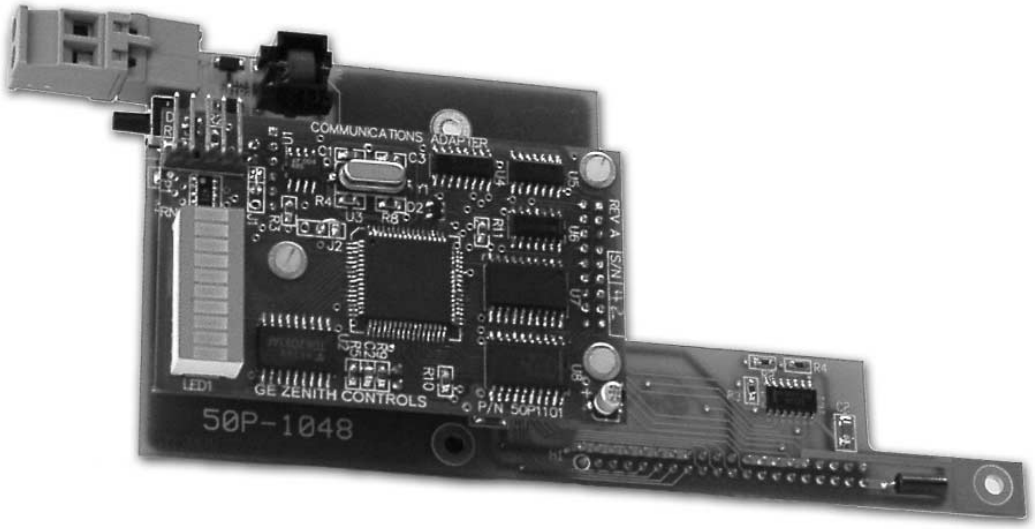
GE Zenith Controls



50R-2200B
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Operation and Maintenance Manual

Disclaimer

GE Zenith Controls disclaims any and all liability for use of third-party application software that will be used to control the Automatic Transfer Switches.

⚠ WARNING ⚠

Automatic Transfer Switches are often used in critical applications. Failure of an ATS to operate properly could cause serious personal injury (including death) and property damage. Therefore, extreme caution must be used when designing or using programming software that will communicate with the ATS. Improper use of the Modbus network variables will cause the Automatic Transfer Switch to malfunction. Always conduct a full test and debug of the programming software prior to installing and using it in the system.

Table of Contents

Overview

The Modbus card is a network card designed for the MX200. If the MX200 is ordered with the Modbus option, the Modbus card will reside on the back of the MX200 board and it will be part of the MX200 assembly. The purpose of this card is to allow the MX200 to be available on a Modbus network as a slave device. This allows a master device, such as a programmable logic controller (PLC), to obtain information from the MX200 and have that information available for control, data acquisition and monitoring.

Every Modbus network consists of one master device and at least one slave device. All devices on the network are daisy-chained using a twisted pair cable (see Appendix F). Each slave device is assigned a unique address (factory default for each MX200 Modbus card is Slave Address 1), which is a number from 1-247. This number enables the master to distinguish between the various slaves on the network. It also allows the master device to send a query command to the addressed slave. When the addressed slave receives this command it will send back an appropriate response to the master. *Table 1* shows a list of Modbus commands which the MX200 Modbus network card supports. Reference Appendix H for a more detailed description of the Modbus commands.

Modbus Command	Modbus Command Description
01	Read Coil Status
03	Read Holding Register
05	Write Single Coil
06	Write Single Holding Register
15	Write Multiple Coils
16	Write Multiple Holding Registers

Table 1 – Supported Modbus Commands

The Modbus commands allow the master device to read data from, and write data to, specific memory locations in the MX200. These memory locations, which are listed in Appendix A and B, make up the Modbus network variables for the MX200. These variables allow the reading of MX200 status, configuration, voltage and frequency, serial number, time on emergency, number of transfers, timer values, and pickup/dropout settings. The variables, which can be written to (reference Appendix B), include timer values, pickup/dropout settings, and control variables. Appendix A lists the Read Only memory locations and Appendix B lists the Read/Write memory locations in the MX200.

