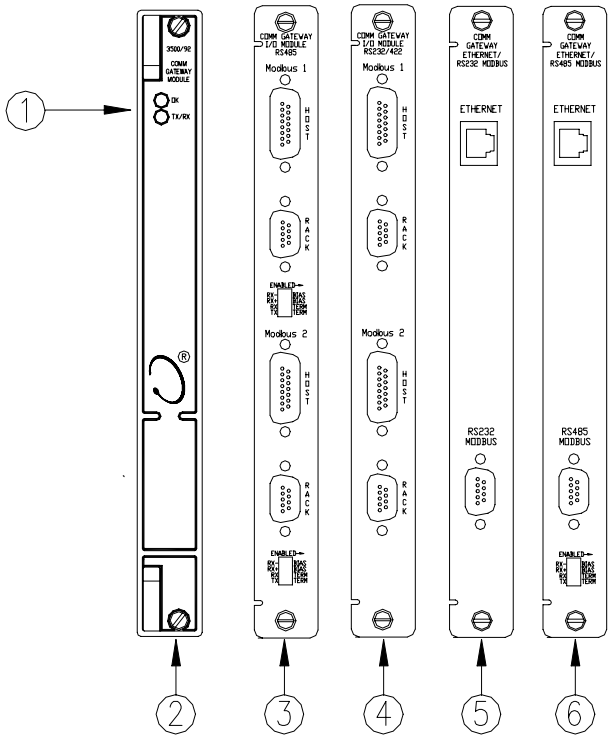
1.3 Disposal Statement

Customers and third parties that are in control of product at the end of its life or at the end of its use are solely responsible for proper disposal of product. No person, firm, corporation, association or agency that is in control of product shall dispose of it in a manner that is in violation of United States state laws, United States federal laws, or any applicable international law. Bently Nevada Corporation is not responsible for disposal of product at the end of its life or at the end of its use.

2. General Information

The Communication Gateway Module provides serial communications between the 3500 Monitor System and a plant information system such as a distributed control system (DCS) or a programmable logic controller (PLC). The Communication Gateway Module collects static data from the modules in the rack over a high-speed internal network and sends this data to the information system upon request.

The Communication Gateway is able to communicate via Ethernet with up to six hosts. Hosts can be Modbus protocol based or computers with 3500 Rack Configuration and Data Acquisition software. Only one Comm Gateway module per 3500 rack can be configured to accept Rack Configuration or Data Acquisition hosts.



Front View **Rear View**

1) Status LEDs, refer to Section 2.5
2) Comm Gateway Module
3) RS485 I/O Module
4) RS232/422 I/O Module
5) Ethernet/RS232 I/O Module
6) Ethernet/RS485 I/O Module

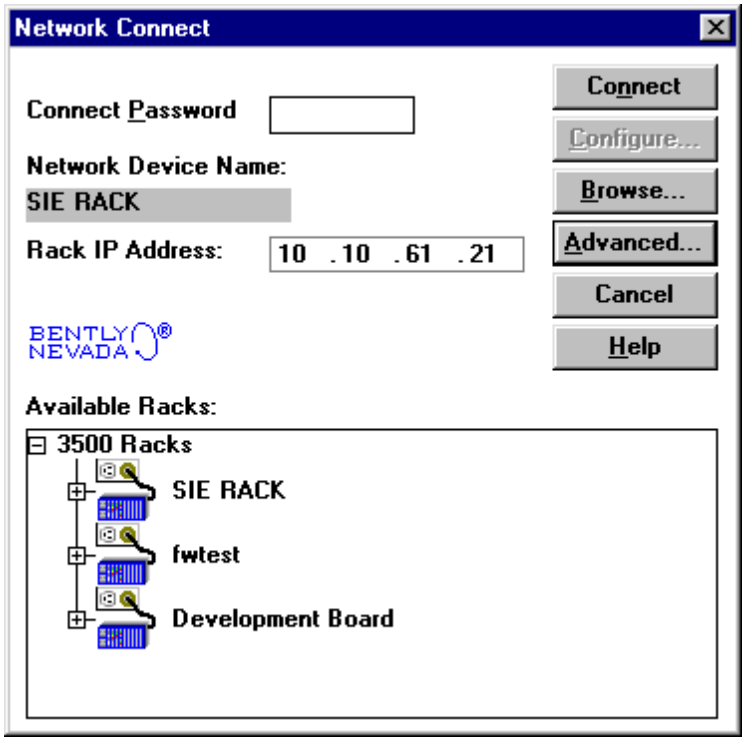
Refer to Section 4 for all I/O Module information.

The Communication Gateway Module can support a variety of protocols by using a different I/O module for each protocol. The module also lets you optimize the communications with external devices using the 3500 Rack Configuration Software to assign the most important data to contiguous registers in the module.

The main part of this manual contains information about the LED states, the module and channel statuses, and detailed configuration information for the Communication Gateway Module. The appendices contain information about using the different protocols to retrieve data from the rack.

2.1 Communications from 3500/92 to 3500 Configuration Software

You can configure an entire 3500 rack through the Ethernet link on the 3500/92. This link provides broader access than the serial port on the RIM. Establish this link by selecting “connect” in the file pull down menu and then the “network” option.



Connect Password

Connect Password is the same password used for direct communications via the RIM. This Password is set in the RIM configuration.

Connect

This button selects the device listed in the “Network Device Name” field. Upon entering this screen, the previous device will be named. Simply click on connect

and connection to this device will be established. If this is not the device desired, select browse, highlight the desired device, and click on connect; or, select browse and double click on the desired device.

Browse

This button searches for 3500 racks on the local network (within the same subnet).

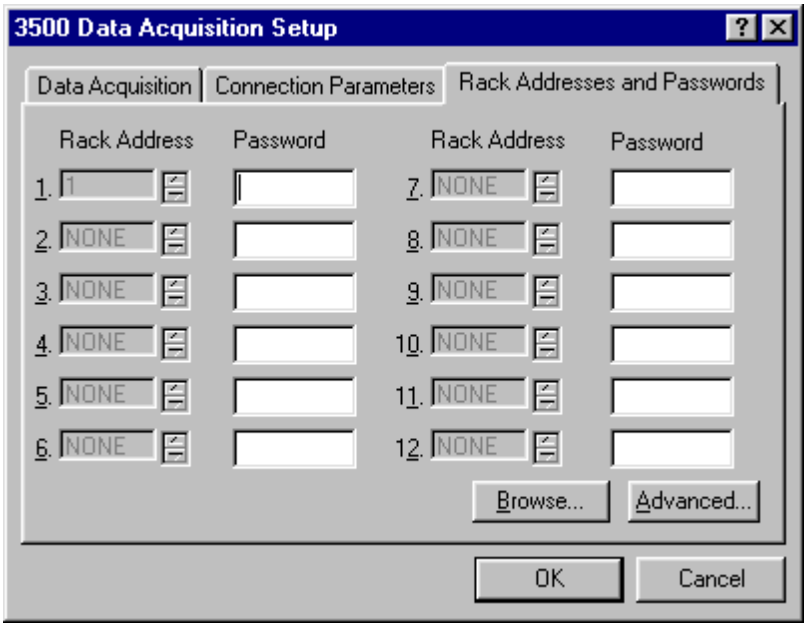
Advanced

Settings that will assist in establishing network communications. Set these parameters with the help of a network administrator.

2.2 Communications from 3500/92 to 3500 Data Acquisition Software

To establish a link between a 3500/92 and 3500 Data Acquisition software:

1) Select Setup in the Data Acquistion Software. The following screen will appear.



2) In the Connection Parameters tab, select the network connection type.

3) In the Rack Addresses and Passwords tab, select the appropriate rack address.

If no rack address appears in the Rack Addresses and Passwords, you can Browse the network and assign a networked rack to a rack address. If Browse doesn't work than use the Advanced button and contact a network administrator for assistance.

2.3 Triple Modular Redundant (TMR) Description

The Communication Gateway is considered a "Consumer" of data because it receives data from other modules, formats it, and sends it on to an external device. Since the module does not produce data or provide data to other modules in the 3500 rack, redundant Communication Gateway Modules with voting options are not required. For applications that require redundant communication links, two or more Communication Gateway Modules can operate in parallel in the same rack, provided that only one module is configured to allow the "Bently Centurion Protocol" (see section 3.2). This configuration can be used in both standard and TMR rack types.

2.4 Module and Channel Statuses

The Communication Gateway Module returns both module and channel statuses. This section describes the available statuses and where they can be found.

Module Status
OK
Indicates if the Communication Gateway is functioning correctly. A not OK status is returned under any of the following conditions:

- Hardware Failure in the module
- Node Voltage Failure
- Configuration Failure
- Slot ID Failure

If the Module OK status goes not OK, the system OK Relay on the Rack Interface I/O Module will be driven not OK.

Configuration Fault
Indicates if the Communication Gateway Module configuration is invalid.

Bypass
Indicates whether the Communication Gateway Monitor is communicating. An active module bypass may be caused by the following events:
The Communication Gateway Module has detected a serious internal fault.
The Bypass switch has been set for a channel in the Communication Gateway Module.

Channel Status
OK
Indicates if the associated Communication Gateway Module communication port has detected some internal fault. If the Communication Gateway Module goes not OK, then all the channels are not OK.

Bypass
Indicates if the associated Communication Gateway Module communication port has been bypassed. Channel Bypass can result from an internal fault or switch setting and causes the Communication Gateway port to stop communicating.

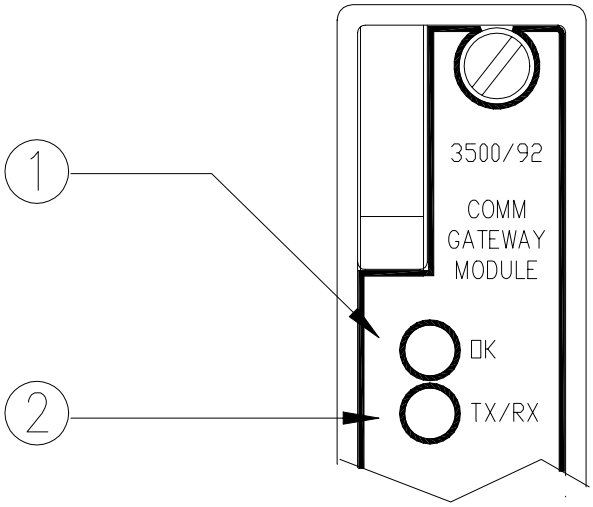
Off
Indicates that the associated Communication Gateway Module communication port has been turned off. The Communication Gateway Module communication ports may be turned off (inactivated) in the Rack Configuration Software.

The following table shows where the statuses can be found.

Statuses	Communication Gateway Module	Rack Configuration Software	Operator Display Software
Module OK	X	X	
Module Bypass		X	
Module Configuration Fault		X	
Channel OK	X	X	
Channel Bypass	X	X	
Channel Off	X	X	

2.5 LED Descriptions

The LEDs on the front panel of the Communication Gateway Module indicate the operating status of the module as shown in the following figure. Refer to Section 7.2 for all the available LED conditions.



1) OK

Indicates that the Communication Gateway Module and the I/O module are operating correctly

2) TX/RX

Flashes at the rate that messages are received from other 3500 modules.

3. Configuration Information

Configure a Communication Gateway Module by using the 3500 Rack Configuration Software to complete the following tasks:

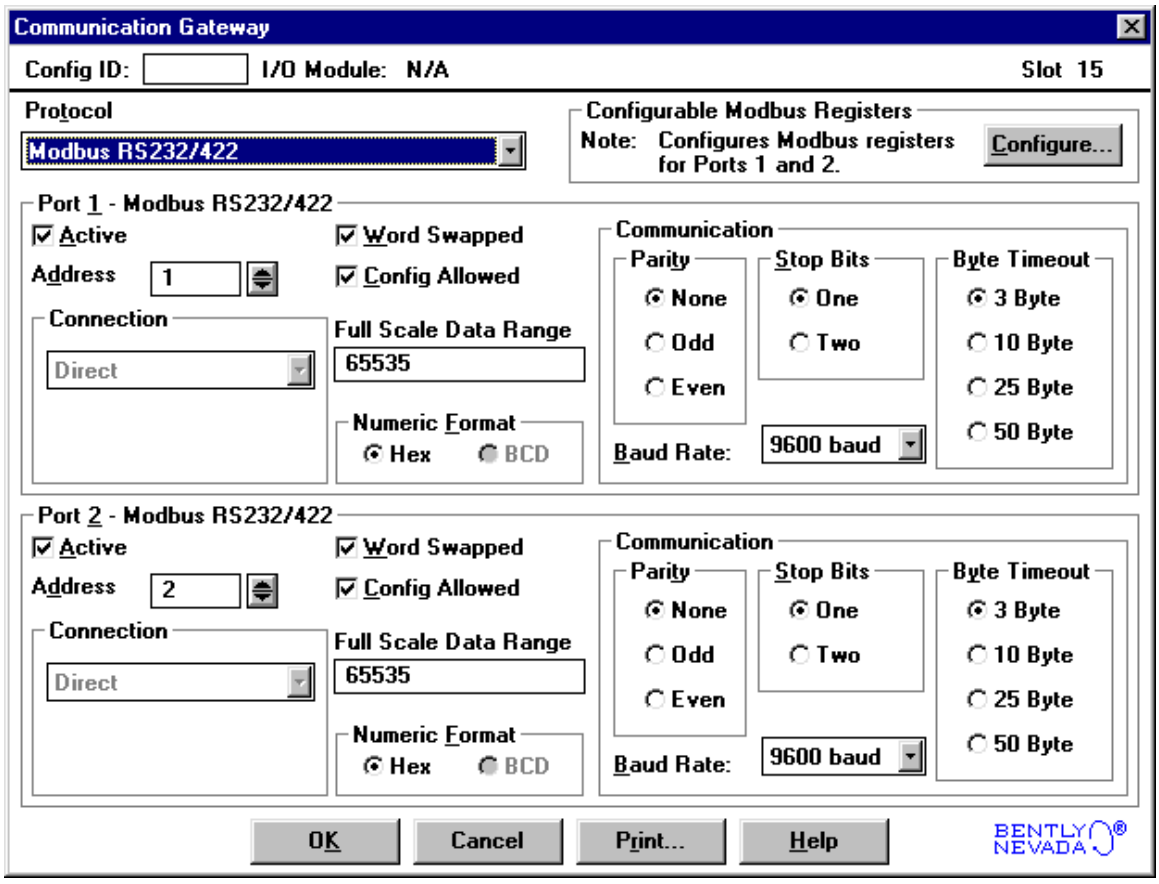
- Set the communication parameters for the ports on the Communication Gateway I/O Module.
- Assign data from rack modules to reserved addresses (Configurable Modbus Registers) in the Communication Gateway Module.
- Set software switches.

3.1 Hardware Considerations

The slots in the rack are numbered from 0 to 15, counting from left to right. The power supplies go into slot 0 and the Rack Interface module goes into slot 1. Slots 2 through 15 are called “monitoring positions”. The 3500/92 module can be installed into any of the monitoring positions. However, if the 3500/20 Rack Interface Module and Data Manager I/O are to be used to interface to DDIX, TDIX, or TDXnet, refer to the manual on the 3500/20 for slot restrictions this may place on your configuration.

3.2 Setting Communication Parameters

The Modbus Protocol Setup screen lets you set the communication parameters for the HOST and RACK connectors on the Communication Gateway I/O Module.



Reference Information

These fields contain information that indicates which module you are configuring.

Slot

The location of the Communication Gateway Module in the 3500 rack.

Protocol
Selects which I/O card is being used. The I/O cards are ordered as an option to the 3500/92.

Option	Protocol	
	Port 1	Port2
-01	Modbus RS-232/422	Modbus RS-232/422
-02	Modbus RS-485	Modbus RS-485
-03	Ethernet TCP/IP	Modbus RS-232
-04	Ethernet TCP/IP	Modbus RS-485

The Ethernet TCP/IP option allows for both Modbus and Bently Nevada 3500 software protocol. These protocols can run simultaneously on the same port.

Configurable Modbus Registers
This links into the dialog box that configures the programmable modbus registers. Configurable Modbus Registers are programmed for both ports together.

Active
Turns the Communication Port on (☒) or off (☐). The port must be on to respond to commands sent by the DCS.

Address
The address used by the Communication Protocol to talk to the Communication Port. If the Communication Gateway Ports are daisy chained, all the ports in the chain must have a unique address. The range of addresses is 1 to 255.

Connection
Direct is the only option available for the Modbus protocol.

Word Swapped
Switches the first sixteen bits of a 32-bit number with the last sixteen bits. This switching applies only to the Modbus data that requires two registers. This flexibility has been added to accommodate different number formats.

Config Allowed
Enables a Modbus user to change Monitor Setpoints, Rack Trip Multiply, Rack Alarm Inhibit, software switches, Rack Reset, and Rack Date and Time.

Communication

Parity
Used for error checking.

None
No parity error checking is used.

Odd
Each word has an odd number of 1 bits.

Even
Each word has an even number of 1 bits.

Baud Rate
Rate of communication between the Communication Gateway Module and the DCS. The available values are:
1200, 2400, 4800, 9600, 19.2, and 38.4 kbaud

Stop Bits
Signifies the end of the character. One or two bits can be used.

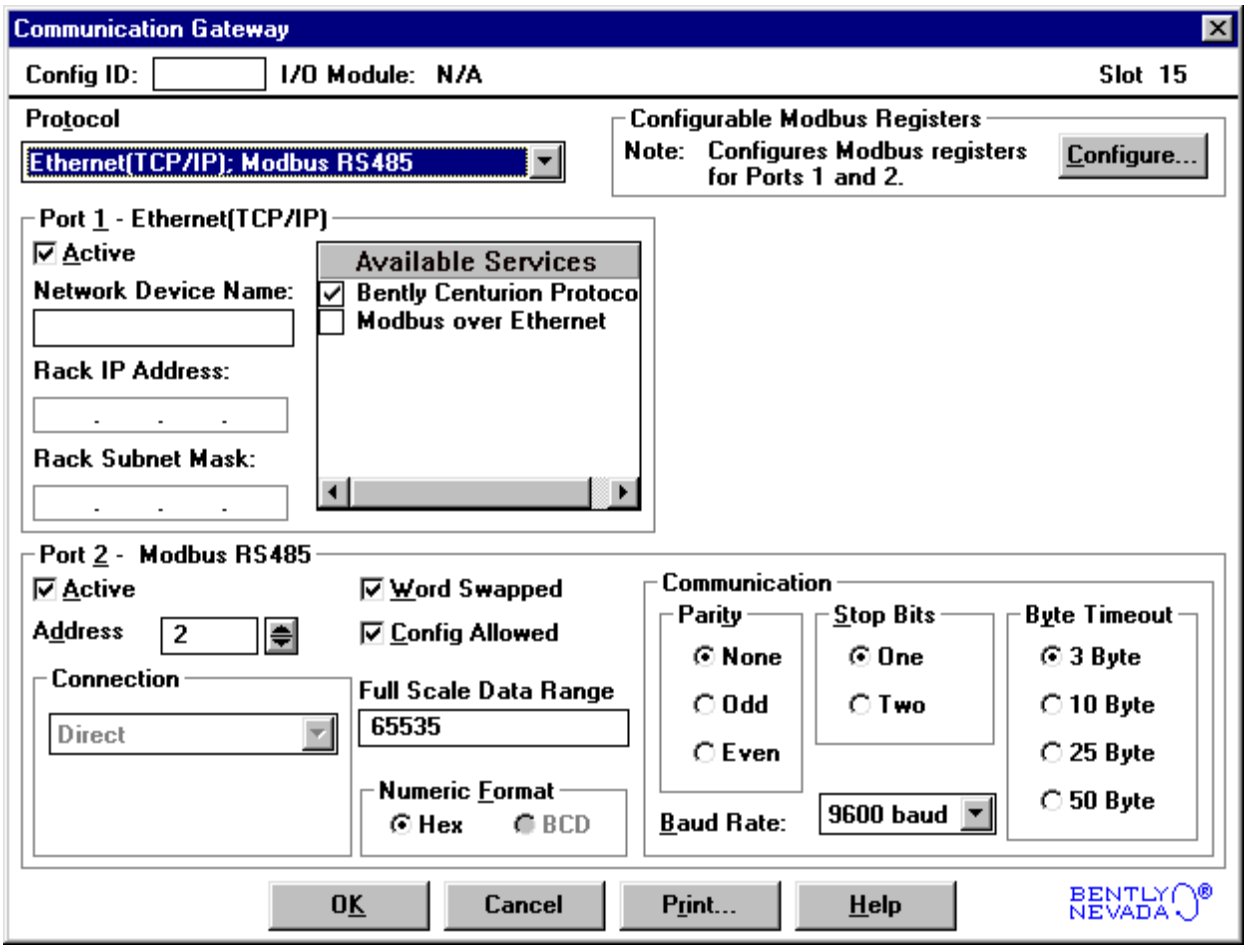
Byte Timeout
The number of byte periods, which the communication line must be idle before a communication, is considered complete. One byte period is a function of the baud rate selected. The available values are 3, 10, 25, or 50 bytes.

Full Scale Data Range
A value between 1 and 65535 that is the maximum value in the full-scale range. The Current Proportional Values and the Primary Values will be scaled between 0 and the selected value.

For example: If the Full Scale Data Range field is set to 4096, then the Current Proportional Values and the Primary Values will be scaled between 0 and 4096.

Numeric Format

Hex
Base 16 numbering system used by the Modbus protocol to receive and transmit values.



Network Device Name
Name assigned to the 3500/92. This name is often used to uniquely identify a 3500 rack on a network.

Rack IP Address
IP (Internet Protocol) Address is the unique address for an Ethernet network device. The address is a string of 4 numbers each from 0 to 255. For networks managed through an Information Systems department, consult the network administrator for a valid IP address. Note that addresses 0.0.0.0 and 255.255.255.255 are not valid.

Rack Subnet Mask
The Subnet Mask identifies which bits of the IP address are address bits for the physical network. Typically, the Subnet Mask is the same for the LAN (local area network); however, consult the network administrator for valid settings.