Both lists contain the Parameter Name column that displays the name of the memory locations. The non-indented names in that column are 16-bit registers while the indented ones are individual bits, which make up the 16-bit registers. For example, Status 0, a non-indented name, is a 16-bit register that consists of the following eight bits:

- Automatic Transfer Relay
- ATS Not in Auto Mode
- Fault
- Exerciser Enabled
- Load Test Running
- Normal Source Available
- Load, No Load, Fast Load Test Status
- Emergency Source Available

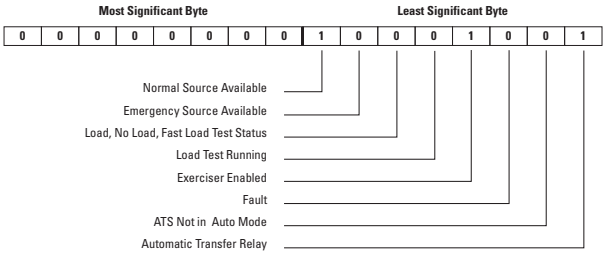


Figure 1 – Status 0 Register

These eight bits make up the least significant byte of the Status 0 register, while the most significant byte of the Status 0 register contains zeros. *Figure 1* shows an example of what the Master device would see if it read back the entire Status 0 register. In this example, the Master device would read back the decimal value of 137 from the Status 0 register. When this value is decoded, the Master finds out that the normal source is available, the exerciser is on and the automatic transfer relay is on. The Master also has the option of reading the individual bits, indented under Status0. This allows the Master to know the status of each parameter without doing any decoding. The second column contains the actual addresses for the network variables. These addresses are used when the Master is reading a Holding Register (16-bit reg). The third column contains addresses that are used when the Master is reading a Coil (individual bit). The remaining columns show the values, ranges (only in Appendix B) and register types for the network variables.

LED Indicator

The Modbus card has a 10-segment LED module (Refer to Appendix E for location). These LED's display the slave address of the card as well as the transmit and receive status. The first LED from the bottom indicates the receive status. The second LED indicates the transmit status. When a Modbus packet has been successfully transmitted or received, the associated LED will light for 100ms. If another packet is sent or received before the 100ms elapses, the LED on time will be extended by another 100ms. LED's 3-10 display the slave address of the MX200 as a binary number with each LED corresponding to a bit. *Figure 2* shows the 10-segment LED module along with LED's 3, 5, and 6 being lit. The lit LED's correspond to slave address 13 for the MX200.

LED 10 - 2^7
LED 9 - 2^6
LED 8 - 2^5
LED 7 - 2^4
LED 6 - 2^3
LED 5 - 2^2
LED 4 - 2^1
LED 3 - 2^0
LED 2 - Transmit
LED 1 - Receive

Figure 2 – LED Module

Installation

Installing the Network Card on the MX200

If the Modbus network card is not installed on the MX200, do the following to install it:

1. Open the ATS cabinet. If the ATS has power going to it, be EXTREMELY cautious not to touch any energized parts.
2. Unscrew the black metal cover from the back of the MX200. Be sure not to lose any screws.
3. Remove the two Engine Start wires from the P-Relay(s) if applicable (not applicable in Utility-Utility applications). Use electrical tape to tape over the exposed ends of both wires.
4. Remove the J5 and J6 plugs from the MX200 (located on bottom of board), this will remove power from the MX200. When power is removed from the MX200, the ATS will not transfer.
5. Obtain a grounding wrist strap and put the elastic end of the strap on your wrist. Attach the alligator clip end to the MX200 chassis or an equivalent earth ground.
6. Remove the three screws from the metal standoffs on the MX200. Connect the Modbus network card to the MX200 and fasten it to the controller with the three screws (Reference Appendix G).
7. Once the Modbus card is installed connect the J5 and J6 plugs back into the MX200.
8. Screw the black metal cover back on and connect the two Engine Start wires to the P-Relay(s) if applicable.
9. Close the ATS cabinet.
10. Once the MX200 has power, the network option needs to be enabled. Go into the CNFG menu and enable the network option (Reference Appendix I).
11. When the network option is enabled, exit the CNFG menu.

Termination Resistor

Located on the bottom of the Modbus card is jumper J6 (See Appendix C), which enables or disables a termination resistor on the board *(Figure 3)*. Jumper J6 is disabled when it comes from the factory.

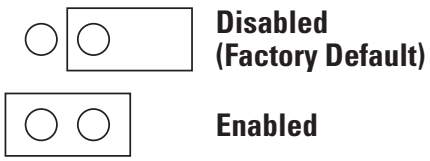


Figure 3 – Jumper J6

The only time that Jumper J6 should be enabled is when its corresponding Modbus card is the last device on the network.

Configuring a Modbus Network Card

The Modbus card can be configured in a variety of ways. The configuration of the card includes configuring the slave address, RTU or ASCII mode, baud rate, parity, and stop bits **(the default settings are Slave Address 1, RTU mode, 9600 Baud, No Parity and 2 Stop Bits).** These slave settings will be setup by the user and must match the master device settings for proper communications. The user configures these settings using a Modbus Configuration software package (GE Zenith Part # 50P-1111) that allows for the changes to be made and then writes them to the card. This software can also read the configuration of the card. The following is a procedure for configuring the Modbus Network card (See Appendix D for wiring connections).

1. In order to change the configuration settings the user must first make sure that **J4 is jumped and J6 is not jumped on the card** (Refer to Appendix C for location). **Make sure that the power to the Modbus card is off when doing this.**
2. Make sure that the Modbus Network Card Assembly is installed on the MX200. If it is not, refer to the "Installing the Network Card on the MX200" section on this page.
3. Power down MX200 and connect one end (DB9 female) of the RS232/485 converter (GE Zenith Part # 50W-1208) to the PC that has the Configuration software. The other end of the cable needs to be connected to the RS485 connector of the Modbus card. Check to make sure that the polarity connections are correct.
4. Power up the MX200 and Modbus card.
5. Run the Configuration software on the PC.
6. When loaded, check settings in the Configure PC's Serial port section, make changes as needed. The serial port settings are 9600 baud, no parity, 8 data bits and 1 stop bit.
7. Click on the CONFIG button to configure the specified serial port.
8. Click on the READ button to read the device's current configuration.
9. Click on the MODIFY button to enable parameter changing.
10. Make necessary changes in the Device information section.
11. Click on the WRITE button to write new configuration to the device.
12. To verify that the configuration was written to the device, click the READ button and verify the settings in the Device information section.
13. **Cycle power to ATS/MX200 controller to enable settings on the Modbus card.**

Downloading New Firmware

The Modbus Network card firmware can be updated in the field by downloading the new firmware to the onboard Flash using the Configuration software (GE Zenith Part # 50P-1111). This allows the Modbus card to be updated with new firmware upgrades. The downloading procedure is as follows (See Appendix E for wiring connections):

1. Power down the MX200 and carefully remove the Modbus card. Make sure that you are wearing a grounding wrist strap or following proper electrostatic device handling procedures. Failure to do this may result in damage to the Modbus card.
2. Check to make sure there is no jumper on J4 (Refer to Appendix C for location). If there is, remove it.
3. Connect one end (DB9 female) of the programming adapter (GE Zenith Part # 50P-1103) to the RS232 serial port on the PC.
4. Connect the other end (DB9 male) of the programming adapter to the programmer cable (GE Zenith Part # 50P-1102).
5. Connect the 5-pin connector of the programming cable to the Modbus card's 5-pin header; be sure to line up the brown color wire with pin 1 of Modbus card's 5-pin header.
6. Plug in the AC adapter. This AC adapter provides power throughout the firmware downloading process.
7. Run the Configuration software on the PC.
8. When loaded, check settings in the Configure PC's Serial port section, make changes as needed. The serial port settings are 9600 baud, no parity, 8 data bits and 1 stop bit.
9. Click on the CONFIG button to configure the specified serial port.
10. Click on the DOWNLOAD button to start the downloading firmware process.
11. Answer YES if you are ready to download firmware.
12. Select the GE Zenith Controls supplied ".s19" firmware file (GE Zenith Part # 50P-1112) from the file selection window and click OK. This is the new firmware file that will be downloaded to the card.