Available Services
Different communication protocols available with the 3500/92. Ethernet networks allow multiple protocols running at the same time.

Bently Centurion Protocol
Protocol used to communicate between the 3500/92 and a computer running 3500 Configuration and 3500 Data Acquisition software. If multiple 3500/92s

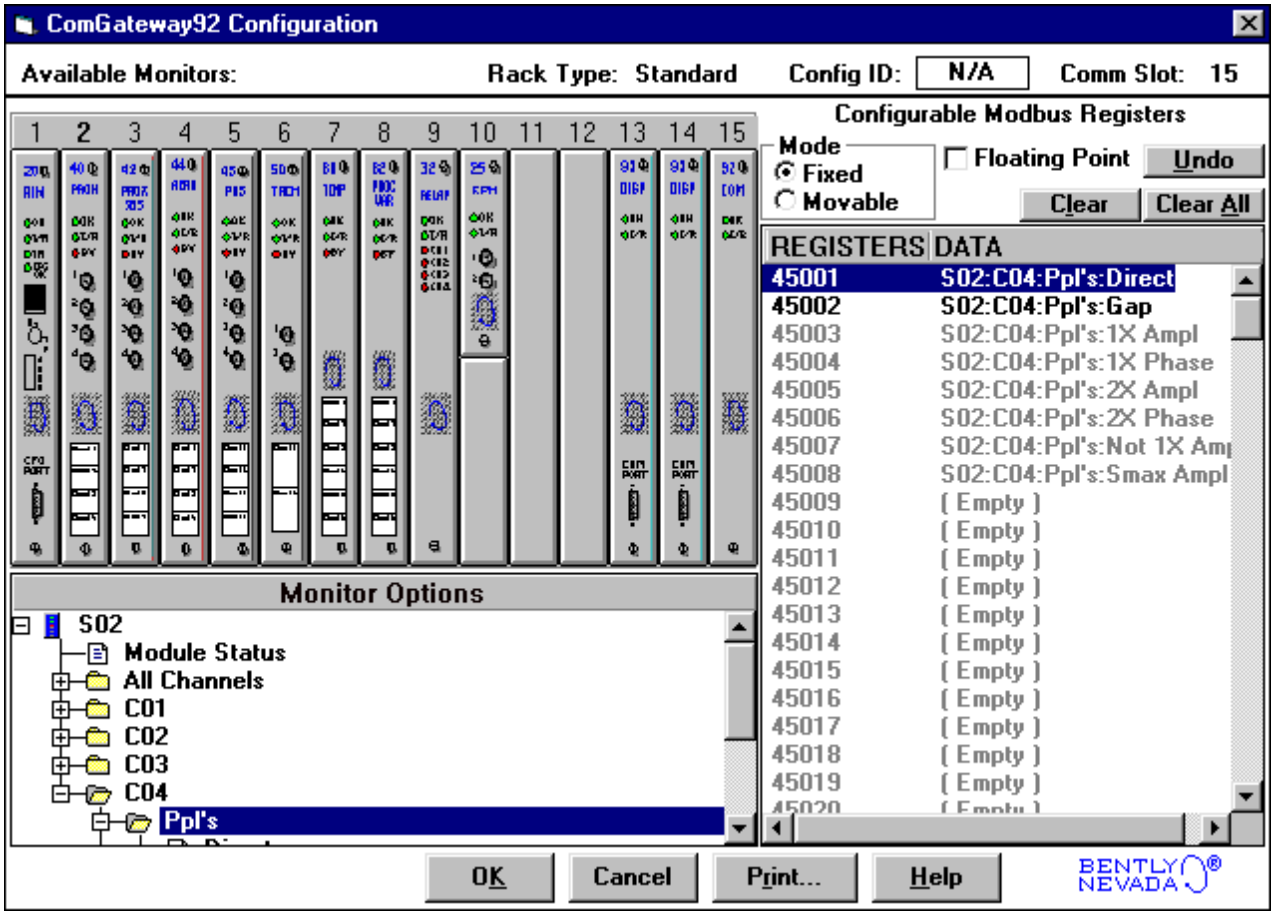
are present in a 3500 rack, only one may have Bently Centurion Protocol enabled.

Modbus over Ethernet
Modbus Application Protocol communicates on Ethernet networks between 3500/92 and PLC's, DCS's, and MMI's also running TCP/IP.

3.3 Configurable Modbus Registers

Configurable Modbus Registers is a reserved area of the modbus register map that consists of 500 registers starting at address 45000. These registers let you assign important proportional values, statuses, and setpoints to consecutive registers so that the communication with the 3500 rack is more efficient and the need for supporting hardware is reduced.

Use the ComGateway92 Configuration screen to assign values to these registers.



Assign values to registers by either double-clicking or by dragging and dropping. As you assign values to registers, keep the following guidelines in mind:

To assign all values from a monitor to a set of consecutive registers, double-click on the monitor or drag and drop the monitor to the appropriate starting register in the REGISTERS | DATA box.

To assign specific values to a register, use the tree in the Monitor Options box. Dragging and dropping a folder assigns all the data underneath the folder. To maximize flexibility, folders have been arranged by specific register types, channels, and a combination of both.

To control how data is assigned to registers, use Fixed or Moveable in the Mode box. Fixed places the register or block of registers in the selected address and overwrites any existing data in registers below the selected address. Moveable places the register or block of registers in the selected address and moves any existing registers down. Registers over the end of the 500 block will be lost.

Mode

Fixed

Places the register or block of registers from address selected and below, and will overwrite existing registers.

Moveable

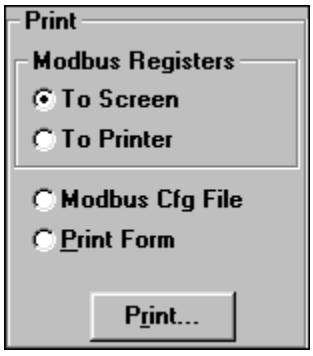
Places the register or block of registers from the address selected and will move the existing registers down. Registers over the end of the 500 block will be lost.

Floating Point

Selects the data type that is being displayed either scaled integer or floating point. Both data types are always available but at different addresses within the memory map. The memory map for integer registers ranges from 45000 to 45499, and the floating point registers range from 46000 to 46999. Floating point numbers can be read directly without any scaling conversions; however, they are represented in two registers and take up twice the memory space.

Print

Four functions are available with the printing features of the 3500/92 configuration screens. These functions are selected through the pop up menu activated by moving the mouse cursor over the print button. The print button within the pop up menu will then execute the selected option.



Modbus Registers

To Screen

This prints the Modbus Register Map to WordPad for editing or document formatting purposes. Saving this to a file after editing is completed within WordPad.

To Printer

Simply prints the Modbus Register Map to a printer.

Modbus Cfg file

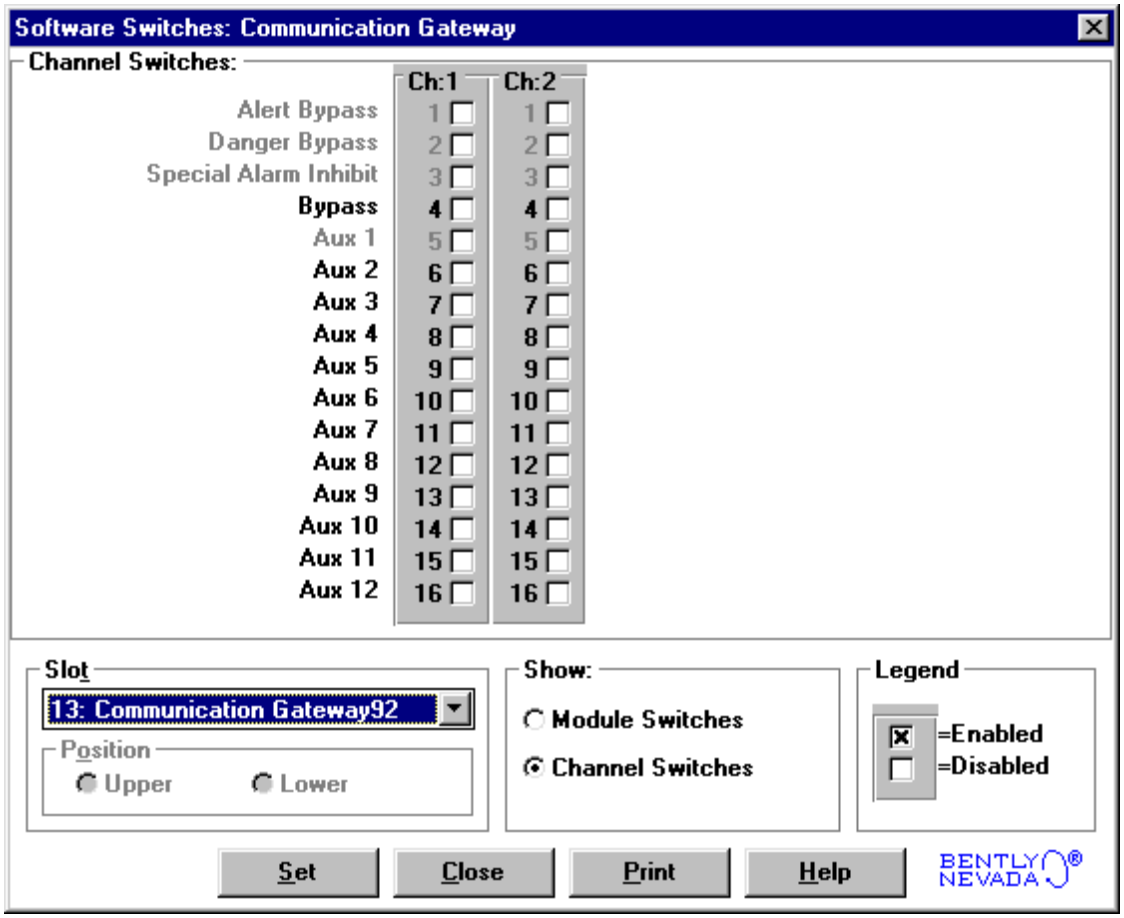
This feature activates a Save dialog box which will save rack configuration data to a file. This aids in the configuration of PLC's, DCS's, and/or MMI's.

Print Form

Prints the active configuration screen to a printer.

3.4 Setting Software Switches

The Communication Gateway Module supports two software switches that let you temporarily bypass the module and channel functions. Set these switches on the **Software Switches** screen under the **Utilities** Option on the main screen of the Rack Configuration Software.



No changes will take effect until the **Set** button is pressed.

Module Switches

Configuration Mode

A switch that allows the Communication Gateway Module to be configured. To configure the module, enable (☒) this switch and set the key switch on the front of the Rack Interface Module in the PROGRAM position. When downloading a configuration from the Rack Configuration Software, this switch will automatically be enabled and disabled by the Rack Configuration Software. If the connection to the rack is lost during the configuration process, use this switch to remove the module from Configuration Mode.

The module switch number is used in the Communication Gateway Module.

Module Switch Number	Switch Name
1	Configuration Mode

Channel Switches

Bypass
Turn the associated Communication Port on the Communication Gateway I/O Module (Modbus) on (☒) or off (☐).

The channel switch number is used in the Communication Gateway Module.

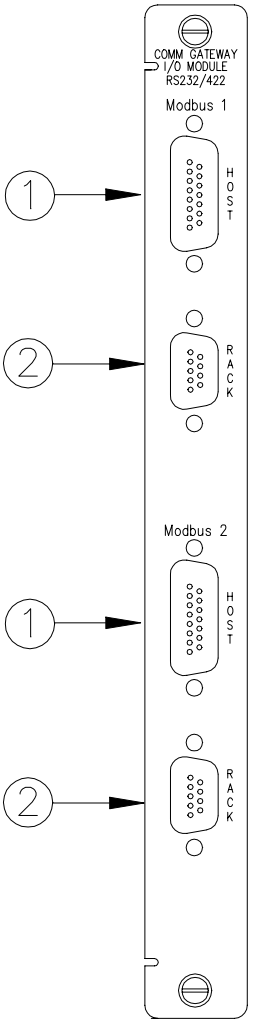
Channel Switch Number	Switch Name
4	Bypass

4. I/O Module Description

This section describes the Communication Gateway Modbus RS-232/422, Modbus RS-485, Ethernet RS-232, and Ethernet RS-485 I/O Modules. It also contains the information needed to use the Communication Gateway I/O Modules and a distributed control system (DCS), display, or host computer to communicate with a 3500 rack using the Modicon Modbus protocol.

4.1 Modbus RS-232/422 I/O Module Description

The Communication Gateway Modbus RS-232/422 I/O Module is used with a DCS, display, or host computer to collect data from a 3500 rack and change setpoints or switches using the Modicon Modbus protocol. The Communication Gateway I/O Module must be installed behind the Communication Gateway Module (in a Rack Mount or a Panel Mount rack) or above the Communication Gateway Module (in a Bulkhead rack).



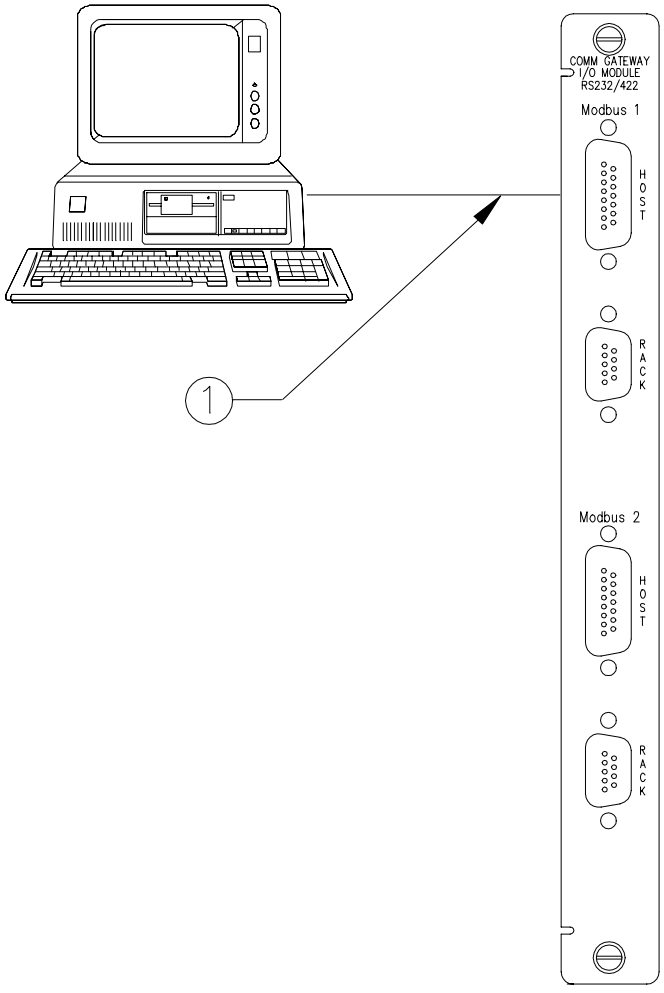
1) These connectors are used to connect Ports 1 and 2 of the Communication Gateway Modbus RS-232/422 I/O Module to the host (DCS, display, or host computer). This connection can be RS-232 or RS-422. Refer to Sections 4.1.2, 4.1.3, 4.1.4.
2) These connectors are used to connect this Communication Gateway Modbus RS-232/422 I/O Module to the next Communication Gateway Modbus RS-232/422 I/O Module in the chain. Only RS-422 can be used for this connection. Refer to Section 4.1.5.

4.1.1 General Response Time

The Communication Gateway Modbus RS-232/422 I/O Module has a general response time of less than 0.5 seconds with a 3 byte time out.

4.1.2 Connecting a Modbus RS-232/422 I/O Module Port to the Host (Display or Host Computer) via RS-232

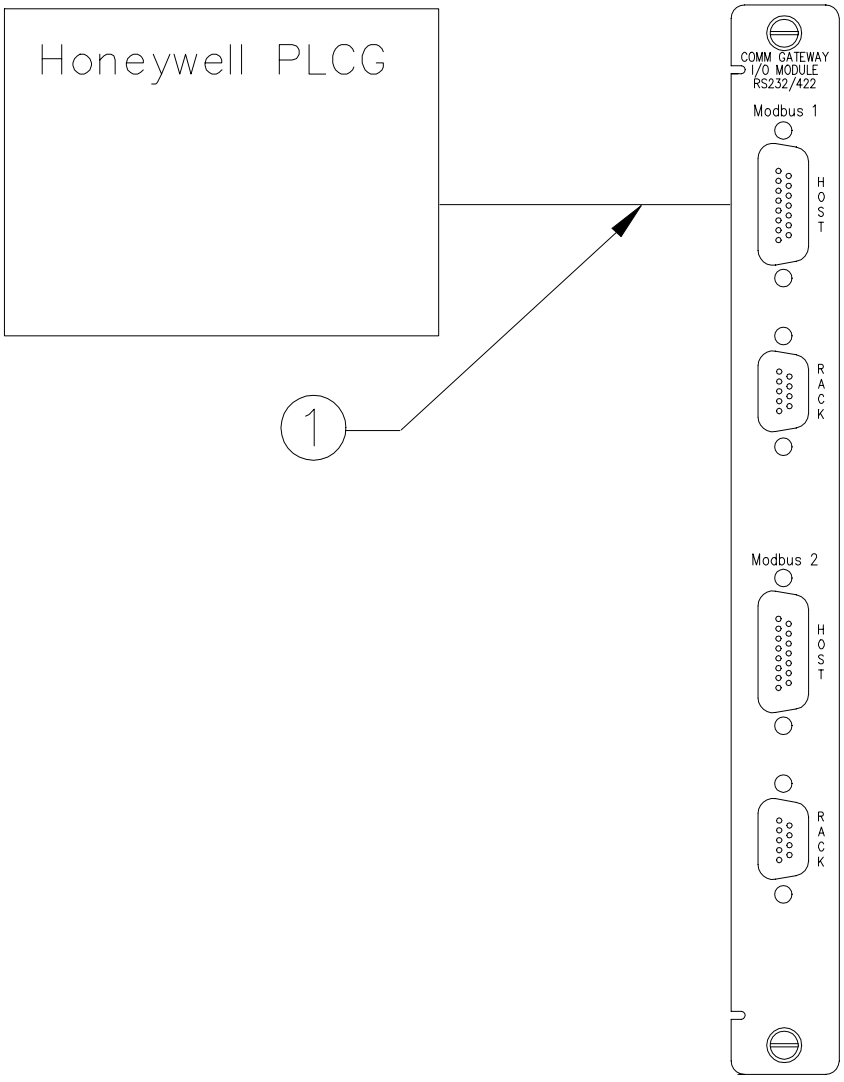
The communication rate is limited by the baud rate selected between the host (display or host computer) and the first Communication Gateway Modbus RS-232/422 I/O Module port.



1) Cable 130419-XXXX-XX is available in various lengths up to 30 meters (100 ft). Refer to Section 8 for the specific options.

4.1.3 Connecting a Modbus RS-232/422 I/O Module Port to the Honeywell PLCG via RS-232

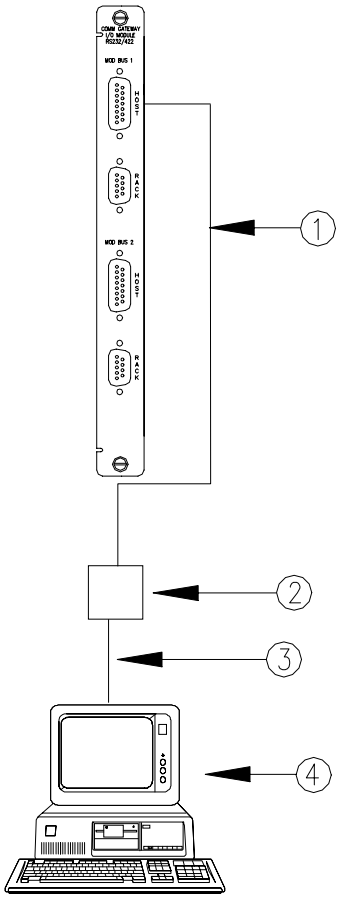
The communication rate is limited by the baud rate selected between the Honeywell PLCG and the first Communication Gateway Modbus RS-232/422 I/O Module port.



1) Cable 130420-XXX-XX is available in various lengths up to 30 meters (100 ft). Refer to Section 8 for the specific options.

4.1.4 Connecting a Modbus RS-232/422 I/O Module Port to a Host (Display or Host Computer) via RS-422

The baud rate selected between the host (display or host computer) and the first Communication Gateway I/O Module (Modbus) port limit the communication rate.



1) For lengths of 150 meters (500 ft) or less, use cable 130530-XXXX-XX (PVC insulation) or cable 131109-XXXX-XX (Teflon insulation).

For lengths greater than 150 meters (500 ft), use one cable 130530-XXXX-XX (PVC insulation) or cable 131109-XXXX-XX (Teflon insulation) along with as many RS-422 extension cables 130531-XX-XX (150 meters (500 ft) standard length) to create a cable up to the maximum 1220 meters (4000 ft).

2) RS-232/422 Converter.

For 110 VAC use part number 02230411. For 220 VAC use part number 02230412. A converter is not necessary if the host computer is equipped with an RS422 port.