Testing a Modbus Network

The Modbus network can be tested using the components in the Modbus Configuration package (GE Zenith Part # 50P-1124). Reference Appendix D for connections.

1. If testing a network consisting of more than one card, make sure that all of the cards are daisy chained as shown in Appendix F. Verify that all Modbus cards are in the run mode (termination jumper J4 must not be installed). Termination jumper (J6) is only installed on the last card on the network.
2. Connect one end (DB9 female) of the RS232/485 converter (GE Zenith Part # 50W-1208) to the PC that contains the Configuration software (GE Zenith Part # 50P-1111). The other end of the cable needs to be connected to the RS485 connector of the Modbus card. Check to make sure that the polarity connections are correct.
3. Run the Configuration software on the PC.
4. Press the TEST button and then verify that the settings in the Communication Settings section match the settings of the Modbus network. If necessary, make changes to the settings and click the NEXT button.
5. The software will now scan the network and display the serial number of all MX200 controllers, which have the Modbus card attached. The user can select any of the listed serial numbers and execute a load test on a controller associated with the selected serial number, but only one controller can be tested at a time.

Appendix A – Read Only Register List

Parameter Name	Holding Register	Coil	Value	Register Type
Status 0	40001			Read-Only
Automatic Transfer Relay		1	1 = On , 0 = Off	Read-Only
ATS Not in Auto Mode		2	1 = Not in Auto	Read-Only
Fault		3		Read-Only
Exerciser Enabled		4	1 = Enabled	Read-Only
Load test running		5	1 = Running	Read-Only
Load, No Load, Fast Load Test status		6	1 = Running	Read-Only
Emergency Source available		7	1 = Available	Read-Only
Normal Source available		8	1 = Available	Read-Only
Status 1	40002			Read-Only
SN limit switch		9	1 = On , 0 = Off	Read-Only
SE limit switch		10	1 = On , 0 = Off	Read-Only
SNO limit switch		11	1 = On , 0 = Off	Read-Only
SEO limit switch		12	1 = On , 0 = Off	Read-Only
Emergency Phase Rotation		13	1 = On , 0 = Off	Read-Only
Normal Phase Rotation		14	1 = On , 0 = Off	Read-Only
Number of Phases on Emergency		15	1 = Three , 0 = Single	Read-Only
Number of Phases on Normal		16	1 = Three , 0 = Single	Read-Only
Status 2	40003			Read-Only
N/A		17		Read-Only
S5 selector switch		18	1 = On , 0 = Off	Read-Only
S12 selector switch		19	1 = On , 0 = Off	Read-Only
Load Shed input		20	1 = On , 0 = Off	Read-Only
Q7 input		21	1 = On , 0 = Off	Read-Only
Q3 input		22	1 = On , 0 = Off	Read-Only
Auxiliary 2 Input		23	1 = On , 0 = Off	Read-Only
Auxiliary 1 Input		24	1 = On , 0 = Off	Read-Only
Timer ID	40004			Read-Only
Timer Bit 0		25	See Table 2	Read-Only
Timer Bit 1		26	See Table 2	Read-Only
Timer Bit 2		27	See Table 2	Read-Only
N/A		28		Read-Only
N/A		29		Read-Only
N/A		30		Read-Only
N/A		31		Read-Only
N/A		32		Read-Only
Timer active		33	1 = Timer running	Read-Only
Normal Position Status		34	1 = Normal Position	Read-Only
Emergency Position Status		35	1 = Emergency Position	Read-Only
MX200 - Mod Card Comm Error		36	1 = Comm Error	Read-Only
N/A		37		Read-Only
N/A		38		Read-Only
N/A		39		Read-Only
N/A		40		Read-Only
Timer Countdown Value	40005		Seconds	Read-Only
Normal Voltage Ph1-Ph2	40006		Volts	Read-Only
Normal Voltage Ph2-Ph3	40007		Volts	Read-Only
Normal Voltage Ph3-Ph1	40008		Volts	Read-Only
Emergency Voltage Ph1-Ph2	40009		Volts	Read-Only
Emergency Voltage Ph2-Ph3	40010		Volts	Read-Only
Emergency Voltage Ph3-Ph1	40011		Volts	Read-Only
Normal Frequency (scaled value)	40013		Freq Value = scaled value/10	Read-Only
Emergency Frequency (scaled value)	40015		Freq Value = scaled value/10	Read-Only
Time On Emergency	40016		Seconds	Read-Only
Number of Transfers	40017			Read-Only
N/A	40018			Read-Only
Serial Number - MSR	40019			Read-Only
Serial Number - LSR	40020			Read-Only
Nominal Full Scale Voltage Value	40021			Read-Only

Appendix A – Read Only Register List *(cont'd)*

Parameter Name	Holding Register	Coil	Value	Register Type
Net Config 0	40022			Read-Only
T3 Timer Bypass Option		41	1 = Configured	Read-Only
T3 Timer Option		42	1 = Configured	Read-Only
W3 Timer Bypass Option		43	1 = Configured	Read-Only
W3 Timer Option		44	1 = Configured	Read-Only
T Timer Bypass Option		45	1 = Configured	Read-Only
W Timer Bypass Option		46	1 = Configured	Read-Only
In Phase Monitor / Closed Transition		47	1 = Configured (Std ATS) 1 = Configured (Delay ATS)	Read-Only
ATS Type		48	1 = Delay , 0 = Standard	Read-Only
Net Config 1	40023			Read-Only
S12 Auto/Manual Option		49	1 = Configured	Read-Only
S5 Auto/Manual Bypass Option		50	1 = Configured	Read-Only
Phase Sequence Check Option		51	1 = Configured	Read-Only
Emg Over Frequency Option		52	1 = Configured	Read-Only
Emg Over Voltage Option		53	1 = Configured	Read-Only
Norm Over Frequency Option		54	1 = Configured	Read-Only
Norm Under Frequency Option		55	1 = Configured	Read-Only
Norm Over Voltage Option		56	1 = Configured	Read-Only
Net Config 2	40024			Read-Only
N/A		57		Read-Only
N/A		58		Read-Only
N/A		59		Read-Only
N/A		60		Read-Only
N/A		61		Read-Only
N/A		62		Read-Only
N/A		63		Read-Only
N/A		64		Read-Only
Normal Voltage Ph1-Ph2	40025		A/D Raw Value (See Note 1)	Read-Only
Normal Voltage Ph2-Ph3	40026		A/D Raw Value (See Note 1)	Read-Only
Normal Voltage Ph3-Ph1	40027		A/D Raw Value (See Note 1)	Read-Only
Emergency Voltage Ph1-Ph2	40028		A/D Raw Value (See Note 1)	Read-Only
Emergency Voltage Ph2-Ph3	40029		A/D Raw Value (See Note 1)	Read-Only
Emergency Voltage Ph3-Ph1	40030		A/D Raw Value (See Note 1)	Read-Only
Normal Period Count	40031		Raw Value Unsigned Integer (See Note 1)	Read-Only
Emergency Period Count	40032		Raw Value Unsigned Integer (See Note 1)	Read-Only

NOTE 1: Registers 40025-40027 (Normal) and 40028-40030 (Emergency) contain unscaled voltage values. In order to obtain a full-scale voltage value, use the following formula:
*Voltage = (A/D Raw Value / 192) * Full Scale Voltage (Register 40021)*

NOTE 2: Registers 40031 (Normal) and 40032 (Emergency) contain unscaled frequency values. In order to obtain a full-scale frequency value, use the following formula: *Scaled Frequency = (20,000,000 / Period Count)*