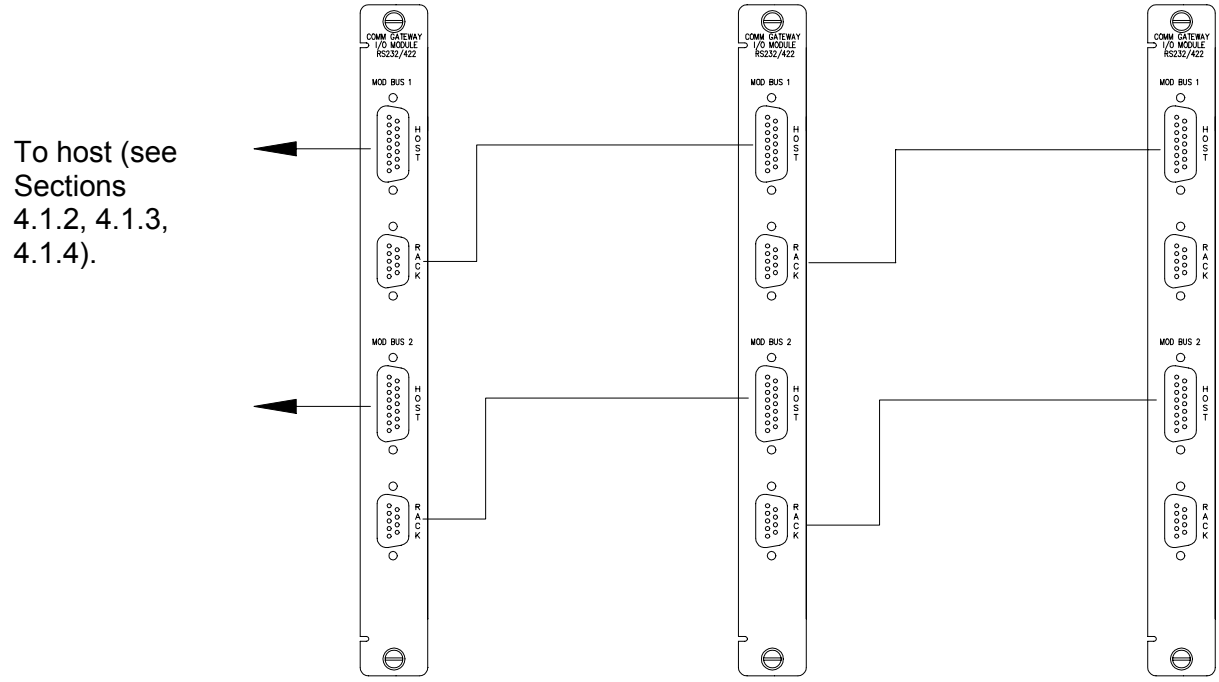
3) Cable 130119-01 is available in a 3 meter (10 ft) length.

4) Display or host computer

Refer to Section 8 for the specific options of the cables listed above.

4.1.5 Daisy Chaining Modbus RS-232/422 I/O Module Ports via RS-422

This section shows how to daisy chain Communication Gateway Modbus RS-232/422 I/O Module ports together.



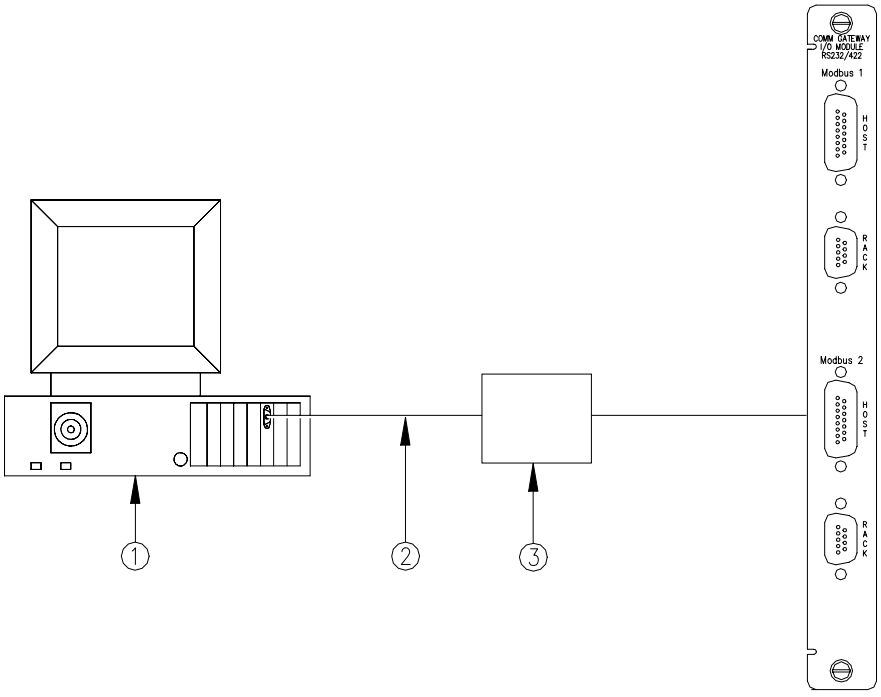
Take note of the following items when daisy chaining Communication Gateway Modbus RS-232/422 I/O Module ports:

- Use the HOST port to connect to the DCS, display or host computer, or the rack in the daisy chain that is closer to the host.
- Use the RACK port to connect to the rack that is farther from the host.
- Use the following cables for the connection between the racks in the daisy chain:
  - For lengths of 150 metres (500 ft) or less, use cable 129665-XXXX-XX (PVC Insulation) or cable 131108-XXXX-XX (Teflon Insulation).
  - For lengths greater than 150 metres (500 ft), use one cable 129665-XXXX-XX (PVC Insulation) or cable 131108-XXXX-XX (Teflon Insulation) along with as many RS-422 extension cables 130531-XX-XX (150 metres (500 ft) standard length) to create a cable up to 1220 metres (4000 ft).

Refer to Section 8 for the specific options of the cables listed above.

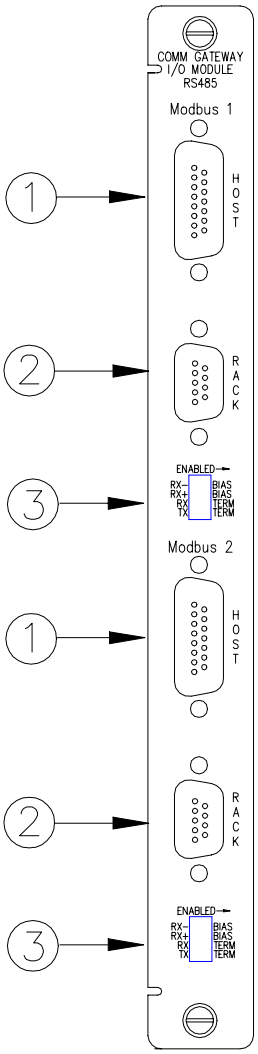
4.1.6 Additional Information for Connecting an RS-232 I/O Module to a Host Computer in an Intrinsically Safe Application

To avoid ground loops, the system must provide a single point ground. In Intrinsically Safe applications the 3500 Rack is floated and referenced to an intrinsically safe ground instead of earth ground. RS-232 communications are referenced to earth ground, and therefore to keep the rack isolated from earth ground, a serial data isolator must be used. RS-485 uses an isolated ground and hence no additional isolation is required.



1) Host Computer
2) Cable 130118-XXXX-XX is available in various lengths up to 30 meters (100 ft).
3) Serial Data Isolator P/N 02200633

4.2 Modbus RS-485 I/O Module Description



The Communication Gateway Modbus RS-485 I/O Module is used with a DCS, display, or host computer to collect data from a 3500 rack and change setpoints or switches using the Modicon Modbus protocol. The Communication Gateway I/O Module must be installed behind the Communication Gateway Module (in a Rack Mount or a Panel Mount rack) or above the Communication Gateway Module (in a Bulkhead rack). The RS-485 interface allows up to 32 devices multi-dropped on up to 4000 feet of cable.

1) These connectors are used to connect Ports 1 and 2 of the Communication Gateway Modbus RS-485 I/O Module to the host (DCS, display, or host computer). Refer to Section 4.2.2.

2) These connectors are used to connect Communication Gateway Modbus RS-485 I/O Modules together. Refer to Section 4.2.2 and the drawing in Section 4.2.3.

3) These switches are used for RS-485 line termination. Refer to Section 4.2.4.

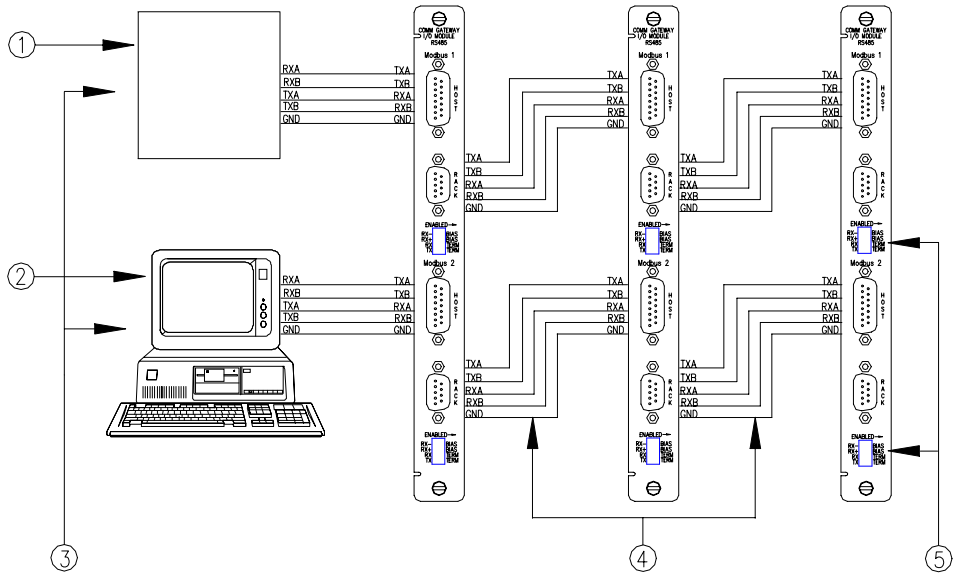
4.2.1 General Response Time

The Communication Gateway Modbus RS-485 I/O Module has a general response time of less than 0.5 seconds with a 3 byte time out.

4.2.2 Four-Wire Connections

When connecting the Modbus RS-485 I/O Module to a host device or to another I/O module, the connections are made per the diagram below. See the following table for connector designations.

Signal	Name	Host Connector (15 Pin) Pin #	Rack Connector (9 pin) Pin #
GND	Ground	8	5
TXB	Transmit Positive	7	3
TXA	Transmit Negative	15	9
RXB	Receive Positive	13	4
RXA	Receive Negative	6	6



1) Distributed Control System
2) Remote Display or Host Computer
3) Terminate these devices
4) For lengths of 150 metres (500 ft) or less, use cable 129665-XXXX-XX (PVC Insulation) or cable 131108-XXXX-XX (Teflon Insulation).

   For lengths greater than 150 metres (500 ft), use one cable 129665-XXXX-XX (PVC Insulation) or cable 131108-XXXX-XX (Teflon

Insulation) along with as many RS-422/RS-485 extension cables 130531-XX-XX (150 metres (500 ft) standard length) to create a total RS-485 cable run up to 1220 metres (4000 ft).

5) Terminate these devices

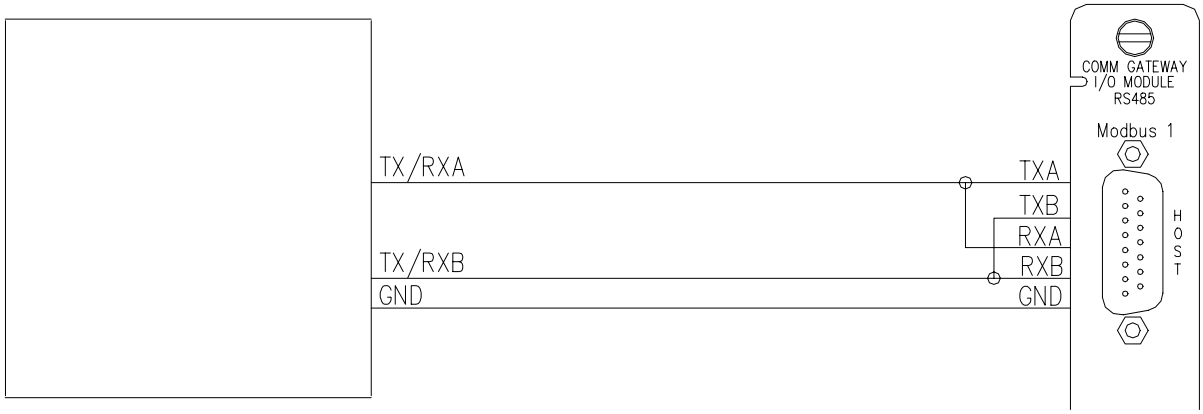
4.2.3 Two-Wire Connections

Bently Nevada Corporation recommends using 4 wire communications when possible. In order to use 2 wire communications the devices in the 485 chain must meet the following conditions:

- All devices must automatically tri-state the line
- At least one device must have proper biasing to ensure the line remains in a known state during idle conditions (see section 4.2.4)
- The master device in the Modbus chain must have a configurable delay between the time it receives its response and when it requests data again. This delay must give sufficient time for every device in the chain to transition into tri-state mode. 10ms delay is recommended.

If these conditions cannot be met 4 wire must be used to ensure a reliable connection.

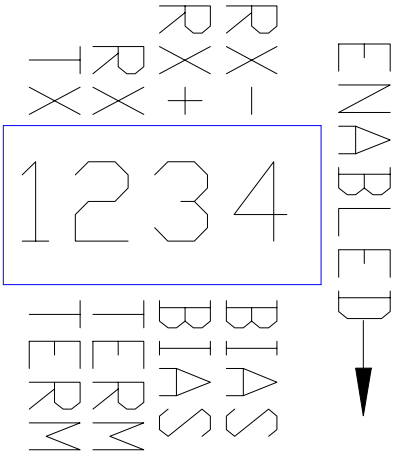
When using the Modbus RS-485 I/O Module in a 2-wire configuration, the wiring between the host device and the I/O module is shown below.



4.2.4 Termination

Proper termination is critical for reliable communications. Improper termination can result in a loss of communication. In normal 4 wire applications the last device of each end of the chain should be terminated. The transmitting pair should use a standard termination and the receiving pair should use a bias termination (also called a fail-safe termination or a power termination). Biasing prevents the appearance of a false bit being received at a device when communications are idle. In normal 2 wire applications the Modbus master

should have a bias termination and the farthest device should have a standard termination. If the Modbus master does not provide a bias termination another device in the chain must provide the bias. With long distances or in noisy environments it may be necessary to provide a bias at additional devices regardless of termination. The I/O provides 4 switches that allow configuration of a termination scheme.



1) This switch provides a 120-ohm termination across the transmitting lines

2) This switch provides a 120-ohm termination across the receiving lines

3&4) These switches add bias to the receiving lines and when used with switch 2 provide a bias termination across the receiving lines.

Suggested switch settings (X indicates switch depressed)

	1	2	3&4
Standard 4 Wire installation	X	X	X
Standard 2 Wire installation		X	
2 wire with master not providing bias		X	X
Unterminated			
Unterminated with biasing			X

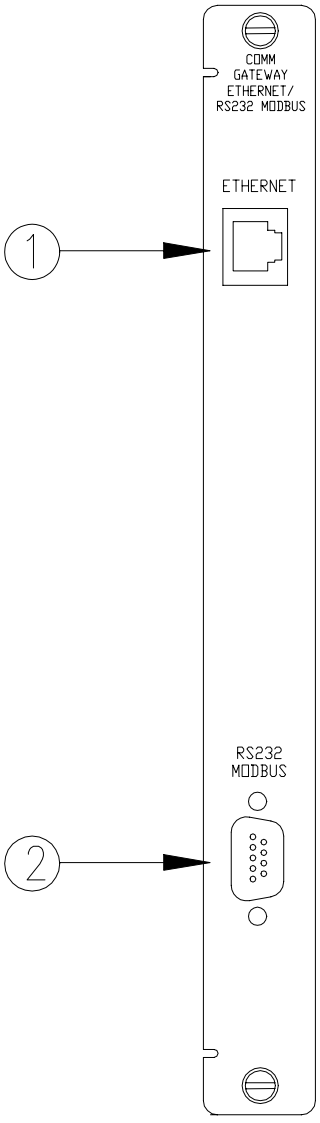
Older RS485 I/O's use a single "Term/Unterm" switch that provides a normal 4 wire termination. For these older I/O's in a 2 wire installation, use a discrete120 ohm resistor between RX+ and RX- to terminate; always leave the switch in the "UNTERM" position.

4.3 Ethernet/RS-232 I/O

This I/O provides for Ethernet network communications and PLC/DCS network communications at the same time.

1) Port 1 – Ethernet

2) Port 2 – RS-232



4.3.1 Ethernet - port 1

This port connects to networks running TCP/IP. The connector, RJ45, is a single-drop connector and is standard in most applications. For multi-drop applications a network hub is required. This port allows for communication to six devices running either 3500 software or Modbus Application Protocol (MBAP). Cable number 138131-xxx connects to this port

4.3.2 RS-232 - port 2

RS-232 port is a 9 pin sub D connector. The standard pins are listed below:

Signal	Name	Connector (9-pin) Pin #
GND	Ground	5
TXD	Transmit	3
RXB	Receive	2

Additional pins are provided for the Modbus Master devices with this capability:

Signal	Name	Connector (9-pin) Pin #
GND	Ground	1
DTR	Data Transmit Ready	4
DSR	Data Send Ready	6
RTS	Ready To Send	7
CTS	Clear To Send	8
CD	Carrier Detect	9

Standard 9 pin RS-232 cabling will work with this port.

For information about using this I/O in an intrinsically safe environment see section 4.1.6

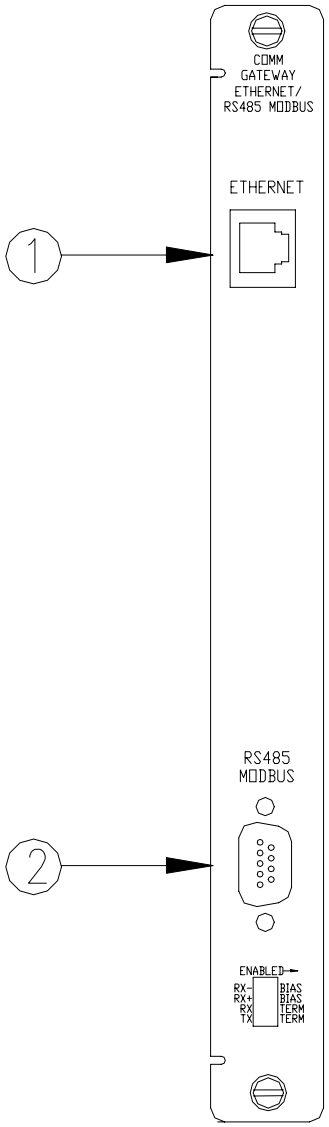
Note, the RS-232 port is not intended to be connected to a multiple device network. Instead, the RS-485 with a “Y” cable is a better solution (see below).

4.4 Ethernet/RS-485 I/O

This I/O is used for Ethernet network communications and PLC/DCS network communications.

1) Port 1 – Ethernet

2) Port 2 – RS-485



4.4.1 Ethernet – port 1

This port connects to networks running TCP/IP. The connector, RJ45, is a single-drop connector and is standard in most applications. For multi-drop applications a network hub is required. This port allows for communication to six devices running either 3500 software or Modbus Application Protocol (MBAP). Cable number 138131-xxx connects to this port

4.4.2 RS-485 – port 2

RS-485 port is a 9-pin sub-D connector with the following pin outs

Signal	Name	Connector (9 pin) Pin #
GND	Ground	5
TXB	Transmit Positive	3
TXA	Transmit Negative	9
RXB	Receive Positive	4
RXA	Receive Negative	6

RS485 is preferred for a multiple device network. The multi-drop connection allows devices on the chain to continue to communicate when other devices are not operating. A “Y” connection provides multi-drop capability.

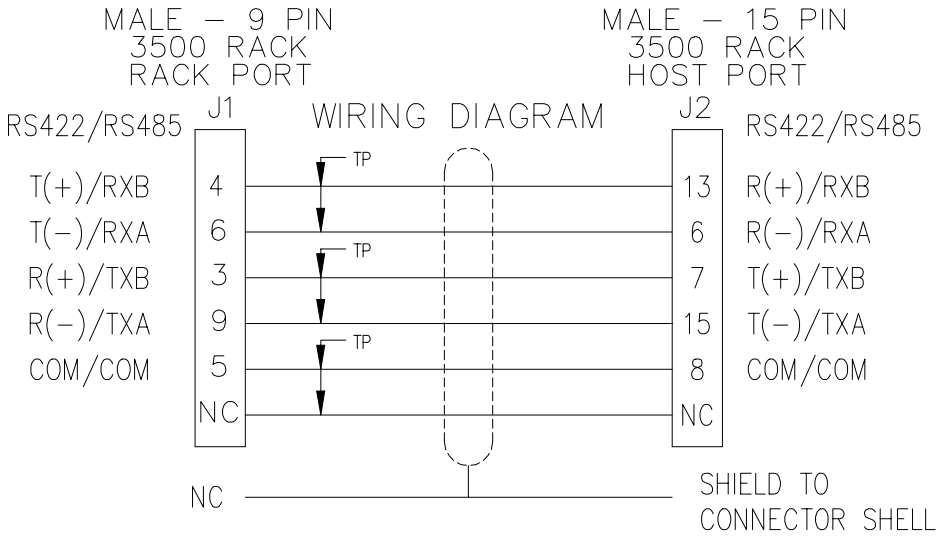
Use cable number 139036-01 for the “Y” connection.

Cable number 131179-AAAA-BB-CC connects to this port.

See sections 4.2.3 and 4.2.4 for important information regarding installation and termination for this I/O.