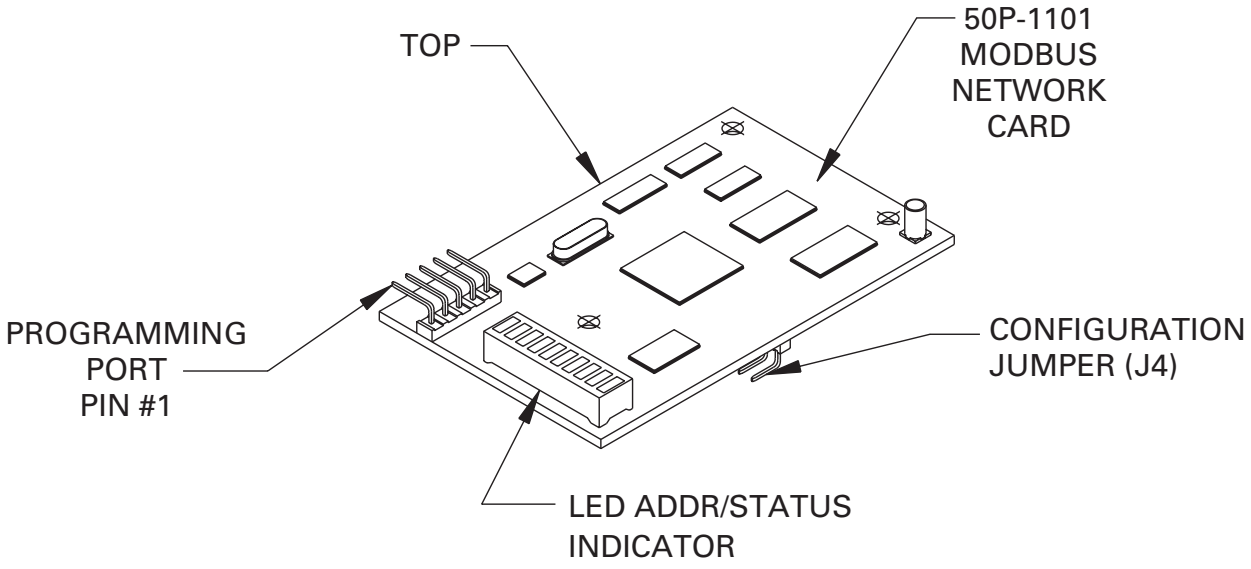
Timer Bits 0, 1, and 2 stand for the specific timer which is counting down during a transfer. The table below shows the combinations of the Timer Bits that make up each timer for a certain type of ATS. Starting from left to right are Timer Bits 2, 1, and 0.

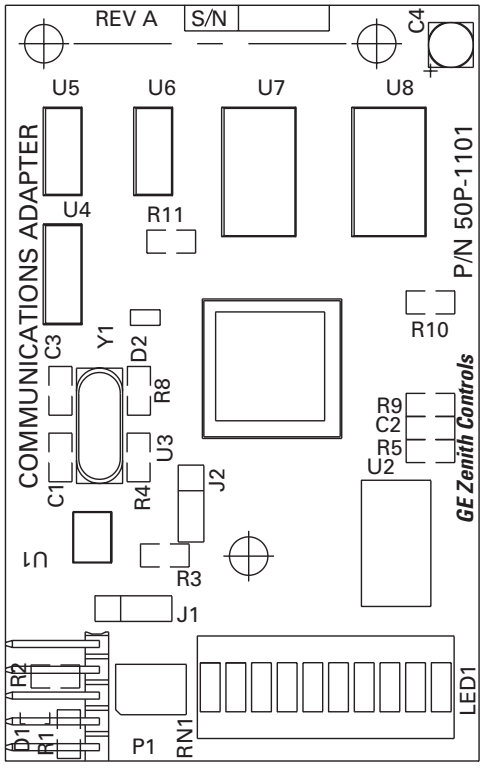
ATS Type	TIMER							
	P	W	W3	DW	T	T3	DT	U
Standard	111	101	N/A	N/A	010	N/A	N/A	000
Standard with Pre-Signal	111	110	101	N/A	011	010	N/A	000
Delay	111	100	N/A	101	001	N/A	010	000
Delay with Pre-Signal	111	110	100	101	011	001	010	000

Table 2 – Timer Bits

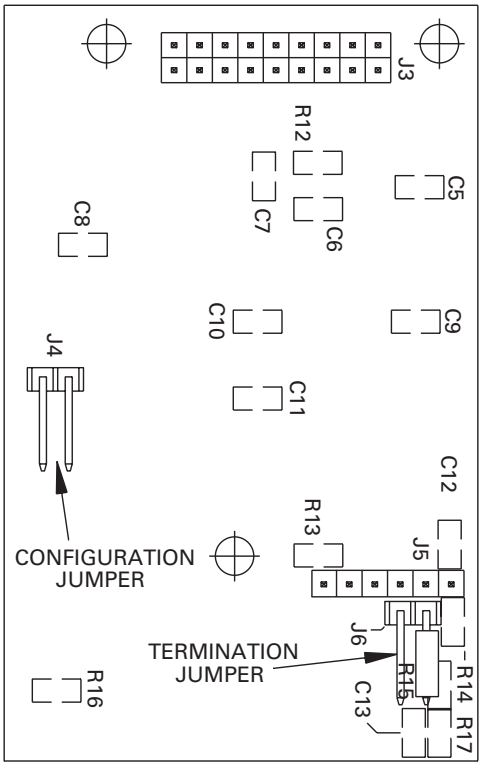
Parameter Name	Holding Register	Coil	Value	Range	Register Type
P time	40033		10 seconds max	0-1000 1/100 of a second	Read/Write
W time	40034		5 minute max	0-300 seconds	Read/Write
W3 time	40035		1 minute max	0-60 seconds	Read/Write
DW time	40036		10 minute max	0-600 seconds	Read/Write
T time	40037		1 hour max	0-3600 seconds	Read/Write
T3 time	40038		1 minute max	0-60 seconds	Read/Write
DT time	40039		10 minute max	0-600 seconds	Read/Write
U time	40040		1 hour max	0-3600 seconds	Read/Write
Normal Pickup Voltage	40041			85-100 percent	Read/Write
Normal Dropout Voltage	40042			75-98 percent	Read/Write
Emergency Pickup Voltage	40043			85-100 percent	Read/Write
Emergency Dropout Voltage	40044			75-98 percent	Read/Write
Normal Pickup Frequency	40045			90-100 percent	Read/Write
Emergency Pickup Frequency	40046			90-100 percent	Read/Write
Net Control 0	40047				Read/Write
N/A		65			Read/Write
N/A		66			Read/Write
N/A		67			Read/Write
YE control		68		1 = On , 0 = Off	Read/Write
YN control		69		1 = On , 0 = Off	Read/Write
No Load Test control		70		1 = On , 0 = Off	Read/Write
Load Test control		71		1 = On , 0 = Off	Read/Write
Fast Load Test control		72		1 = On , 0 = Off	Read/Write
Net Control 1	40048				Read/Write
N/A		73			Read/Write
S5 control		74		1 = On , 0 = Off	Read/Write
S12 control		75		1 = On , 0 = Off	Read/Write
LS control		76		1 = On , 0 = Off	Read/Write
Q7 control		77		1 = On , 0 = Off	Read/Write
Q3 control		78		1 = On , 0 = Off	Read/Write
AUX2 control		79		1 = On , 0 = Off	Read/Write
AUX1 control		80		1 = On , 0 = Off	Read/Write