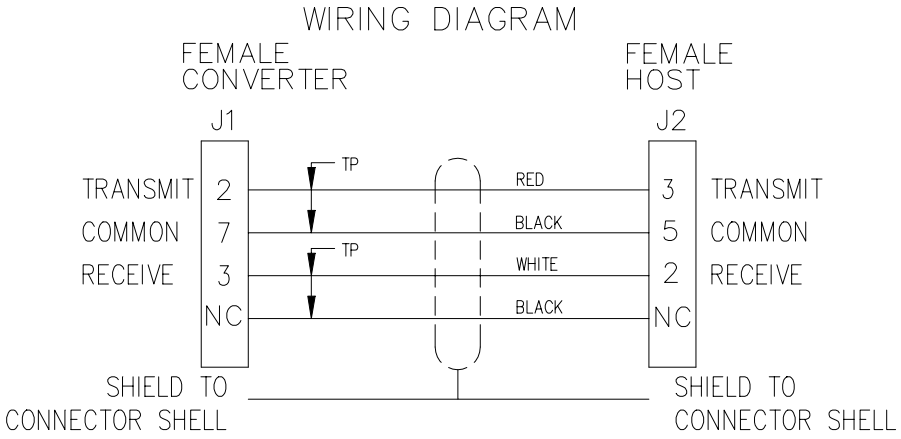
4.5 Cable Pin Outs

Cable Number 129665-XXXX-XX (PVC Insulation)
Cable Number 131108-XXXX-XX (Teflon Insulation)

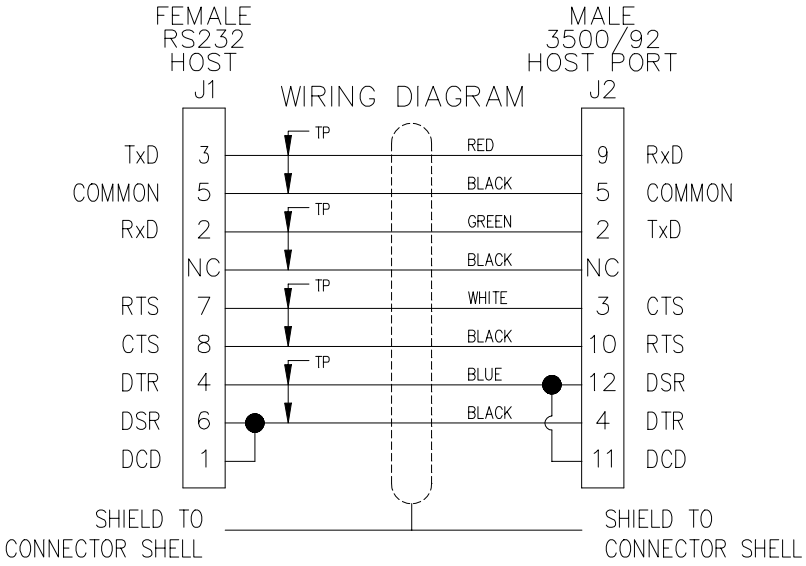


RS-422/RS-485 - 3500/92 to 3500/92 Cable

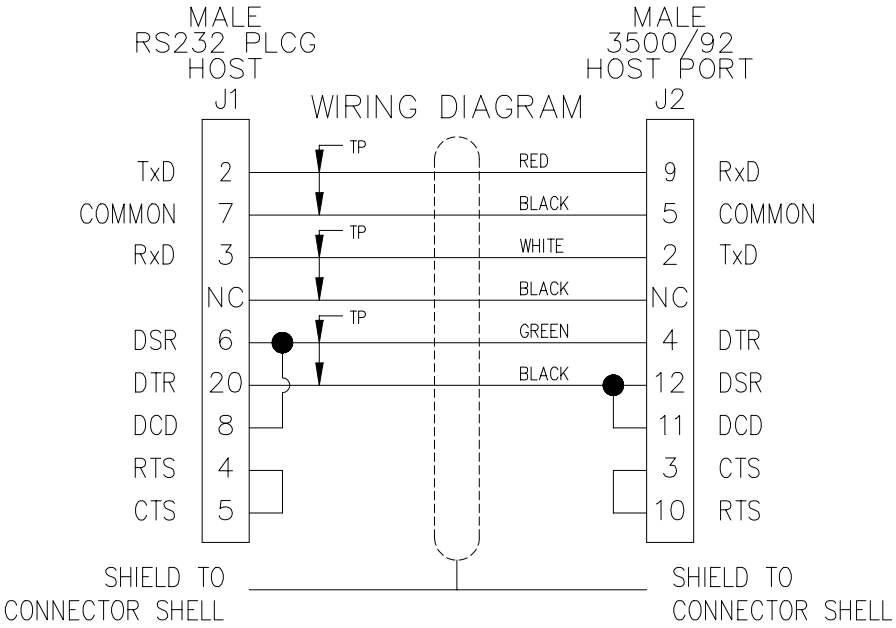
Cable Number 130119-01
Host Computer to RS-232/422 Converter Cable



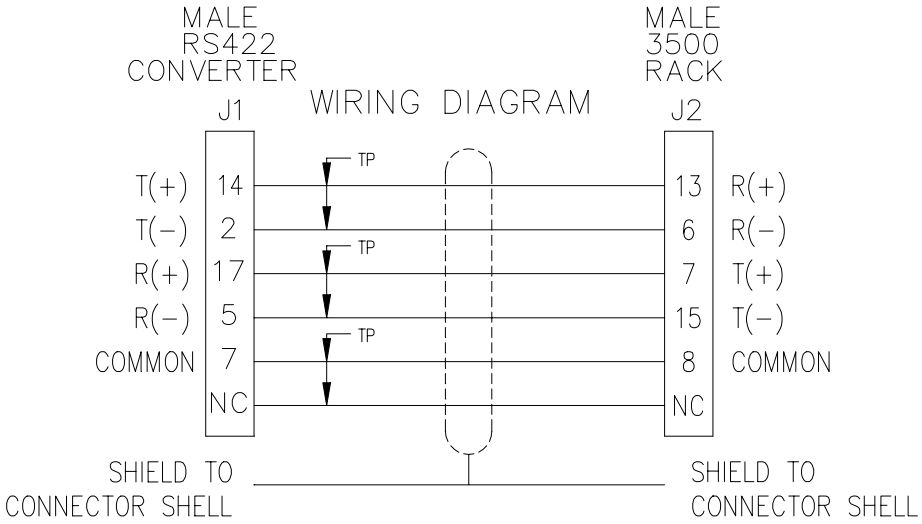
Cable Number 130419-XXXX-XX
RS-232 Host Computer to 3500/92 Cable



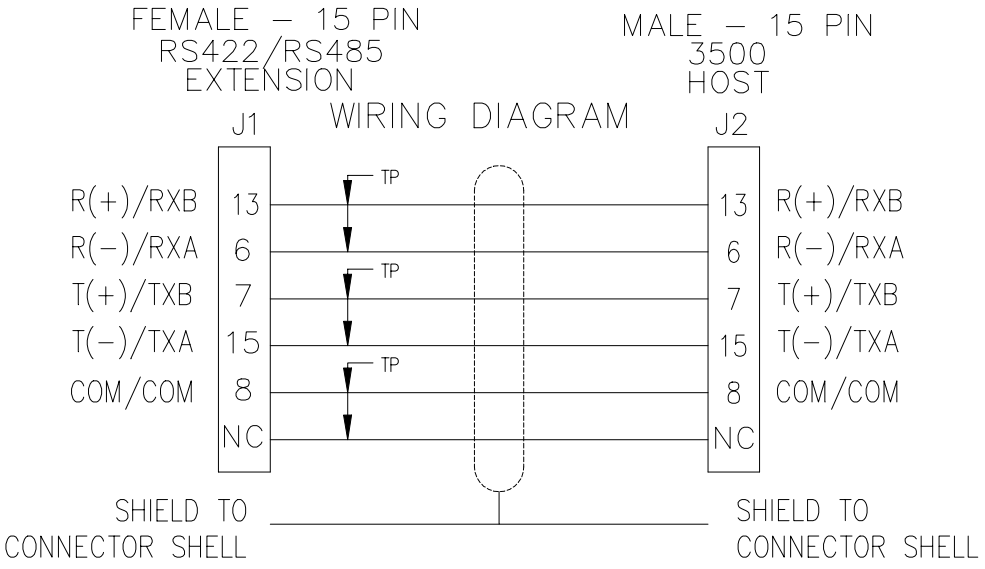
Cable Number 130420-XXXX-XX
RS-232 Honeywell PLCG to 3500/92 Cable



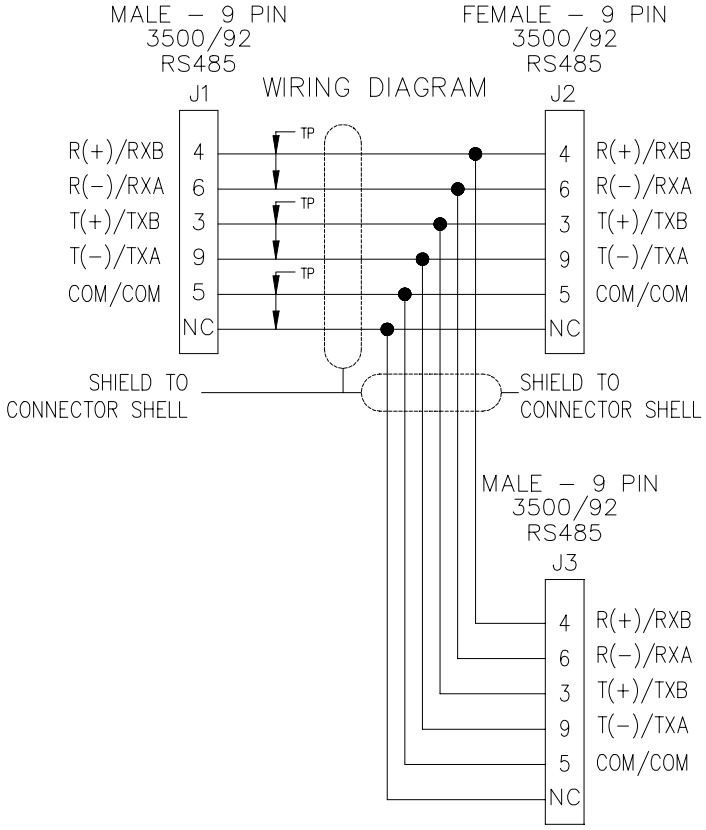
Cable Number 130530-XXXX-XX (PVC Insulation)
Cable Number 131109-XXXX-XX (Teflon Insulation)
RS-232/422 Converter to 3500/92 Cable RS-422



Cable Number 130531-XX-XX
RS-422 Extension Cable - 3500/92



Cable Number 139036-XX-XX
RS-485 “Y” Cable - 3500/92



5. Protocols

5.1 Modbus

5.1.1 Modbus Interface Description

This section describes the Modbus Interface and shows how it relates to the Communication Gateway Module. Before you begin programming, use the following document to become familiar with the basics of the Modbus protocol:

- AEG Modicon Modbus Protocol Reference Guide, Publication PI-MBUS-300 Rev E - March 1993

This section **does not** tell you how to program your DCS computer to access the Communication Gateway Module nor how to configure the interface database. You must refer to the DCS computer or controller manuals for this information.

5.1.1.1 Register Map

This section describes the function codes, addressing notation, and registers supported by the Communication Gateway Module.

5.1.1.1.1 Supported Function Codes

Modbus Function Code		Communication Gateway Module Data
Code	Meaning	
02	Read Input Status	Rack, Module, and Channel Statuses
03	Read Holding Registers	Setpoint Configuration, Switch Settings, Configuration Lock, Alarm Event List, System Event List, Rack Date and Time, Rack Reset, Rack Trip Multiply - Software, Rack Trip Multiply - Hardware, Rack Alarm Inhibit - Software, Rack Alarm Inhibit - Hardware, Last Command Success, Full-scale Data Range, Port Number, Data Ready, Repeated Read Input Status Data, Repeated Read Input Register Data and Configurable Registers
04	Read Input Registers	Current Proportional Values, Last Read Proportional Time Stamp
06 and 16	Preset Single Register And Preset Multiple	Setpoint Configuration, Switch Settings, Configuration Lock, Alarm Event List, System Event List, Rack Date and Time,

Modbus Function Code		Communication Gateway Module Data
Code	**Meaning**	
	Registers	Rack Reset, Rack Trip Multiply - Software, Rack Alarm Inhibit – Software, Configurable Registers
08	Loopback/Maintenance Diagnostic Codes:	
	0	Query Data
	2	Diagnostic Register
	10	Clear Counters
	11	Message Count
	12	Communication Error Count
	13	Exception Count
	18	Character Overrun Count
17	Report Slave ID	Family ID and current revision number of the Communication Gateway Module's firmware

5.1.1.1.2 DCS and Modbus Addressing Notation

The following table shows the notation used to refer to the function code addresses in the DCS computer database and in the Modbus queries.

Data Type	Modbus Programmable Controller Register (1-based)		Query Address (zero-based)	
	Format	**Range**	**Format**	**Range**
Input Status	1XXXX	10001-19999	XXXX	0000-9998
Holding Registers	4XXXX	40001-49999	XXXX	0000-9998
Input Registers	3XXXX	30001-39999	XXXX	0000-9998
Preset Single Register	4XXXX	40001-49999	XXXX	0000-9998
Preset Multiple Registers	4XXXX	44001-49999	XXXX	0000-9998

Note

Addresses are listed in this section using 2 formats: the Modbus Programmable Controller format (1-based) and the query address format (zero-based). Use whichever format is appropriate for your host.

5.1.1.1.3 General Register Layout

The Communication Gateway Module uses fixed protocol addresses for the starting locations of data in the rack. The data addresses are used in the protocol messages to access data that is available from the module and are not the physical data addresses in the Communication Gateway Module. The protocol starting addresses and Modicon PC Registers are as follows:

Data Type	Function Code	Address Ranges	
		Query Address Format (zero-based)	Modbus Programmable Controller Format (1-based)
Not Used	-	0-447	30001-30448
Current Proportional Values	4	500-947	30501-30948
Last Read Proportional Time Stamp	4	950-956	30951-30957
Module Statuses (Input Status Format)	2	0-95	10001-10096
Channel Statuses	2	100-3683	10101-13684
Rack Status	2	3684-3692	13685-13693
Setpoint Configuration	3, 6	0-5	40001-40006
Switch Settings	3, 6	6-10	40007-40011
Configuration Lock	3, 6	11	40012
Alarm Event List	3, 6	12-29	40013-40030
System Event List	3, 6	30-63	40031-40064
Rack Date and Time	3, 6	80-93	40081-40094
Rack Reset	3, 6	94	40095
Trip Multiply Group	3, 6	95	40096
Rack Trip Multiply – Software	3, 6	96	40097
Rack Trip Multiply - Hardware	3	97	40098
Rack Alarm Inhibit - Software	3, 6	98	40099
Rack Alarm Inhibit – Hardware	3	99	40100
Last Command Success	3	100-112	40101-40113
Full-scale Data Range	3	113	40114

Data Type	Function Code	Address Ranges	
		Query Address Format (zero-based)	Modbus Programmable Controller Format (1-based)
Port ID	3	114	40115
Data Ready	3	115	40116
*Unused	-	1000-1447	41001-41448
*Repeated Current Proportional Values	3	1500-1947	41501-41948
*Repeated Last Read Time Stamp	3	1950-1956	41951-41957
*Repeated Module Statuses	3	2000-2005	42001-42006
*Repeated Channel Statuses	3	2006-2229	42007-42230
*Repeated Rack Status	3	2230	42231
*Repeated Current Proportional Values Floating Point	3	2500-3395	42501-43396
*Repeated Setpoint Configuration Floating Point	3,6, or 16	4000-4007	44001-44008
Configurable Registers			
Setpoints	3,6, or 16	5000-5499	45001-45500
Otherwise	3		
Configurable Registers Floating Point			
Setpoints	3,6, or 16	6000-6999	46001-47000
Otherwise	3		

*The repeated data registers contain duplicated data in different registers for some Modbus devices that only support the 4XXXX series registers. Status data is bit packed in the 4XXXX registers such that the least significant bit (bit 0) of register 42001 corresponds to register 10001 and the most significant bit (bit 15) of register 42001 corresponds to register 10016.

For more information about these data types, refer to the following pages:

5.1.1.2 Data Type Details

This section describes each data type in detail and describes what each register is used for.

Primary Values

The primary values are not used in the 3500/92. Instead, the configurable registers were added to accomplish this (see page 61). Because of this difference, the 3500/92 is not completely compatible with the 3500/90. Users will need to reconfigure their DCS or PLC with the addresses of the configurable registers. In addition the configurable registers will need to be mapped using the 3500 Configuration software. All proportional values can be configured, expanding the scope and adding flexibility to the contiguous register set.

Current Proportional Values

The current proportional values include monitor values such as direct (overall vibration amplitude), probe gap, and 1X and 2X amplitude and phase lag. These values are different for each channel pair type. Page 78, lists the proportional values for each module. Use the READ INPUT REGISTERS command (function code 4) to read the Current Proportional Values. Current proportional values have space available for 32 values per monitor slot. Each slot can return from 0 to 32 channels and 0 to 8 values per channel, but not more than 32 values total per slot. Each value is sent high byte to low byte. The value returned is scaled to the value set for Full Scale Data Range in the Rack Configuration Software (see Section 3.3). The Current Proportional Values are fixed with 32 addresses for each slot. If a full-height monitor does not use all 32 proportional values, then the addresses are filled with zeros.

Starting Addresses for Current Proportional Values

3500 Rack Slot Number	Starting Address			
	Full Height Module or Upper Half-height Module		Lower Half-height Module	
	Modbus PC Format	Query Format	Modbus PC Format	Query Format
2	30501	500	30517	516
3	30533	532	30549	548
4	30565	564	30581	580
5	30597	596	30613	612
6	30629	628	30645	644
7	30661	660	30677	676
8	30693	692	30709	708
9	30725	724	30741	740
10	30757	756	30773	772
11	30789	788	30805	804
12	30821	820	30837	836
13	30853	852	30869	868
14	30885	884	30901	900
15	30917	916	30933	932

For example, for a 3500/40 Proximitor Monitor installed in slot 3 with channel 1 and 2 optioned as Thrust Position and channel 3 and 4 optioned as Radial Vibration, the proportional values for this monitor will be setup as follows:

Addresses for Sample 3500/40 Proximitor Monitor

Proportional Value		Address	
Number	**Name**	**Query Format (zero-based)**	**Modbus Programmable Controller Format (1-based)**
1	Direct	532	30533
2	Gap	533	30534
3	Direct	534	30535
4	Gap	535	30536
5	Direct	536	30537
6	Gap	537	30538
7	1X Amplitude	538	30539
8	1X Phase Lag	539	30540
9	2X Amplitude	540	30541
10	2X Phase Lag	541	30542
11	Not 1X Amplitude	542	30543
12	Smax Amplitude	543	30544
13	Direct	544	30545
14	Gap	545	30546
15	1X Amplitude	546	30547
16	1X Phase Lag	547	30548
17	2X Amplitude	548	30549
18	2X Phase Lag	549	30550
19	Not 1X Amplitude	550	30551
20	Smax Amplitude	551	30552
21	0	552	30553
22	0	553	30554
23	0	554	30555
24	0	555	30556
25	0	556	30557
26	0	557	30558
27	0	558	30559
28	0	559	30560
29	0	560	30561
30	0	561	30562
31	0	562	30563
32	0	563	30564

If half-height modules are installed, then each module is fixed with 16 addresses. Similar to a full-height module, a half-height module will fill unused addresses with zeros. In addition, the topmost half-height module will send the entire 16 proportional values, including zeros, before the bottom module sends its block of 16 proportional values, including zeros.

Last Read Proportional Time Stamp

This set of registers is a time stamp of when the last read proportional value was last updated. All the proportional values in one channel are updated at the same time and therefore have the same time stamp. When a proportional value is read, the time stamp for that proportional value is put into the Last Read Proportional Time Stamp Registers. To find the time that proportional values were obtained, first read a single proportional value or multiple proportional values in the same channel by following the directions for Current Proportional Values or Primary Values, then use the READ INPUT REGISTERS command (function code 4) to read the time stamp at the addresses shown in the table below. If a single read command requests proportional values from more than one channel, then the time stamp data will be the time stamp of the last requested register. The format for the Last Read Proportional Time Stamp Registers is shown in the table below.

Last Read Proportional Value or Status Time Stamp Address		**Field Name**	**Code Range**	**Notes**
Query Format	**Modbus PC Format**			
950	30951	Year	00 – 99*	Months are in sequential order (e.g. 1 = Jan) 24-hour clock: 12 = Noon and 00 = Midnight
951	30952	Month	1 - 12	
952	30953	Day	1 - 31	
953	30954	Hour	0 - 23	
954	30955	Minute	0 - 59	
955	30956	Second	0 - 59	
956	30957	1/100 Second	0 - 99	
* Year = 00 implies the year 2000				

Module Statuses (Input Status Format)

The Module Statuses have a value of "1" for true and "0" for false. Each half-slot module has three status bits associated with it, Alert/Alarm 1, Danger/Alarm 2, and not OK. (Full-height modules will not use the Lower Slot statuses.) For relay modules, the Alert/Alarm 1 status bit indicates that a relay has tripped. The Alert/Alarm 1 and Danger/Alarm 2 status bits have no meaning for Keyphasor Modules and Communication Gateway Modules and so are always false (status bit equals "0"). The Power Supplies and Rack Interface Module only use the not OK status so the other statuses are not used. If the Power Supply is faulted or not installed, then the status for that power supply will be not OK ("1"). If the Rack Interface Module is not OK then the not OK status will be set to "1". If the state of the Module Status is unknown then it will be defaulted to "0" for false.

Use the READ INPUT STATUS command (Function code 2) to read the Module Statuses. A simple formula to compute the starting address in zero-based format for any slot status is:

Upper Slot Starting Address = 6 * slot number
Lower Slot Starting Address = (6 * slot number) + 3

Module Status Addresses

Slot	Module Status	Address	
		Query Format	Modbus PC Format
0 Upper	Rack OK Relay (0=ok, 1=not ok)	0	10001
0 Upper	(not used)	1	10002
0 Upper	Power Supply 1 not OK	2	10003
0 Lower	(not used)	3	10004
0 Lower	(not used)	4	10005
0 Lower	Power Supply 2 not OK	5	10006
1 Upper	(not used)	6	10007
1 Upper	(not used)	7	10008
1 Upper	RIM not OK	8	10009
1 Lower	(not used)	9	10010
1 Lower	(not used)	10	10011
1 Lower	(not used)	11	10012
2 Upper	Alert/Alarm 1	12	10013
2 Upper	Danger/Alarm 2	13	10014
2 Upper	not OK	14	10015
2 Lower	Alert/Alarm 1	15	10016
2 Lower	Danger/Alarm 2	16	10017
2 Lower	not OK	17	10018
3 Upper	Alert/Alarm 1	18	10019
3 Upper	Danger/Alarm 2	19	10020
3 Upper	not OK	20	10021
3 Lower	Alert/Alarm 1	21	10022
3 Lower	Danger/Alarm 2	22	10023
3 Lower	not OK	23	10024
4 Upper	Alert/Alarm 1	24	10025
4 Upper	Danger/Alarm 2	25	10026
4 Upper	not OK	26	10027
4 Lower	Alert/Alarm 1	27	10028
4 Lower	Danger/Alarm 2	28	10029
4 Lower	not OK	29	10030

Slot	Module Status	Address	
		Query Format	Modbus PC Format
5 Upper	Alert/Alarm 1	30	10031
5 Upper	Danger/Alarm 2	31	10032
5 Upper	not OK	32	10033
5 Lower	Alert/Alarm 1	33	10034
5 Lower	Danger/Alarm 2	34	10035
5 Lower	not OK	35	10036
6 Upper	Alert/Alarm 1	36	10037
6 Upper	Danger/Alarm 2	37	10038
6 Upper	not OK	38	10039
6 Lower	Alert/Alarm 1	39	10040
6 Lower	Danger/Alarm 2	40	10041
6 Lower	not OK	41	10042
7 Upper	Alert/Alarm 1	42	10043
7 Upper	Danger/Alarm 2	43	10044
7 Upper	not OK	44	10045
7 Lower	Alert/Alarm 1	45	10046
7 Lower	Danger/Alarm 2	46	10047
7 Lower	not OK	47	10048
8 Upper	Alert/Alarm 1	48	10049
8 Upper	Danger/Alarm 2	49	10050
8 Upper	not OK	50	10051
8 Lower	Alert/Alarm 1	51	10052
8 Lower	Danger/Alarm 2	52	10053
8 Lower	not OK	53	10054
9 Upper	Alert/Alarm 1	54	10055
9 Upper	Danger/Alarm 2	55	10056
9 Upper	not OK	56	10057
9 Lower	Alert/Alarm 1	57	10058
9 Lower	Danger/Alarm 2	58	10059
9 Lower	not OK	59	10060
10 Upper	Alert/Alarm 1	60	10061
10 Upper	Danger/Alarm 2	61	10062
10 Upper	not OK	62	10063
10 Lower	Alert/Alarm 1	63	10064
10 Lower	Danger/Alarm 2	64	10065
10 Lower	not OK	65	10066

Slot	Module Status	Address	
		Query Format	Modbus PC Format
11 Upper	Alert/Alarm 1	66	10067
11 Upper	Danger/Alarm 2	67	10068
11 Upper	not OK	68	10069
11 Lower	Alert/Alarm 1	69	10070
11 Lower	Danger/Alarm 2	70	10071
11 Lower	not OK	71	10072
12 Upper	Alert/Alarm 1	72	10073
12 Upper	Danger/Alarm 2	73	10074
12 Upper	not OK	74	10075
12 Lower	Alert/Alarm 1	75	10076
12 Lower	Danger/Alarm 2	76	10077
12 Lower	not OK	77	10078
13 Upper	Alert/Alarm 1	78	10079
13 Upper	Danger/Alarm 2	79	10080
13 Upper	not OK	80	10081
13 Lower	Alert/Alarm 1	81	10082
13 Lower	Danger/Alarm 2	82	10083
13 Lower	not OK	83	10084
14 Upper	Alert/Alarm 1	84	10085
14 Upper	Danger/Alarm 2	85	10086
14 Upper	not OK	86	10087
14 Lower	Alert/Alarm 1	87	10088
14 Lower	Danger/Alarm 2	88	10089
14 Lower	not OK	89	10090
15 Upper	Alert/Alarm 1	90	10091
15 Upper	Danger/Alarm 2	91	10092
15 Upper	not OK	92	10093
15 Lower	Alert/Alarm 1	93	10094
15 Lower	Danger/Alarm 2	94	10095
15 Lower	not OK	95	10096

Channel Statuses

Channel statuses are only available for slot 2 through slot 15. The Communication Gateway stores a true or false value for the channel statuses for each channel. A "0" indicates false and a "1" indicates true. Each slot is fixed with 32 channels. If a full-height monitor does not have all 32 channels, then the Channel Status bits for the unused channels will be zero. Use the READ INPUT STATUS command (Function Code 2) to access the Channel Status values for the Rack. Refer the specific module's Operation and Maintenance Manual to determine what channel statuses it returns. (Half-height modules can only have up to 16 channels with 8 status values each.) The status bits for each channel is in the following order:

Bit	Channel Statuses
0	Channel not OK
1	Channel Alert / Alarm 1
2	Channel Danger / Alarm 2
3	Channel In Bypass Mode
4	Channel Off
5	Channel Trip Multiply Mode
6	Channel Special Alarm Inhibit
7	Channel Not Communicating

Starting Addresses for Channel Statuses

3500 Rack Slot Number	Starting Address			
	Full Height Module or Upper Half-height Module		Lower Half-height Module	
	Modbus PC Format	Query Format	Modbus PC Format	Query Format
2	10101	100	10229	228
3	10357	356	10485	484
4	10613	612	10741	740
5	10869	868	10997	996
6	11125	1124	11253	1252
7	11381	1380	11509	1508
8	11637	1636	11765	1764
9	11893	1892	12021	2020
10	12149	2148	12277	2276
11	12405	2404	12533	2532
12	12661	2660	12789	2788
13	12917	2916	13045	3044
14	13173	3172	13301	3300
15	13429	3428	13557	3556

The equation for the upper **not OK** address is the following:

address for upper **not OK** = 100 + ((slot # - 2) * 256) + ((channel # - 1) * 8)

For example: calculate the address for **not OK** of upper slot 3, channel 1 as follows:

address = 100 + ((3 - 2) * 256) + ((1 - 1) * 8)

address = 356

The equation for the lower **not OK** address is the following:

address for lower **not OK** = 228 + ((slot # - 2) * 256) + ((channel # - 1) * 8)

For example: calculate the address for **not OK** of lower slot 2, channel 1 as follows:

address = 228 + ((2 - 2) * 256) + ((1 - 1) * 8)

address = 228

Rack Status

The rack status is a range of registers that summarize the channel status registers for all modules. Register 3684 corresponds to channel status bit 0 (channel not OK) and register 3692 corresponds to channel status bit 7 (channel not communicating). Registers between 3684 and 3692 are used similarly for the remaining channel statuses. If any module in the rack sets a channel status bit, the corresponding rack status register will also be set.

The repeated rack status register (address 2230) is a single register with 8 bits. Each bit summarizes the channel status registers for all modules in the rack. The least significant bit (LSB) corresponds to channel status bit 0 (channel not OK) and the remaining bits are used similarly for the remaining channel statuses. If any module in the rack sets a channel status bit, the corresponding repeated rack status bit will also be set.

Setpoint Configuration

Monitor setpoints may be either read or written. The setpoints are acquired one at a time. The following information is required to read or write setpoints:

Setpoint Information	Refer to...
Setpoint types	Page 76 of this manual
Setpoint number	Operation and maintenance manual for the monitor
Proportional value full-scale range	Channel Option screens in the Rack Configuration Software

Take the following precautions when you use the Communication Gateway Module to adjust setpoints:

- Adjust setpoints so that the over setpoint is greater than the under setpoint. Refer to page 49 for additional information about 1X and 2X phase setpoints.
- Since the Communication Gateway requires that you adjust one setpoint at a time, turn channel bypass on before you change setpoints for proportional values that have over and under setpoints.
- Check that adjusted setpoints are within the linear range of the transducer.

To read a setpoint:

1. Use the PRESET MULTIPLE REGISTERS command (function code 16) or PRESET SINGLE REGISTER command (function code 6) to write to the Slot Number, Channel Number, and Setpoint Number Registers at addresses 0, 1, and 2 (Modicon PC Registers 40001 to 40003) to specify which setpoint is desired. Once these registers have been written, the Setpoint Value, Setpoint Type, and Setpoint Enabled will be loaded into addresses 3, 4, and 5 (Modicon PC Registers 40004 to 40006).
2. Use the READ HOLDING REGISTERS command (function code 3) to read addresses 0 to 5 (Modicon PC Registers 40001 to 40006). Reading those addresses before they have been updated will yield the previous setpoint value from the previous setpoint request.

To write a new setpoint value:

1. **Acquire Configuration Lock** - Write a "1" to the Configuration Lock Register using a function code 6 or 16 to request the Configuration Lock.
2. **Verify Configuration Lock is granted** - Read the Configuration Lock Register using function code 3. A "0" means the Configuration Lock is granted to another port and a "1" means the Configuration Lock is granted

Note

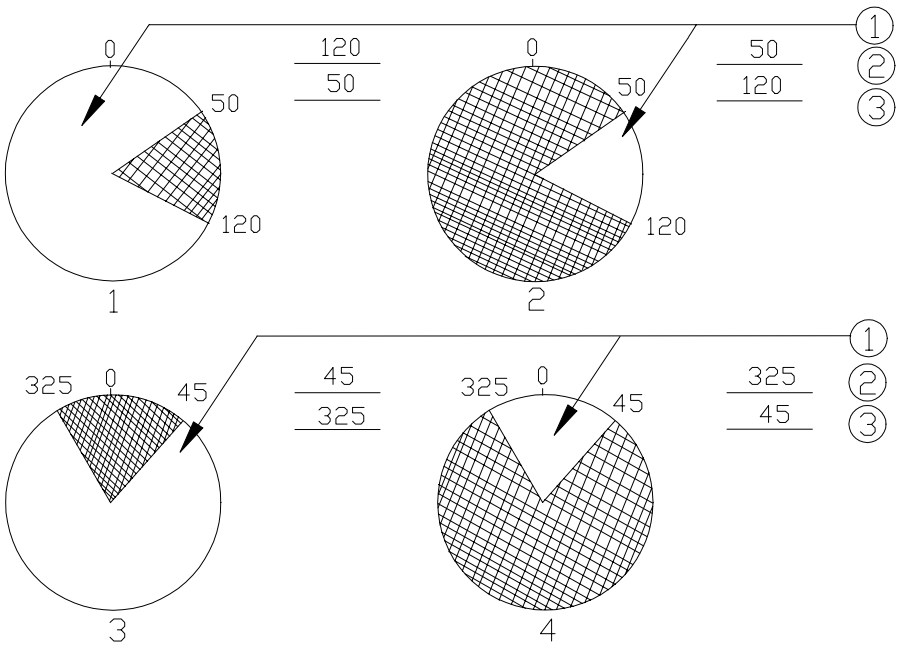
The Configuration Lock will not be granted and setpoint values can not be changed if any other port has the Configuration Lock. Also, if the Communication Gateway is configured to not allow changing configuration, then writing to the Configuration Lock Register will cause an illegal address response. For details, refer to page 53 (Configuration Lock).

3. **Write new setpoint value** - Use the PRESET MULTIPLE REGISTERS command (function code 16) or PRESET SINGLE REGISTER command (function code 6) to write to the Slot Number, Channel Number, Setpoint Number, and Setpoint Value Registers at addresses 0 to 3 (Modicon PC Registers 40001 to 40004) to specify which setpoint is to be changed and the new value it is to be changed to. You may change multiple setpoints in the same slot by repeating step 3.

Application Alert

The Communication Gateway Module allows the Under setpoint to be set above the Over Setpoint. Reversing the Over and Under setpoints results in different acceptance regions as shown in the following 4 scenarios.

Scenarios 1 through 4



1) Acceptance Region
2) Over Setpoint for Scenarios 1 through 4
3) Under Setpoint for Scenarios 1 through 4

Note

Phase acceptance regions define the areas for a nonalarm state. The endpoints (setpoints) are included in the nonalarm state.

For 1X and 2X Phase Lag, the Over Setpoint does not have to be greater than the Under Setpoint.

The acceptance region is always from the Under Setpoint to the Over Setpoint in a counter-clockwise direction.

If the Under Setpoint equals the Over Setpoint, then there is full acceptance (no alarms).

4. **Verify new setpoint value** - If you did not receive an error code when the setpoint was written, you can verify the new setpoint value by either following the read setpoint steps to read back the setpoint value (the value read back may be slightly different from what was written due to scaling), or read the Last Command Success registers (see page 60).
5. **Relinquish the Configuration Lock** - Write a "0" to the Configuration Lock Register using a function code 6 or 16 to relinquish the Configuration Lock.

Setpoint Configuration	Query Address	Modicon PC Register	Floating Point Registers	Read or Write	Data Range (Decimal)
Slot Number	0	40001	44001	Read/Write	2 - 15
Channel Number	1	40002	44002	Read/Write	1 - 32
Setpoint Number	2	40003	44003	Read/Write	1 - 20
Setpoint Value	3	40004	44004 44005	Read/Write	0 – 65535
Setpoint Type	4	40005	44006	Read Only	0 - 255
Setpoint Enabled	5	40006	44007	Read Only	0 = FALSE 1 = TRUE

Switch Settings

Use the Switch Setting to read or write channel settings. Setup which Switch Setting is desired by writing to the Slot Number, Upper/Lower, Channel Number, and Switch Number registers. Refer to the switch section of the module operation and maintenance manual for the switch numbers.

To read Channel Settings:

1. Use the PRESET MULTIPLE REGISTERS command (function code 16) or PRESET SINGLE REGISTER command (function code 6) to write to the Slot Number, Upper/Lower, Channel Number, and Switch Number registers to specify which Switch Setting is desired. Once these registers have been written, the Channel Setting information will be loaded into the Switch Value register.
2. Use the READ HOLDING REGISTERS command (function code 3) to read the Slot Number, Upper/Lower, Channel Number, Switch Number, and Switch Value. Reading those addresses before they have been updated will yield the previous Channel Settings from the previous Switch Setting request.

To write a new Switch Setting value:

1. **Acquire Configuration Lock** - Requisition the configuration lock by writing a "1" to the Configuration Lock Register using a function code 6 or 16.
2. **Verify that the Configuration Lock is granted** - Read the Configuration Lock Register using function code 3. A "0" means the Configuration Lock is not granted and a "1" means the Configuration Lock is granted.

Note

The Configuration Lock will not be granted and switch values can not be changed if any other port has the Configuration Lock. Also, if the Communication Gateway is configured to not allow changing configuration, then writing to the Configuration Lock Register will cause an illegal address response. For details, see page 53 (Configuration Lock).

3. **Write the new Channel Setting** - Use the PRESET MULTIPLE REGISTERS command (function code 16) or PRESET SINGLE REGISTER command (function code 6) to write to the Slot Number, Upper/Lower, Channel Number, Switch Number, and Switch Setting Registers to specify which Channel Setting is to be changed and the new value it is to be changed to. (To change the module switches, then specify Channel 0.) You may change Switch Settings on different channels in the same slot by repeating step 3.
4. **Verify new Switch Setting** - If you did not receive an error code when the switch was written, you can verify the new switch value by either following the read Switch Setting steps to read back the switch value or read the Last Command Success registers (see page 60).
5. **Relinquish the Configuration Lock** - Relinquish the Configuration Lock by writing a "0" to the Configuration Lock Register using a function code 6 or 16.

Switch Setting	Query Address	Modicon PC Register	Read or Write	Data Range (Decimal)
Slot Number	6	40007	Read/Write	0 - 15
Upper/Lower	7	40008	Read/Write	0 = UPPER 1 = LOWER
Channel Number	8	40009	Read/Write	0 - 32
Switch Number	9	40010	Read/Write	1 - 16
Switch Value	10	40011	Read/Write	0 = OFF 1 = ON

Configuration Lock

The Configuration Lock allows only one device to configure the 3500 rack at a time. To acquire the Configuration Lock, write a "1" to the Configuration Lock Register using the PRESET SINGLE REGISTER command (function code 6) or the PRESET MULTIPLE REGISTERS command (function code 16).

To see if the Configuration Lock has been granted, read the Configuration Lock Register using the READ HOLDING REGISTERS command (function code 3).

A "0" means that the Configuration Lock is granted to another port and a "1" means the Configuration Lock is granted.

To relinquish the Configuration Lock, write a "0" to the Configuration Lock Register using the PRESET SINGLE REGISTER command (function code 6) or the PRESET MULTIPLE REGISTERS command (function code 16). To verify that the Configuration Lock was relinquished, you can read the Last Command Success registers (see page 60).

The Configuration Lock will not be granted if the following conditions are true:

- Another port in the rack has the lock
- The Config Allowed box on the Modbus Protocol Setup screen of the Rack Configuration Software is cleared (☐)

Writing to the Configuration Lock Register when one of these conditions is true will cause an illegal address response.

Register	Query Address	Modicon PC Register	Read or Write	Data Range (Decimal)
Configuration Lock	11	40012	Read/Write	0 - 1

Alarm Event List

The Alarm Event List contains the latest 1000 Alarm Events. Each Alarm Event is identified with a unique 32 bit sequence number. The Last Posted Alarm Event Register contains the sequence number of the latest Alarm Event. To request an Alarm Event, first write the desired sequence number to the Requested Alarm Event Registers using the PRESET SINGLE REGISTER command (function code 6) or the PRESET MULTIPLE REGISTERS command (function code 16). The specified event can then be read using the READ HOLDING REGISTERS command (Function code 3).

If you read the holding register before the registers are updated, the last requested event will be returned. If the event requested is more than 999 events older than the last posted alarm event sequence number, then the exception code "ILLEGAL DATA VALUE" will be returned.

Alarm Event List Description	Query Address	Modicon PC Register	Data Range (decimal)	Read or Write
Requested Alarm Event Sequence Number	12 - 13	40013 - 40014	0 - 4,294,967,245	Read/Write
Last Posted Alarm Event Sequence Number	14 - 15	40015 - 40016	0 - 4,294,967,245	Read Only
Alarm Event Sequence No.	16 - 17	40017 - 40018	0 - 4,294,967,245	Read Only
Slot Number	18	40019	0 - 15	Read Only
Upper/Lower	19	40020	0 = UPPER 1 = LOWER	Read Only
Channel	20	40021	0 - 32	Read Only
Alarm Type	21	40022	0 = Alert 1 = Danger 2 = not OK 3 = Relay Trip	Read Only
Alarm Direction	22	40023	0 = Entered Alarm 1 = Exit Alarm	Read Only
Year	23	40024	00 – 99*	Read Only
Month	24	40025	1 - 12	Read Only
Day	25	40026	1 - 31	Read Only
Hour	26	40027	0 - 23	Read Only
Minute	27	40028	0 - 59	Read Only
Second	28	40029	0 - 59	Read Only
1/100 Second	29	40030	0 - 99	Read Only
* Year = 00 implies the year 2000				

System Event List

The System Event List contains the latest 500 System Events. Each System Event is identified with a unique 32 bit sequence number. The Last Posted System Event Register contains the sequence number of the latest System Event. To request a System Event, first write the desired sequence number to the Requested System Event Registers using the PRESET SINGLE REGISTER command (function code 6) or the PRESET MULTIPLE REGISTERS command (function code 16). The specified event can then be read using the READ HOLDING REGISTERS command (Function code 3).

If you read the holding registers before the registers are updated, the last requested event will be returned. If the event requested is 499 events older than the last posted alarm event sequence number, then the exception code "ILLEGAL DATA VALUE" will be returned.

System Event List Description	Query Address	Modicon PC Register	Data Range (Decimal)	Read or Write
Requested System Event Sequence Number	30 - 31	40031 - 40032	0 - 4,294,967,295	Read/Write
Last Posted System Event Sequence Number	32 - 33	40033 - 40034	0 - 4,294,967,295	Read Only
Sequence Number	34 - 35	40035 - 40036	0 - 4,294,967,295	Read Only
Event Classification	36	40037	0= Severe/Fatal Event 1 = Potential Problem Event 2 = Typical logged Event 3 = Reserved	Read Only
System Event Number	37	40038	0 - 65535	Read Only
Source Slot	38	40039	0 - 15	Read Only
Upper/Lower	39	40040	0 = Upper Slot 1 = Lower Slot	Read Only
Destination Slot*	40	40041	0 - 15	Read Only
Upper/Lower*	41	40042	0 = Upper Slot 1 = Lower Slot	Read Only
Year	42	40043	00 - 99*	Read Only
Month	43	40044	1 - 12	Read Only
Day	44	40045	1 - 31	Read Only
Hour	45	40046	0 - 23	Read Only
Minute	46	40047	0 - 59	Read Only
Second	47	40048	0 - 59	Read Only
1/100 Second	48	40049	0 - 99	Read Only
Event Specific String	49 - 51	40050 - 40052	ASCII text	Read Only
Event String	52 - 63	40053 - 40064	ASCII text	Read Only
* Year = 00 implies the year 2000				

Refer to the module's operation and maintenance manual for the System Event List Messages. The Source Slot number is the module that caused the action (for example if the Communication Gateway Module changed the module's setpoint the Communication Gateway Module would be listed as the source slot).

* Refer to the operation and maintenance manual for the module installed in this slot (upper or lower).

Rack Date and Time

The rack date and time can be either read or written. To read the actual rack date and time, use READ HOLDING REGISTER command (function code 3) and the Actual Rack Date and Time Registers shown in the table below.

To write a new rack date and time, write the desired time using PRESET SINGLE REGISTERS command (function code 6) or PRESET MULTIPLE REGISTERS command (function code 16) to the Write and Verify Rack Date and Time Registers shown in the table below. The Write and Verify Rack Date and Time Registers can be read back to verify what you entered. You can preload the date and time except for the 1/100 second register. When the 1/100 second register is written to, the new rack date and time will be stored.

To verify the new rack date and time, you can either read the rack date and time using the Actual Rack Date and Time Registers, or you can read the Last Command Success registers (see page 60).

Rack Date/Time Address	Modicon PC Register	Field Name	Code Range	Notes	Read or Write
Actual Rack Date and Time Registers					
80	40081	Year	00 - 99*		Read Only
81	40082	Month	1 - 12	Months are in sequential order	Read Only
82	40083	Day	1 - 31	(e.g. 1 = Jan)	Read Only
83	40084	Hour	0 - 23		Read Only
84	40085	Minute	0 - 59	24-hour clock: 12 = Noon and	Read Only
85	40086	Second	0 - 59	00 = Midnight	Read Only
86	40087	1/100 Second	0 - 99		Read Only
Write and Verify Rack Date and Time Registers					
87	40088	Year	00 - 99*		Read/Write
88	40089	Month	1 - 12	Months are in sequential order	Read/Write
89	40090	Day	1 - 31	(e.g. 1 = Jan)	Read/Write
90	40091	Hour	0 - 23		Read/Write
91	40092	Minute	0 - 59	24-hour clock: 12 = Noon and	Read/Write
92	40093	Second	0 - 59	00 = Midnight	Read/Write
93	40094	1/100 Second	0 – 99	(Writing to the 1/100 Second register causes the time stored in the Write/Verify Rack date and Time Registers to be written to the Actual Rack Date and Time Registers)	Read/Write
* Year = 00 implies the year 2000					

Rack Reset

Before you perform this command, use the 3500 Rack Configuration Software to verify that the Config Allowed box on the Modbus Protocol Setup screen is checked (☒). If you attempt to write a "1" to the software Rack Reset software address when the Config Allowed box is cleared (☐), an ILLEGAL DATA ADDRESS will be returned. To enable the software Rack Reset for that group with the Modbus protocol, write a the group number of the monitor or 255 for all monitors to software Rack Reset address using the PRESET MULTIPLE

REGISTERS command (function code 16) or PRESET SINGLE REGISTER (function code 6).

To verify that the software Rack Reset was enabled, you can read the Last Command Success registers (see page 60).

Register	Query Address	Modicon PC Register	Read or Write	Data Range (decimal)
Rack Reset	94	40095	Read/Write	1 - 16 or 255

Rack Group

This register controls the group referred in the software Rack Trip Multiply register. Groups are set in the RIM. The default value, 255, means all groups; in other words the entire rack.

Register	Query Address	Modicon PC Register	Read or Write	Data Range (decimal)
Rack Group	95	40096	Read/Write	1 – 16 or 255

Rack Trip Multiply (Software)

Before you perform this command, use the 3500 Rack Configuration Software to verify that the Config Allowed box on the Modbus Protocol Setup screen is checked (☒). If you attempt to write a "1" to the software Rack Trip Multiply software address when the Config Allowed box is cleared (☐), an ILLEGAL DATA ADDRESS will be returned. First, set the Rack Group Register. To enable the software Rack Trip Multiply for that group with the Modbus protocol, write a "1" to software Rack Trip Multiply address using the PRESET MULTIPLE REGISTERS command (function code 16) or PRESET SINGLE REGISTER (function code 6).

To disable the software Rack Trip Multiply with the Modbus protocol, write a "0" to the Rack Trip Multiply using the PRESET MULTIPLE REGISTERS command (function code 16) or PRESET SINGLE REGISTER (function code 6).

To verify that the software Rack Trip Multiply was either enabled or disabled, you can read back the software Rack Trip Multiply register using the READ HOLDING REGISTERS command (function code 3) or read the Last Command Success registers (see page 60).

Register	Query Address	Modicon PC Register	Read or Write	Data Range (decimal)
Rack Trip Multiply (Software)	96	40097	Read/Write	0 - 1

Rack Trip Multiply (Hardware)

To see if the Rack Trip Multiply contact on the Rack Interface I/O Module is enabled or disabled, read the hardware Rack Trip Multiply register using the READ HOLDING REGISTERS command (function code 3). If the value in the register is a "1" then the hardware Rack Trip Multiply is enabled. If the value in the register is a "0", the hardware Rack Trip Multiply is disabled.

Register	Query Address	Modicon PC Register	Read or Write	Data Range (decimal)
Rack Trip Multiply (Hardware)	97	40098	Read Only	0 - 1

Rack Alarm Inhibit (Software)

Before you perform this command, use the 3500 Rack Configuration Software to verify that the Config Allowed box on the Modbus Protocol Setup screen is checked (☒). To enable the software Rack Alarm Inhibit with the Modbus protocol, write a "1" to the software Rack Alarm Inhibit register using the PRESET MULTIPLE REGISTERS command (function code 16) or PRESET SINGLE REGISTER (function code 6).

To disable the software Rack Alarm Inhibit with the Modbus protocol, write a "0" to the software Rack Alarm Inhibit register using the PRESET MULTIPLE REGISTERS command (function code 16) or PRESET SINGLE REGISTER (function code 6).

To verify that the software Rack Alarm Inhibit was either enabled or disabled, read back the software Rack Alarm Inhibit register using the READ HOLDING REGISTERS command (function code 3) or read the Last Command Success registers (see page 60).

Register	Query Address	Modicon PC Register	Read or Write	Data Range (decimal)
Rack Alarm Inhibit (Software)	98	40099	Read/Write	0 - 1

Rack Alarm Inhibit (Hardware)

To see if the Rack Alarm Inhibit contact on the Rack Interface I/O Module is enabled or disabled, read the hardware Rack Alarm Inhibit register using the READ HOLDING REGISTERS command (function code 3). If the value in the register is a "1", then the hardware Rack Alarm Inhibit is enabled. If the value is a "0", the hardware Rack Alarm Inhibit is disabled.

Register	Query Address	Modicon PC Register	Read or Write	Data Range (decimal)
Rack Alarm Inhibit (Hardware)	99	40100	Read Only	0 - 1

Last Command Success

The Last Command Success Error Code indicates if

- the last command was executed successfully
- the last command was not completed
- an error was detected

The Last Command Success String contains a message that

- explains the error
- states if the command was successful or unsuccessful
- indicates if the register is busy

Register	Query Address	Modicon PC Register	Data Range (decimal)
Last Command Success Error Code Status String	 100 101 - 112	 40101 40102 - 40113	 0 - 65535 text

Full-scale Data Range

The Full-scale Data Range register indicates the maximum size for values that are returned from the port. Typical values for this register are 12 bits (4095), 16 bits (65535), etc…

Register	Query Address	Modicon PC Register	Data Range (decimal)	Read/Write
Full-scale Data Range	113	40114	1 - 65535	Read Only

Data is scaled between zero and the number entered for the Full-scale Data Range in the Rack Configuration Software. The Full-scale Data Range value is equivalent to 100% of full-scale.

Refer to Page 62(Scaling the Data) for examples.

Port Number

The port number will return which of the two comm ports that you are connected to and talking on.

Register	Query Address	Modicon PC Register	Read or Write	Data Range (decimal)
Port Number	114	40115	Read Only	0 - 1

Data Ready

The data ready register indicates whether or not a request for any of the multiple registers (setpoints, switch settings, events, or date/time) have completed fetching the information from the rim. This register can be set manually if the transition from zero to one is desired to be seen or it will toggle automatically upon request for the information.

Register	Query Address	Modicon PC Register	Read or Write	Data Range (decimal)
Data Ready	115	40116	Read/ Write	0 - 1

5.1.1.3 Configurable Registers

Configurable registers are user selected proportional values, channel status, module status, and setpoints. This data is a subset of what is available in the rack. Selecting only the important registers and packing them together allows a faster, more efficient map. Two register maps, each capable of storing 500, values are duplicated for the configurable registers: integer mapped from 45001 to 45500; floating point mapped from 46001 to 47000 if needed. Floating point (IEEE 32 bit standard) values span across 2 registers. In the case of a setpoint both registers can be written to at once because both registers make up one value.

Channel Status

Bits 0-7 are described in “Channel Statuses” page 46.

Bits 8-15 are specific to the monitor. Details can be reviewed from the printed register map in the 3500 Config Software.

Module Status

This is specific to the monitor. Details can be reviewed from the printed register map in the 3500 Config Software.

PPL Status

This is specific to the monitor. Details can be reviewed from the printed register map in the 3500 Config Software.

Proportional Values

All proportional values are available to be configured and are described throughout this document. Specific proportional values for each monitor are listed on page 78

Setpoints

Setpoints can be read (function code 3) or written (function code 6,16). In a Modbus command only one setpoint can be set at a time.

5.1.2 Scaling the Data

To scale the data, you must do one of the following:

- set the full-scale range for the proportional value or the setpoint in the Rack Configuration Software
- know the full-scale range for the proportional value or the setpoint

5.1.2.1 Proportional Value Example

Use the following equation to convert the output of the ports on a Communication Gateway I/O Module to engineering units:

$$\begin{matrix}\text{Scaled Value}\\(\text{engineering}\\\text{units})\end{matrix} = \frac{\text{Proportional Value}}{\text{Gateway Full-Scale Value}} \bullet \begin{pmatrix}\text{Upper}\\\text{Monitor}\\\text{Range}\end{pmatrix} - \begin{pmatrix}\text{Lower}\\\text{Monitor}\\\text{Range}\end{pmatrix} + \begin{matrix}\text{Lower}\\\text{Monitor}\\\text{Range}\end{matrix}$$

For example, for a monitor channel that is operating as shown in the following table...

Parameter	Value
Direct Full-scale range	0 - 10 mil
Measured value	39321
Full-scale Data Range	65535

...calculate the output as follows:

$$\begin{matrix}\text{Scaled Value}\\(\text{engineering units})\end{matrix} = \frac{39321}{65535} \bullet (10 - 0) + 0 = 6 \text{ mil}$$

5.1.2.2 Setpoint Example

Calculate the setpoint value to send to the Communication Gate Module using the following equation:

$$\begin{matrix}\text{Scaled}\\\text{setpoint value}\end{matrix} = \frac{\begin{pmatrix}\text{Desired}\\\text{setpoint value}\end{pmatrix} - \begin{matrix}\text{Lower}\\\text{Monitor Range}\end{matrix}\bullet \begin{matrix}\text{Gateway}\\\text{Full - scale}\end{matrix}}{\begin{pmatrix}\text{Upper}\\\text{Monitor Range}\end{pmatrix} - \begin{matrix}\text{Lower}\\\text{Monitor Range}\end{matrix}}$$

For example, for a monitor channel that is operating as shown in the following table...

Parameter	Value
Direct Full-scale range	25-0-25 mil
Desired Setpoint Value	8.2 mil
Full-scale Data Range	65535

...calculate the setpoint to input to the Communication Gateway Module as follows:

$$\text{Scaled setpoint value} = \frac{(8.2 - (-25)) \bullet 65535}{25 - (-25)} = 43515$$

If 43515 is successfully sent to the Communication Gateway Module, the data read back may be a few counts off because of scale differences.

5.1.3 Modbus Language Description

The Modbus interface complies with EIA standard RS-232C, interface type D. The communications transactions are carried out in a half-duplex mode. A transaction consists of a master sending a command and a slave device returning a response. The commands and responses are communicated asynchronously via a bit serial protocol. By design, Modbus can support multiple stations with one master and up to 255 responder stations. The Communication Gateway I/O Module (Modbus) supports 255 daisy chained Communication Gateway I/O Module (Modbus) stations when using any available baud rate. Assign each responder a unique fixed device address in the range of 1 to 255 by setting the address in the Rack Configuration Software.

In Communication Gateway I/O Module (Modbus) connections, the Communication Gateway I/O Module (Modbus) will behave as a slave on the communication link. A separate interfacing device, called a gateway, will serve as the master on this connection and usually as a protocol converter between Modbus protocol and a higher level Data Highway system. This section is concerned only with the Modbus communication link and does not discuss any special features or requirements of the gateway or the data highway.

5.1.3.1 Message Definition

When the word **status** or **point** is used in the Modbus context, it means alarm status or control bit status. This status is discrete data, which usually is represented as a single bit in a 16-bit word. When the word **register** is used in Modbus, it represents a 16-bit word of memory.

5.1.3.2 Byte Layout of Modbus Commands (RTU Framing)

Each Modbus transaction consists of the transmission of a query and response frame. These frame types are all similar and are subdivided into four fields: slave address, function code, information, and error check.

SLAVE ADDRESS	FUNCTION CODE	INFORMATION	CRC

First — Last

Order of Transmission

The length of each field is an integral multiple of 8-bit bytes. The slave address field is sent first and the other fields follow in the order shown.

Slave Address

The slave address field of both the query and the response frames contain the slave address of the affected responder station. Since there is only one initiator station, the initiator is not addressed explicitly.

The slave address field is one byte long and is defined for the values 0 to 255 as follows:

0 Signifies Broadcast frame, all stations are selected. Communication Gateway I/O Module (Modbus) lets you set the time for all the 3500 racks in a daisy chain with this message. No response will be given.

1 to 255 Selects the corresponding Communication Gateway I/O Module (Modbus).

Function Code

A one-byte long portion of the command that identifies the command type. The Communication Gateway I/O Module (Modbus) supports the following values:

Code	Function
2	Read Input Status
3	Read Holding Register
4	Read Input Register
6	Preset Single Register
8	Loopback/Maintenance
16	Preset Multiple Registers
17	Report Slave ID

Information Field

Contains all other information necessary to specify a required function or its response.

CRC Error Check Field

A field that is appended to the frame to detect transmission errors between the sending and receiving stations. The field contains no application information.

The error check field is cyclic redundancy check (CRC-16) and is 2-bytes long. Its value is a function of the preceding data in the frame. The transmitter uses the following method to calculate the CRC value:

1. Load the 16-bit CRC register with FFFF hex (all 1s).
2. Exclusive OR the first 8-bit byte of the message with the low-order byte of the 16-bit CRC register and place the result in the CRC register.
3. Shift the CRC register one bit to the right (toward the LSD) and insert a zero in the MSB.

4. Extract and examine the LSB:

   If LSB = 0: repeat Step 3

   If LSB = 1: exclusive OR the CRC register with the polynomial value A001 hex (1010 0000 0000 0001).

5. Repeat steps 3 and 4 until 8 shifts have been performed. When this is done, a complete 8-bit byte will have been processed.

6. Repeat steps 2 through 5 for the next 8-bit byte of the message. Continue doing this until all bytes have been processed.

The final contents of the CRC register is the CRC value. As each additional byte is transmitted, it is included in the value in the register the same way. The receiver also calculates the CRC value and compares it to the received CRC value to verify the accuracy of the data received.

5.1.3.3 Read Input Status Command

Use this command (function code 02) to obtain the discrete (True or False) Module Statuses and Channel Statuses from the Communication Gateway I/O Module (Modbus). The query frame is shown below:

Slave Address 01	Function Code 02	Start Addr High Byte	Start Addr Low Byte	No. of Points High Byte	No. of Points Low Byte	CRC High Byte XX	CRC Low Byte XX

The data fields and their meanings are described in the following paragraphs. The slave address and the CRC Check have the same format and meaning as described in earlier sections.

Start Address

Start Address is the Modbus address of the first input status in the group to be read. Note that each discrete input is allocated a Modbus Status Address. The higher order byte is transmitted first followed by the lower order byte. The allowed ranges are 0 to 3683 (Zero referenced). Any address outside this range for which a status is requested will result in the exception response "ILLEGAL ADDRESS". See Section 5.1.1.1 for the mapping of the Modicon PC Registers to the Communication Gateway I/O Module (Modbus) data.

Number of Points

This 16-bit field contains the discrete points beginning at the "Start Address". The Communication Gateway I/O Module (Modbus) has a limit of 2000 readable discrete points at one time. The maximum number of discrete inputs may also be limited by the DCS controller. Refer to the appropriate DCS controller manual for more information.

Example

Slave Address	Function Code	Start Addr High Byte	Start Addr Low Byte	No. of Points High Byte	No. of Points Low Byte	CRC High Byte	CRC Low Byte
01	02	00	00	00	60	78	22

The above example shows a Read Input Status Command (the byte values are in Hex) that retrieves 96 Module Statuses starting at address zero.

5.1.3.4 Read Input Status Response

The format of the Read Input Status response is shown below. The response includes the slave address, function code, number of bytes of packed discrete points being sent and the CRC check. The discrete points are packed into bytes with 1 bit for each status ("1" = True/ON "0" = False/OFF). The lower order bit of the first byte of data contains the first addressed input (point) and the remainder follows. For input quantities not a multiple of eight, the last byte will be filled with zeros in the high order bit positions.

Slave Address 01	Function Code 02	Byte Count	First 8 Points	Next 8 Points	...	Last 8 Points	CRC High Byte XX	CRC Low Byte XX

Queries containing requests for data from outside the valid ranges 0 to 3683 (Zero referenced) will result in an "ILLEGAL ADDRESS" exception response.

5.1.3.5 Read Holding Registers Command

Use this command (function code 03) to obtain the following data from the Communication Gateway I/O Module:

Setpoint Configuration	Switch Settings
Configuration Lock	Alarm Event List
System Event List	Rack Date and Time
Rack Reset	Rack Trip Multiply - Software
Rack Trip Multiply - Hardware	Rack Alarm Inhibit - Software
Rack Alarm Inhibit - Hardware	Last Command Success
Full-scale Data Range	Repeated 3XXXX and 1XXXX Data

The data for each register is a 16-bit word. The query frame is shown below:

Slave Address 01	Function Code 03	Start Address High Byte	Start Address Low Byte	No. of Registers High Byte	No. of Registers Low Byte	CRC High Byte XX	CRC Low Byte XX

The data fields and their meanings are described in the following paragraphs. The slave address and the CRC check have the same format and meaning as described in earlier sections.

Start Address

Start Address is the 16-bit Modbus holding register address corresponding to the starting value. The higher order byte is transmitted first followed by the lower order byte. The allowed ranges are 0 to 6999 (Zero referenced). Any address outside this range will result in the exception response "ILLEGAL ADDRESS". See page 35 for the mapping of the Modicon PC Registers to the Communication Gateway I/O Module (Modbus) data.

Number of Registers

This 16-bit field is the number of values to be obtained beginning at the "Start Address". The maximum number of input registers read in a single query is limited to 114 registers by the Communication Gateway I/O Module (Modbus) and may be limited by the DCS controller. Refer to the appropriate DCS controller manual for more information.

Example

Slave Address 01	Function Code 03	Start Address High Byte 00	Start Address Low Byte 06	No. of Registers High Byte 00	No. of Registers Low Byte 05	CRC High Byte 65	CRC Low Byte C8

The above example shows a Read Holding Registers Command (the byte values are in Hex) that retrieves five values starting at address six.

5.1.3.6 Read Holding Registers Response

The format of the response to Read Holding Registers is shown below. The response includes the slave address, function code, number of bytes of data being sent, and the CRC check. The contents of the registers requested are two bytes each: the first byte is the high order and the second byte is the lower order. Note that the Byte Count is the number of **bytes** in the data portion of the response or two times the number of registers.

Slave Address 01	Function Code 03	Byte Count	Data Reg. 1 High | Low	.....	Data Reg. N High | Low	CRC High Byte XX	CRC Low Byte XX

Queries containing requests for data from outside the valid range will result in an "ILLEGAL ADDRESS" exception response.

5.1.3.7 Read Input Registers Command

Use this command (function code 04) to obtain the following data from the Communication Gateway I/O Module (Modbus): the Primary Values, Current Proportional Values, and the Last Read Proportional Time Stamp. The data for each register is a 16-bit word. The query frame is shown below:

Slave Address 01	Function Code 04	Start Address High Byte	Start Address Low Byte	No. of Registers High Byte	No. of Registers Low Byte	CRC High Byte	CRC Low Byte

The data fields and their meanings are described in the following paragraphs. The slave address and the CRC check have the same format and meaning as described in earlier sections.

Start Address

Start address is the 16-bit Modbus input data register address corresponding to the first register. The higher order byte is transmitted first followed by the lower order byte. The allowed ranges are 0 to 956 (Zero referenced). Any address outside this range will result in the exception response "ILLEGAL ADDRESS". See page 35 for the mapping of the Modicon PC Registers to the Communication Gateway I/O Module (Modbus) data.

Number of Registers

This 16-bit field is the number of values to be obtained beginning at the "Start Address". The maximum number of input registers read in a single query is limited to 125 registers by the Communication Gateway I/O Module and may be limited by the DCS controller. Refer to the appropriate DCS controller manual for more information.

Example

Slave Address 01	Function Code 04	Start Address High Byte 02	Start Address Low Byte 01	No. of Registers High Byte 00	No. of Registers Low Byte 06	CRC High Byte 20	CRC Low Byte 70

The above example shows a Read Input Register Command (the byte values are in Hex) that retrieves six values starting at address 513.

5.1.3.8 Read Input Registers Response

The format of the response to Read Input Register is shown below. The response includes the slave address, function code, number of bytes of data being sent, and the CRC check. The contents of the registers requested are two bytes each: the first byte is the high order and the second byte is the lower order. Note that the Byte count is the number of **bytes** in the data portion of the response or two times the number of registers.

Slave Address 01	Function Code 04	Byte Count	Data Reg. 1 High | Low	.....	Data Reg. N High | Low	CRC High Byte XX	CRC Low Byte XX

Queries containing requests for data from addresses outside the valid range 0 to 956 will result in an "ILLEGAL ADDRESS" exception response.

5.1.3.9 Preset Single Register Command

Use this command (function code 06) to preset a value in the Setpoint Configuration, Switch Settings, Configuration Lock, Alarm Event List, System Event List, Rack Date and Time, Rack Reset, Rack Trip Multiply - Software and Rack Alarm Inhibit - Software. The data for each register is a 16-bit word. The query frame is shown below:

Slave Address 01	Function Code 06	Address High Byte	Address Low Byte	Data High Byte	Data Low Byte	CRC High Byte XX	CRC Low Byte XX

The data fields and their meaning are described in the following paragraph. The slave address and the CRC check have the same format and meaning as described in earlier sections.

Address

Address is the 16-bit Modbus address corresponding to the register. The higher order byte is transmitted first followed by the lower order byte. The allowed ranges are 0 -3, 6 -13, 30 - 31, 87 - 96, and 98 (Zero referenced). Any address outside this range will result in the exception response "ILLEGAL ADDRESS". See page 35 for the mapping of the Modicon PC Registers to the Communication Gateway I/O Module (Modbus) data.

Data

Data is the 16-bit word that will be written to the address.

Example

Slave Address 01	Function Code 06	Address High Byte 00	Address Low Byte 62	Data High Byte 00	Data Low Byte 01	CRC High Byte E9	CRC Low Byte D4

The above example shows a Preset Single Register Command (the byte values are in Hex) that sets the address 98 to one.

5.1.3.10 Preset Single Register Response

The format of the response to Preset Single Register is shown below. The response includes the slave address, function code, the address, the preset value and the CRC check.

Slave Address 01	Function Code 06	Address High Byte 00	Address Low Byte 62	Data High Byte 00	Data Low Byte 01	CRC High Byte E9	CRC Low Byte D4

Queries containing addresses outside the valid ranges will result in an "ILLEGAL ADDRESS" exception response. The valid ranges are as follows: 0 -3, 6 -13, 30 - 31, 87 - 96, and 98 (Zero referenced).

5.1.3.11 Preset Multiple Registers Command

Use this command (function code 16 [10 Hex]) to preset a value in the Setpoint Configuration, Switch Settings, Configuration Lock, Alarm Event List, System Event List, Rack Date and Time, Rack Reset, Rack Trip Multiply - Software and Rack Alarm Inhibit - Software. The data for each register is a 16-bit word. The query frame is shown below:

Slave Address 01	Function Code 10	Start Address High Byte	Start Address Low Byte	No. of Registers High Byte	No. of Registers Low Byte	Byte Count 8 bits

(continued)

Data Reg. 1 High Byte	Data Reg. 1 Low Byte	.....	Data Reg. N High Byte	Data Reg. N Low Byte	CRC High Byte XX	CRC Low Byte XX

The data fields and their meanings are described in the following paragraphs. The slave address and the CRC check have the same format and meaning as described in earlier sections.

Start Address

Start Address is the 16-bit Modbus address corresponding to the starting value. The higher order byte is transmitted first followed by the lower order byte. The allowed ranges are 4000 – 4003, 5000 – 5500, and 6000 - 6999 (Zero referenced). Any address outside this range will result in the exception response "ILLEGAL ADDRESS". See page 35 for the mapping of the Modicon PC Registers to the Communication Gateway I/O Module (Modbus) data.

Number of Registers

This 16-bit field is the number of values to be obtained beginning at the "Start Address". The maximum number of registers preset in a single query is limited

to the number of continuous write registers by the Communication Gateway I/O Module (Modbus) and may be limited by the DCS controller. Refer to the appropriate DCS controller manual for more information.

Example

Slave Address 01	Function Code 10	Start Address High Byte 00	Start Address Low Byte 57	No. of Registers High Byte 00	No. of Registers Low Byte 07

(continued)

Byte Count 0E	Data Reg. 1 High Byte 00	Data Reg. 1 Low Byte 5F	Data Reg. 2 High Byte 00	Data Reg. 2 Low Byte 05

(continued)

Data Reg. 3 High Byte 00	Data Reg. 3 Low Byte 12	Data Reg. 4 High Byte 00	Data Reg. 4 Low Byte 16	Data Reg. 5 High Byte 00	Data Reg. 5 Low Byte 09

(continued)

Data Reg. 6 High Byte 00	Data Reg. 6 Low Byte 02	Data Reg. 7 High Byte 00	Data Reg. 7 Low Byte 5E	CRC High Byte XX	CRC Low Byte XX

The above example shows a Preset Multiple Registers Command (the byte values are in Hex) that preset seven values starting at the address 87.

5.1.3.12 Preset Multiple Registers Response

The format of the response to Preset Multiple Registers is shown below. The response includes the slave address, function code, starting address, and the number of registers.

Slave Address 01	Function Code 10	Start Address High Byte	Start Address Low Byte	No. of Registers High Byte	No. of Registers Low Byte	CRC High Byte XX	CRC Low Byte XX

Queries containing addresses outside the valid ranges 4000-4003, 5000-5500, and 6000-6999 will result in an "ILLEGAL ADDRESS" exception response.

5.1.3.13 Loopback/Maintenance Function Code 8

A Diagnostic function code causes the slave to echo the data regardless of the status of the associated device. The code also restarts or interrogates the communication option in the slave without affecting the associated slave device. The query frame format is shown below:

Slave Address 01	Function Code 08	Diagnostic Code High Byte	Diagnostic Code Low Byte	Data 1 Byte	Data 2 Byte	CRC High Byte	CRC Low Byte

Response

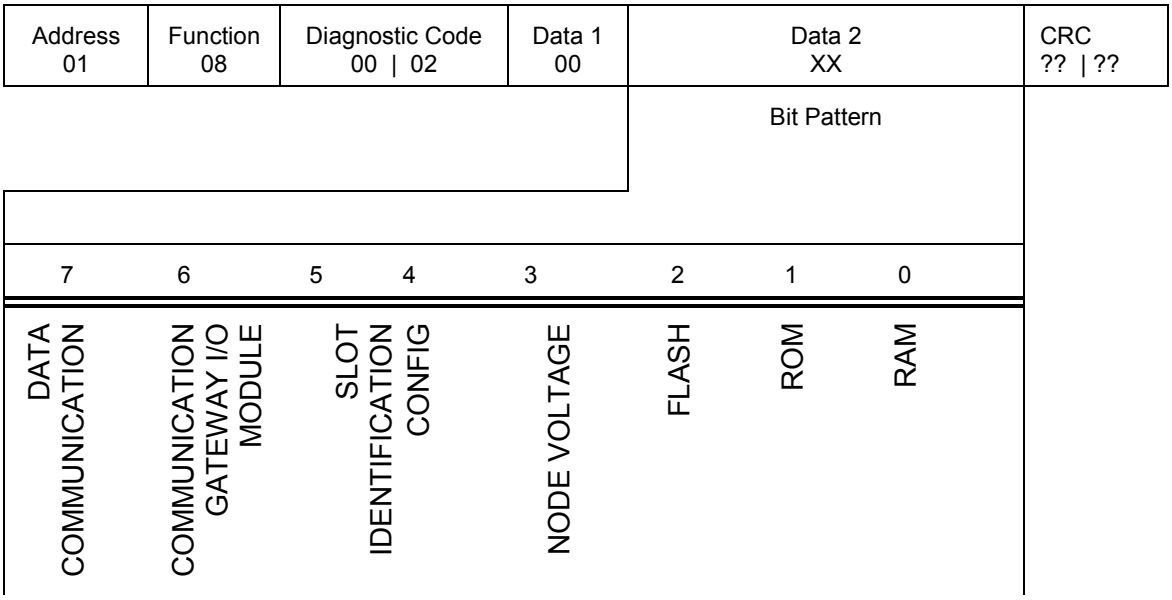
The same as the query except that the DATA field depends on the Diagnostic code.

The following table lists the Diagnostic codes.

Code	Meaning	DATA
0	Return query register	Data 1 = echoes query data Data 2 = echoes query data
2	Return diagnostic register	**
10*	Clear counters and diagnostics registers	16-bit response (This echoes the query data.)
11	Return message count	16-bit count response
12	Return communication error count	16-bit count response
13	Return exception count	16-bit count response
18	Return char overrun count	16-bit count response

* Only power-up or diagnostic code 10 clears counters and diagnostic registers. All counters count modulo 65536.

** The following bit pattern will be returned in the response.



A logic "1" in the bit pattern represents a FAILURE in the respective area.

5.1.3.14 Exception Conditions

If the addressed Communication Gateway I/O Module (Modbus) receives a query frame without a communications error and if some condition stops the Communication Gateway I/O Module (Modbus) from responding, the interface returns an exception response containing the appropriate error code to the master.

The high order bit (Hex 80) of the function code field is set to "0" in a query or normal response frame and "1" in an exception response. And regardless of the function code, the information field of all exception response frames is one byte long. This byte contains the exception code, defined below.

Code	Exception Condition
1	Illegal function. The function code received in the query is not supported.
2	Illegal data address in the information field.
3	Illegal data value in the information field.
6	Slave Device Busy

The Communication Gateway I/O Module (Modbus) implements exception codes 1, 2, 3, and 6.

5.1.3.15 Report Slave ID Function Code 17

Use function code 17 to obtain device dependent status and configuration information from the Communication Gateway I/O Module (Modbus).

Query:

Address	Function	CRC
01	11	C0 | 2C

Response:

Address	Function	Byte Count	Family ID	Family ID
01	11	6	MSB	LSB

(continued)

Communication Gateway I/O Module (Modbus) Major Revision Number	Communication Gateway I/O Module (Modbus) Minor Revision Number	CRC High Byte	CRC Low Byte

Family ID MSB

Most significant byte of the 3500 monitoring system in HEX (0D).

Family ID LSB

Least significant byte of the 3500 monitoring system in HEX (AC).

Major Rev Number

Changed when a major firmware revision occurs.

Minor Rev Number

Changed when a minor firmware revision occurs.

5.1.3.16 Modbus Application Protocol (MBAP)

MBAP is the implementation of the Modbus protocol on TCP/IP Ethernet network. MBAP is the same as the Modbus protocol with a few minor exceptions. These exceptions are necessary to properly operate on a non-deterministic network.

MBAP supports function code 2,3, 4, 6, and 16. All data can be read through function codes 2, 3, and 4. All data can be written through function codes 6 and 16; however, only one value can be changed per command. Using function code 16 to write two registers is only valid for floating point values. All other writes are for single registers.

5.1.3.17 Monitor Setpoints

When writing to the query registers, you will send the slot number (2 to 15), the channel number (1 to 32) and the setpoint number. Refer to the setpoint section of the operation and maintenance manuals of the monitor for the setpoint numbers and values.

The setpoint types are structured in an 8-bit (byte) format. Each bit in the byte has a specified meaning. The byte is broken down as shown below.

Setpoint Types

MSB LSB
WW X YYYYY where WW is alarm type
X is alarm level
YYYYY is type of proportional value

Meaning of the Bits in the Setpoint Byte

Decimal Value	Meaning
WW	
0	Over / From
1	Under / To
2	Differential
3	Unused
X	
0	Alert / Alarm 1
1	Danger / Alarm 2

Decimal Value	Meaning
YYYYY	
0	No Type
1	Direct
2	Gap
3	1X Amplitude
4	1X Phase
5	2X Amplitude
6	2X Phase
7	Max Value
8	Min Value
9	Peak To Peak
10	Speed
11	Prime Spike
12	Power
13	Peak Torque
14	Peak Speed
15	Peak Power
16	Seismic
17	Acceleration
18	Composite
19	nX Amplitude
20	nX Phase
21	Shaft Absolute - 1X Ampl
22	Shaft Absolute - 1X Phase
23	Not 1X Amplitude
24	Smax Amplitude
25	Bandpass
26	Shaft Absolute - Direct
27	Num Reverse Rotations
28	Zero Speed
29	Speed Band
30	Position
31	Differential

5.1.3.18 Module Proportional Values

The following tables list the order of the proportional values for each module. Refer to section 5.1.1.2 for a detailed explanation of the proportional value addressing scheme.

3500/25 Keyphasor Module		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Rpm
2	2	Rpm
	3	0
	4	0
	5	0
	6	0
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0

3500/40(M) Radial Vibration Channels		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Direct
1	2	Gap
1	3	1X Amplitude
1	4	1X Phase
1	5	2X Amplitude
1	6	2X Phase
1	7	Not 1x Amplitude
1	8	S_{max} Amplitude
2	9	Direct
2	10	Gap
2	11	1X Amplitude
2	12	1X Phase
2	13	2X Amplitude
2	14	2X Phase
2	15	Not 1x Amplitude
2	16	S_{max} Amplitude
Applies to monitors with or without the "M".		

3500/40(M) Eccentricity Channels		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Peak to Peak
1	2	Gap
1	3	Direct Max
1	4	Direct Min
2	5	Peak to Peak
2	6	Gap
2	7	Direct Max
2	8	Direct Min
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0
Applies to monitors with or without the "M".		

3500/40(M) Thrust Position Channels		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Direct
1	2	Gap
2	3	Direct
2	4	Gap
	5	0
	6	0
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0
Applies to monitors with or without the "M".		

3500/40(M) Differential Expansion Channels		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Direct
1	2	Gap
2	3	Direct
2	4	Gap
	5	0
	6	0
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0
Applies to monitors with or without the "M".		

3500/42 Velocity Channels		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Direct
2	2	Direct
	3	0
	4	0
	5	0
	6	0
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0

3500/42M Velocity Channels		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Direct
1	2	Gap
1	3	1X Amplitude
1	4	1X Phase
1	5	2X Amplitude
1	6	2X Phase
1	7	Not 1x Amplitude
2	8	Direct
2	9	Gap
2	10	1X Amplitude
2	11	1X Phase
2	12	2X Amplitude
2	13	2X Phase
2	14	Not 1x Amplitude
	15	0
	16	0

3500/42(M) Eccentricity Channels

Channel	Proportional Value Number	Proportional Value Name
1	1	Peak to Peak
1	2	Gap
1	3	Direct Max
1	4	Direct Min
2	5	Peak to Peak
2	6	Gap
2	7	Direct Max
2	8	Direct Min
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0

Applies to monitors with or without the "M".

3500/42(M) Radial Vibration Channels

Channel	Proportional Value Number	Proportional Value Name
1	1	Direct
1	2	Gap
1	3	1X Amplitude
1	4	1X Phase
1	5	2X Amplitude
1	6	2X Phase
1	7	Not 1x Amplitude
1	8	S_{max} Amplitude
2	9	Direct
2	10	Gap
2	11	1X Amplitude
2	12	1X Phase
2	13	2X Amplitude
2	14	2X Phase
2	15	Not 1x Amplitude
2	16	S_{max} Amplitude

Applies to monitors with or without the "M".

3500/42 Acceleration Channels

Channel	Proportional Value Number	Proportional Value Name
1	1	Direct
2	2	Direct
	3	0
	4	0
	5	0
	6	0
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0

3500/42M Acceleration II Channels

Channel	Proportional Value Number	Proportional Value Name
1	1	Direct
1	2	Gap
1	3	1X Amplitude
1	4	1X Phase
1	5	2X Amplitude
1	6	2X Phase
1	7	Not 1x Amplitude
2	8	Direct
2	9	Gap
2	10	1X Amplitude
2	11	1X Phase
2	12	2X Amplitude
2	13	2X Phase
2	14	Not 1x Amplitude
	15	0
	16	0

3500/42(M) Thrust Position Channels		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Direct
1	2	Gap
2	3	Direct
2	4	Gap
	5	0
	6	0
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0
Applies to monitors with or without the "M".		

3500/42(M) Differential Expansion Channels		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Direct
1	2	Gap
2	3	Direct
2	4	Gap
	5	0
	6	0
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0
Applies to monitors with or without the "M".		

3500/42M Shaft Absolute, Radial Vibration Channels		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	RV Direct
1	2	RV Gap
1	3	RV 1X Amplitude
1	4	RV 1X Phase
2	5	RV Direct
2	6	RV Gap
2	7	RV 1X Amplitude
2	8	RV 1X Phase
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0

3500/42M Shaft Absolute, Velocity Channels		
Channel	**Proportional Value Number**	**Proportional Value Name**
3	1	Shaft Abs Direct
3	2	Shaft Abs 1X Amplitude
3	3	Shaft Abs 1X Phase
3	4	Velocity Direct
3	5	Velocity 1X Amplitude
3	6	Velocity 1X Phase
4	7	Shaft Abs Direct
4	8	Shaft Abs 1X Amplitude
4	9	Shaft Abs 1X Phase
4	10	Velocity Direct
4	11	Velocity 1X Amplitude
4	12	Velocity 1X Phase
	13	0
	14	0
	15	0
	16	0

3500/44(M) Aeroderiviative Channels		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Direct
1	2	1X Amplitude
1	3	Band-pass
2	4	Direct
2	5	1X Amplitude
2	6	Band-pass
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0
Applies to monitors with or without the "M".		

3500/45 Thrust Position Channels		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Direct
1	2	Gap
2	3	Direct
2	4	Gap
	5	0
	6	0
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0

3500/45 Differential Expansion Channels		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Direct
1	2	Gap
2	3	Direct
2	4	Gap
	5	0
	6	0
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0

3500/45 Ramp Differential Expansion Channels		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Composite
1	2	Direct
1	3	Gap
2	4	Composite
2	5	Direct
2	6	Gap
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0

3500/45 Complementary Input Channels		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Composite
1	2	Direct
1	3	Gap
2	4	Composite
2	5	Direct
2	6	Gap
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0

3500/45 Case Expansion - Paired		
Channel	**Proportional Value Number**	**Proportional Value Name**
3	1	Direct
3	2	Composite
3	3	Position
4	4	Direct
4	5	Composite
4	6	Position
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0

3500/45 Case Expansion - Single		
Channel	**Proportional Value Number**	**Proportional Value Name**
3	1	Direct
3	2	Position
4	3	Direct
4	4	Position
	5	0
	6	0
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0

3500/45 Valve Position		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Direct
1	2	Position
2	3	Direct
2	4	Position
3	5	Direct
3	6	Position
4	7	Direct
4	8	Position
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0

3500/50 Rotor Acceleration Channel		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Rotor Accel
1	2	Speed
1	3	Peak Speed
	4	0
	5	0
	6	0
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0

3500/50 Zero Speed Channel		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Zero Speed
1	2	Speed
1	3	Peak Speed
	4	0
	5	0
	6	0
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0

3500/50 Rotor Speed Channel		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Speed
1	2	Speed Band
1	3	Peak Band
	4	0
	5	0
	6	0
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0

3500/53 Overspeed Channel		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Speed
1	2	Peak Speed
	3	0
	4	0
	5	0
	6	0
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0

3500/60 Temperature Channels		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Direct
2	2	Direct
3	3	Direct
4	4	Direct
5	5	Direct
6	6	Direct
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0

3500/60 Temperature Channels		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Direct
1	2	Composite
1	3	Differential
	4	0
	5	0
	6	0
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0
Applies if Composite or Differential are enabled.		

3500/61 Temperature Channels		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Direct
2	2	Direct
3	3	Direct
4	4	Direct
5	5	Direct
6	6	Direct
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0

3500/61 Temperature Channels		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Direct
1	2	Composite
1	3	Differential
	4	0
	5	0
	6	0
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0
Applies if Composite or Differential are enabled.		

3500/62 Process Variable		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Direct
2	2	Direct
3	3	Direct
4	4	Direct
5	5	Direct
6	6	Direct
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0

3500/64M Dynamic Pressure		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Direct
2	2	Direct
	3	0
	4	0
	5	0
	6	0
	7	0
	8	0
	9	0
	10	0
	11	0
	12	0
	13	0
	14	0
	15	0
	16	0

6. Maintenance

The boards and components inside of 3500 modules cannot be repaired in the field. Maintaining a 3500 rack consists of testing module channels to verify that they are operating correctly. Modules that are not operating correctly should be replaced with a spare.

When performed properly, this module may be installed into or removed from the rack while power is applied to the rack. Refer to the Rack Installation and Maintenance Manual (part number 129766-01) for the proper procedure.

This section shows how to verify that the Communication Gateway Module is operating correctly.

6.1 Comm Gateway Port Test Utility

Use the Communication (Comm.) Gateway Port Test Utility to verify that the Port 1 HOST connector and the Port 2 HOST connector on the Communication Gateway RS-232/422 I/O Module are operating properly. Before running the Communication Gateway Port Test Utility, connect cable 130419-01 (RS-232 Host to 3500/92) between the HOST connector on the Communication Gateway I/O Module and the computer that has the utility installed.

Refer to the 3500 Monitoring System Rack Configuration and Utilities Guide (part number 129777-01) for more information about this utility.

6.2 Performing Firmware Upgrades

Occasionally it may be necessary to replace the original firmware that is shipped with the 3500/92 Communication Gateway Module. The following instructions describe how to remove the existing firmware and replace it with upgrade firmware. The Monitor will need to be reconfigured using the 3500 Rack Configuration software after having its firmware upgraded.

The following items will be required to perform a firmware upgrade to the Communications Gateway:

Large Flathead Screwdriver.

Grounding Wrist Strap.*

Small Flathead Screwdriver

Upgrade Firmware ICs.*

*Refer to Section 8(Ordering Information) for part numbers. Users may use their own grounding wrist strap or IC removal tool.

6.2.1 Installation Procedure

The following steps will need to be followed to complete the Communication Gateway Module firmware upgrade:

Ensure that the Module's configuration is saved using the 3500 Rack Configuration software.

Refer to Section 1.2 (Handling and Storing Considerations) before handling the monitor or the upgrade firmware IC.

Remove the monitor from the 3500 rack.

Remove the Top Shield from the monitor.

Remove the two original firmware ICs from the monitor PWA.

Install the two upgrade firmware ICs into the sockets on the monitor PWA.

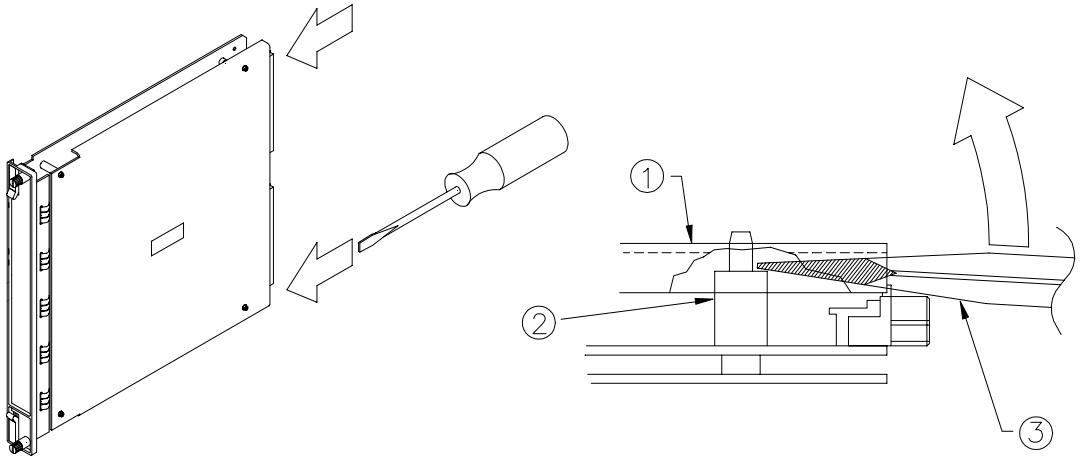
Replace the monitor Top Shield.

Replace the monitor into the 3500 system.

Reconfigure the monitor using the 3500 Rack Configuration software.

Detailed instructions for some of the steps listed above are provided on the following pages. Please review completely before proceeding.

Top Shield Removal



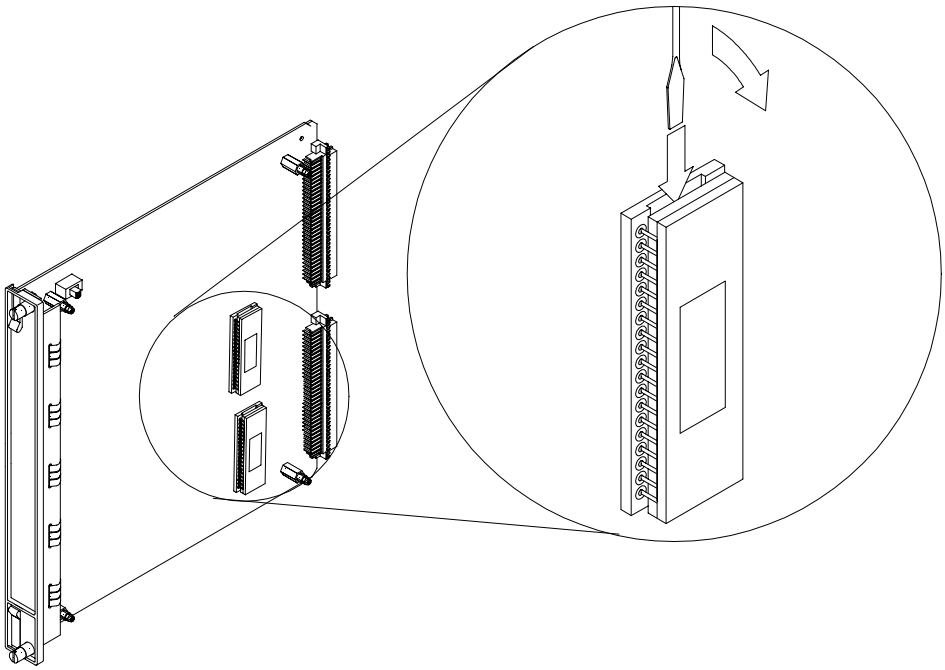
1) Top Shield.
2) Standoff.
3) Screwdriver.

Step 1. Place the large flathead screwdriver under the top shield and on the ridge of the rear standoffs and lift upward on the screwdriver to pop the cover loose from the rear standoffs.

Step 2. Move the top shield up and down to work it loose from the two front standoffs.

Original Firmware IC Removal

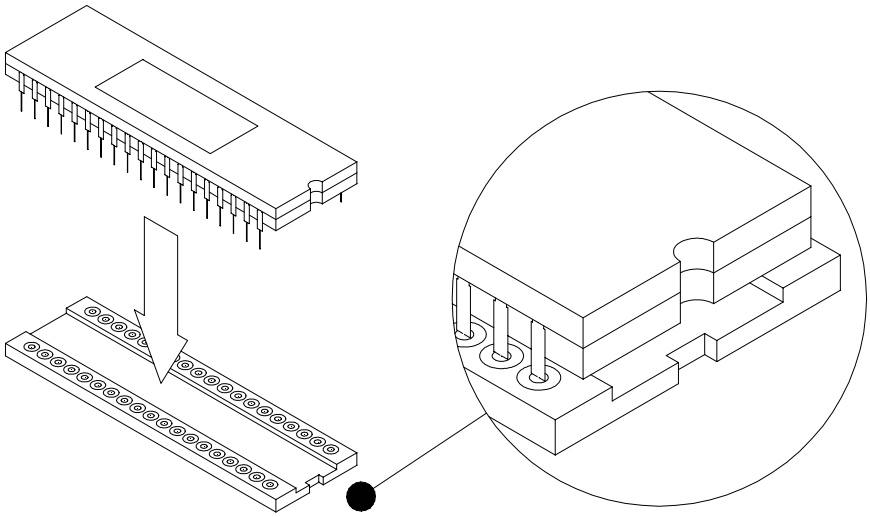
Step 1. Insert the small flathead screwdriver under the lip of either end of U5 or the ODD word IC which is situated above the other firmware IC. The diagram shows the approximate location of the chip to be removed, but not necessarily its orientation.



Step 2. Slightly lift the one end of the chip by gently prying with the screwdriver. Move to the other end of the chip and repeat. Continue this process until the chip comes loose from the socket.

Step 3 Repeat the first two steps for U6, or the EVEN word IC, which is situated below the other firmware IC.

Upgrade Firmware IC Installation



Install the upgrade firmware ICs into the PWA.

Step 1. Install the U5 upgrade. Place part number 137495-01 into the top socket on the PWA. Be sure that the notched end of the IC is matched to the notched end of the socket. Ensure that the IC is firmly seated in the socket.

Step 2. Install the U6 upgrade. Place part number 137494-01 into the bottom socket on the PWA. Be sure that the notched end of the IC is matched to the notched end of the socket. Ensure that the IC is firmly seated in the socket.

Top Shield Replacement

Replace the top shield. Be sure that the notch on the top shield is positioned at the top left corner of the module as shown in the diagram under “Top Shield Removal”. Align the holes in the top shield with the standoffs and press down around each standoff until they snap in place.

7. Troubleshooting

This section describes how to troubleshoot a problem with the Communication Gateway Module or the I/O module by using the information provided by the self-test, the LEDs, the System Event List, and the Alarm Event.

7.1 Self-test

To perform the Communication Gateway Module self-test:

Connect a computer running the Rack Configuration Software to the 3500 rack (if needed).

Select **Utilities** from the main screen of the Rack Configuration Software.

Select **System Events/Module Self-test** from the Utilities menu.

Press the **Module Self-test** button on the System Events screen.

Application Alert
Communication will be lost while the self-test is being performed.

Select the slot that contains the Communication Gateway Module and press the **OK** button. The Communication Gateway Module will perform a full self-test and the System Events screen will be displayed. The list will not contain the results of the self-test.

Wait 30 seconds for the module to run a full self-test.

Press the **Latest Events** button. The System Events screen will be updated to include the results of the self-test.

Verify that the Communication Gateway Module passed the self-test. If the module failed the self-test, refer to Section 7.3

7.2 LED Fault Conditions

The following table shows how to use the LEDs to diagnose and correct problems.

OK LED	TX/RX	Condition	Solution
1 HZ	1HZ	Communication Gateway Module is not configured.	Reconfigure the Communication Gateway Module.
5 HZ		Communication Gateway Module is Not OK.	Check the System Event List.
ON	Flashing	Communication Gateway Module is operating correctly.	No action required.
OFF		Communication Gateway Module is not operating correctly.	Check the System Event List.
	Not Flashing	Communication Gateway Module is not communicating correctly or there are no monitors in the rack.	Check the System Event List.

= behavior of the LED is not related to the condition.

7.3 System Event List Messages

This section describes the System Event List Messages that are entered by the Communication Gateway Module and gives an example of one.

Example of a System Event List Message:

Sequence Number	Event Information	Event Number	Class	Event Date DDMMYY	Event Time	Event Specific	Slot
0000000123	Device Not Communicating	32	1	02/01/90	12:24:31:99		5L

Sequence Number: The number of the event in the System Event List (for example 123).

Event Information: The name of the event (for example Device Not Communicating).

Event Number: Identifies a specific event.

Class: Used to display the severity of the event. The following classes are available:

Class Value	Classification
0	Severe /Fatal Event
1	Potential Problem Event
2	Typical logged Event
3	Reserved

Event Date: The date the event occurred.

Event Time: The time the event occurred.

Event Specific: Provides additional information for the events that use this field.

Slot: Identifies the module that the event is associated with. If a half-height module is installed in the upper slot or a full-height module is installed, the field will be 0 to 15. If a half-height module is installed in the lower slot, then the field will be 0L to 15L. For example, a module installed in the lower position of slot 5 would be 5L.

The following System Event List Messages are associated with the Communication Gateway Module and are listed in numerical order. If an event marked with a star (*) occurs, both ports on the Communication Gateway I/O Module will stop communicating. If you are unable to solve any problems, contact your nearest Bently Nevada Corporation office.

Flash Memory Failure
Event Number: 11
Event Classification: Potential Problem
Action: Replace the Communication Gateway Module as soon as possible.

Internal Network Failure
Event Number: 30
Event Classification: Severe/Fatal Event
Action: Replace the Communication Gateway Module immediately.

Device Not Communicating

Event Number: 32
Event Classification: Potential Problem
Action: Check to see if one of the following components is faulty:
the Communication Gateway Module
the rack backplane

Device Is Communicating
Event Number: 33
Event Classification: Potential Problem
Action: Check to see if one of the following components is faulty:
the Communication Gateway Module
the rack backplane

I/O Module Mismatch
Event Number: 62
Event Classification: Severe / Fatal Event
Action; Verify that the type of I/O module installed matches the protocol selected in the software. If the correct Communication Gateway I/O Module is installed, there may be a fault with the Communication Gateway Module or the Communication Gateway I/O Module.

Fail Main Board +5V-A (Fail Main Board +5V - upper Power Supply)
Event Number: 100
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:
the Communication Gateway Module
the Power Supply installed in the upper slot

Pass Main Board +5V-A (Pass Main Board +5V - upper Power Supply)
Event Number: 101
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:
the Communication Gateway Module
the Power Supply installed in the upper slot

Fail Main Board +5V-B (Fail Main Board +5V - lower Power Supply)
Event Number: 102
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:
the Communication Gateway Module
the Power Supply installed in the lower slot

Pass Main Board +5V-B (Pass Main Board +5V - lower Power Supply)
Event Number: 103
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:
the Communication Gateway Module
the Power Supply installed in the lower slot

*** Fail Main Board +5V-AB** (Fail Main Board +5V - upper and lower Power Supplies)

Event Number: 104
Event Classification: Severe / Fatal Event
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:
the Communication Gateway Module
the Power Supply installed in the lower slot
the Power Supply installed in the upper slot

Pass Main Board +5V-AB (Pass Main Board +5V - upper and lower Power Supplies)

Event Number: 105
Event Classification: Severe / Fatal Event
Action Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:
the Communication Gateway Module
the Power Supply installed in the lower slot
the Power Supply installed in the upper slot

Fail Main Board +15V-A (Fail Main Board +15V - upper Power Supply)
Event Number: 106
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:
the Communication Gateway Module
the Power Supply installed in the upper slot

Pass Main Board +15V-A (Pass Main Board +15V - upper Power Supply)
Event Number: 107
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:
the Communication Gateway Module
the Power Supply installed in the upper slot

Fail Main Board +15V-B (Fail Main Board +15V - lower Power Supply)
Event Number: 108
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:
the Communication Gateway Module
the Power Supply installed in the lower slot

Pass Main Board +15V-B (Pass Main Board +15V - lower Power Supply)
Event Number: 109
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:
the Communication Gateway Module
the Power Supply installed in the lower slot

Fail Main Board +15V-AB (Fail Main Board +15V - upper and lower Power Supplies)
Event Number: 110
Event Classification: Severe / Fatal Event
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:
the Communication Gateway Module
the Power Supply installed in the lower slot
the Power Supply installed in the upper slot

Pass Main Board +15V-AB (Pass Main Board +15V - upper and Power Power Supplies)
Event Number: 111
Event Classification: Severe / Fatal Event
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:
the Communication Gateway Module
the Power Supply installed in the lower slot
the Power Supply installed in the upper slot

Device Configured
Event Number: 300
Event Classification: Typical Logged Event
Action: No action required.

Configuration Failure
Event Number: 301
Event Classification: Severe/Fatal Event
Action: Download a new configuration to the Communication Gateway Module. If the problem still exists, replace the Communication Gateway Module immediately.

Module Entered Cfg Mode (Module Entered Configuration Mode)
Event Number: 302
Event Classification: Typical Logged Event
Action: No action required.

Software Switches Reset
Event Number: 305
Event Classification: Potential Problem
Action: Download the software switches to the Communication Gateway Module. If the software switches are not correct, replace the Communication Gateway Module.

Module Reboot
Event Number: 320
Event Classification: Typical Logged Event
Action: No action required.

Module Removed from Rack
Event Number: 325
Event Classification: Typical Logged Event
Action: No action required.

Module Inserted in Rack
Event Number: 326
Event Classification: Typical Logged Event
Action: No action required.

Device Events Lost
Event Number: 355
Event Classification: Typical Logged Event
Action: No action required.

Module Alarms Lost
Event Number: 356
Event Classification: Typical Logged Event
Action: No action required.

I/O Module Detect Fault
Event Number: 399
Event Classification: Severe/Fatal Event
Action: Verify that the Communication Gateway Module and the Communication Gateway I/O Module are plugged into the 3500 rack correctly. If that does not solve the problem, check to see if one of the following components is faulty:
Communication Gateway Module
Communication Gateway I/O Module

Pass Module Self-test
Event Number: 410
Event Classification: Typical Logged Event
Action: No action required.

Enabled Ch Bypass (Enabled Channel Bypass)
Event Number: 416
Event Classification: Typical logged event
Event Specific: Ch x
The specified channel has been bypassed.
Action: No action required.

Disabled Ch Bypass (Disabled Channel Bypass)
Event Number: 417
Event Classification: Typical logged event
Event Specific: Ch x
The specified channel has been taken out of bypass.
Action: No action required.

Fail Slot Id Test
Event Number: 461
Event Classification: Severe/Fatal Event
Action: Verify that the Communication Gateway Module is fully inserted in the rack. If the Communication Gateway Module is installed correctly, check to see if one of the following components is faulty:
the Communication Gateway Module
the rack backplane

Pass Slot Id Test
Event Number: 462
Event Classification: Severe/Fatal Event
Action: Verify that the Communication Gateway Module is fully inserted in the rack. If the Communication Gateway Module is installed correctly, check to see if one of the following components is faulty:
the Communication Gateway Module
the rack backplane

Flash Contents Corrupted
Event Number: 666
Event Classification: Severe/Fatal Event
Action: Replace the Communication Gateway Module as soon as possible.

7.4 Alarm Event List Messages

The following Alarm Event List Messages are returned by the Communication Gateway Module.

Alarm Event List Message	When the message will occur
Entered not OK	module went not OK
Left not OK	module returned to the OK state

8. Ordering Information

Part number 3500/92 - A A - B B - C C

A ☐☐ I/O Module Type

01	MODBUS RS-232/422 I/O Module
02	MODBUS RS-485 I/O Module
03	Ethernet/MODBUS RS-232
04	Ethernet/MODBUS RS-485

B ☐☐ Memory Option

00	Not Available
01	Low Memory

C ☐☐ Agency Approval Option

00	None
01	CSA-NRTL/C

Note

If the 3500/92 Communications Gateway Module is added to an existing 3500 Monitoring System, the following (or later) hardware and software versions are required:

3500 Rack Configuration Software – Version 2.3

3500/20 Main PWA – Revision N (if using a 3500/92 Ethernet option)

TMR 3500/20 Main PWA – Revision P (if using a 3500/92 Ethernet option)

Spares

Communication Gateway Module	136180-01
MODBUS I/O Module RS-232/422	125736-01
MODBUS RS-485 I/O Module	133323-01
Ethernet/MODBUS RS-232 I/O Module	136188-01
Ethernet/MODBUS RS-485 I/O Module	136188-02
Communication Gateway Module Manual	138629-01
Grounding Wrist Strap (single use only)	04425545
Firmware IC (ODD)	137495-01*
Firmware IC (EVEN)	137494-01*

*Note: The firmware ICs must be ordered and installed as a set when performing a firmware upgrade.

Cables

Host Computer to RS-232/422 Converter Cable RS-232	130119-01
RS-232 to RS-422 Converter 110 VAC	02230411
RS-232 to RS-422 Converter 220 VAC	02230412
RS-485 “Y”	139036-01

Ethernet RJ45 Cable

A

Part number 138131 - ☐☐☐

A ☐☐☐ **Cable Length**

006	6 feet (1.8 metres)
010	10 feet (3 metres)
025	25 feet (7.6 metres)
040	40 feet (12.2 metres)
050	50 feet (15.3 metres)
075	75 feet (23 metres)
085	85 feet (25.9 metres)
100	100 feet (30.5 metres)
120	120 feet (36.6 metres)
150	150 feet (45.8 metres)
200	200 feet (61 metres)
250	250 feet (76.3 metres)
320	320 feet (97.5 metres)

Fiber Optic Cable

A

Part number 130419 - ☐☐☐☐

A ☐☐☐☐ **Cable Length**

0XXX	10 ft - 500 ft. (3 metres to 152.4 metres) in 10 ft (3 metere) increments only
XX00	500 ft - 6500 ft. (152.4 metres to 1981.2 metres) in 100 ft (30.5 metere) increments only

Host to 3500/92 Cable RS-232

A **B**

Part number 130419 - ☐☐☐☐ - ☐☐

A ☐☐☐☐ **Cable Length**

0010	10 feet (3 metres)
0025	25 feet (7.5 metres)
0050	50 feet (15 metres)
0100	100 feet (30.5 metres)

B ☐☐ **Assembly Instructions**

01	Not Assembled
02	Assembled

RS-232/422 Converter to 3500/92 Cable RS-422 PVC Insulated

	A	B
Part number 130530 -	☐☐☐☐ -	☐☐

A ☐☐☐☐ Cable Length

0010	10 feet (3 metres)
0025	25 feet (7.5 metres)
0050	50 feet (15 metres)
0100	100 feet (30.5 metres)
0250	250 feet (76 metres)
0500	500 feet (152 metres)

B ☐☐ Assembly Instructions

01	Not Assembled
02	Assembled

RS-232/422 Converter to 3500/92 Cable RS-422 Teflon Insulated

	A	B
Part number 131109 -	☐☐☐☐ -	☐☐

A ☐☐☐☐ Cable Length

0010	10 feet (3 metres)
0025	25 feet (7.5 metres)
0050	50 feet (15 metres)
0100	100 feet (30.5 metres)
0250	250 feet (76 metres)
0500	500 feet (152 metres)

B ☐☐ Assembly Instructions

01	Not Assembled
02	Assembled

Honeywell PLCG to 3500/92 RS-232

	A	B
Part number 130420 -	☐☐☐☐ -	☐☐

A ☐☐☐☐ Cable Length

0010	10 feet (3 metres)
0025	25 feet (7.5 metres)
0050	50 feet (15 metres)
0100	100 feet (30.5 metres)

B ☐☐ Assembly Instructions

01	Not Assembled
02	Assembled

3500/92 to 3500/92 Cable RS-422/RS-485 PVC Insulated

Part number 129665 - A (4 boxes) - B (2 boxes)

A Cable Length

0010	10 feet (3 metres)
0025	25 feet (7.5 metres)
0050	50 feet (15 metres)
0100	100 feet (30.5 metres)
0250	250 feet (76 metres)
0500	500 feet (152 metres)

B Assembly Instructions

01	Not Assembled
02	Assembled

3500/92 to 3500/92 Cable RS-422/RS-485 Teflon Insulated

Part number 131108 - A (4 boxes) - B (2 boxes)

A Cable Length

0010	10 feet (3 metres)
0025	25 feet (7.5 metres)
0050	50 feet (15 metres)
0100	100 feet (30.5 metres)
0250	250 feet (76 metres)
0500	500 feet (152 metres)

B Assembly Instructions

00	Not Assembled
01	Assembled

Extension Cable RS-422/RS-485 (Used with Cables 129665, 131108, 130530, and 131109 for lengths greater than 152 metres (500 feet))

Part number 130531- A (2 boxes) - B (2 boxes)

A Assembly Instructions

01	Not Assembled
02	Assembled

B Insulation

01	PVC Insulated
02	Teflon Insulated

9. Specifications

INPUTS

Power Consumption:	5 watts Typical
Data:	Collects data, such as current values and current alarm statuses, via a high speed internal network.

OUTPUTS

Front Panel LEDs:	
OK LED:	Indicates when the 3500/92 is operating properly.
TX/RX LED:	Indicates when the 3500/92 is communicating with other modules in the 3500 rack.
Protocols:	
Modbus:	Based on AEG PI-MBUS-300 Rev. E Reference Manual
3500 Software:	Bently Nevada Proprietary Protocol for 3500 Configuration and Data Acquisition

ENVIRONMENTAL LIMITS

Temperature:	-30° C to 65° C (-22° F to 149° F) operating -40° C to 85° C (-40° F to 185° F) storage
Humidity:	95% non-condensing

CE MARK DIRECTIVES:

EMC Directives:

EN50081-2:

Radiated Emissions:	EN 55011, Class A
Conducted Emissions:	EN 55011, Class A

EN50082-2:

Electrostatic Discharge:	EN 61000-4-2, Criteria B
Radiated Susceptibility:	ENV 50140, Criteria A
Conducted Susceptibility:	ENV 50141, Criteria A
Electrical Fast Transient:	EN 61000-4-4, Criteria B
Surge Capability:	EN 61000-4-5, Criteria B
Magnetic Field:	EN 61000-4-8, Criteria A

Power Supply Dip:	EN 61000-4-11, Criteria B
Radio Telephone:	ENV 50204, Criteria B

Low Voltage Directives:

Safety Requirements:	EN 61010-01

HAZARDOUS AREA APPROVALS

CSA-NRTL/C	Class I, Division 2, Groups A through D

PHYSICAL

Main Board:

Dimensions (Height x Width x Depth)	241 mm x 24.4 mm x 242 mm (9.50 in x 0.96 in x 9.52 in)
Weight:	0.82 kg (1.8 lbs)

I/O Module (Modbus RS-232/422 and Modbus RS-485):

Dimensions (Height x Width x Depth)	241 mm x 24.4 mm x 99.1 mm (9.50 in x 0.96 in x 3.90 in)
Weight:	0.44 kg (0.96 lbs)

RACK SPACE REQUIREMENTS

Main Board:	1 full-height front slot
I/O Modules:	1 full-height rear slot