Appendix C – Modbus Network Card





TOP OF MODBUS CARD



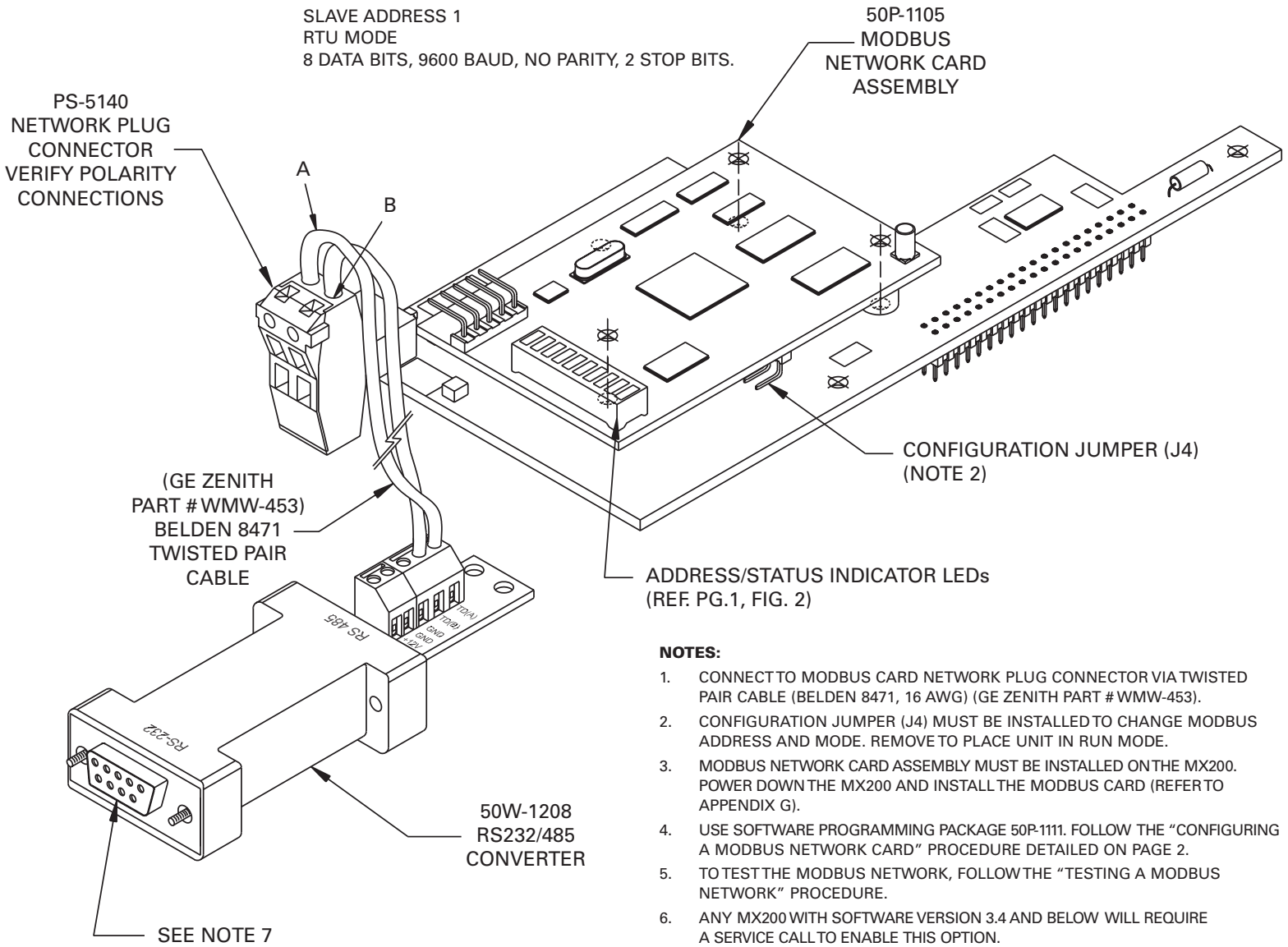
BOTTOM OF MODBUS CARD

Appendix D

Connections for Configuring and Testing the Modbus Card

MODBUS NETWORK CARD DEFAULT SETTINGS

SLAVE ADDRESS 1
RTU MODE
8 DATA BITS, 9600 BAUD, NO PARITY, 2 STOP BITS.

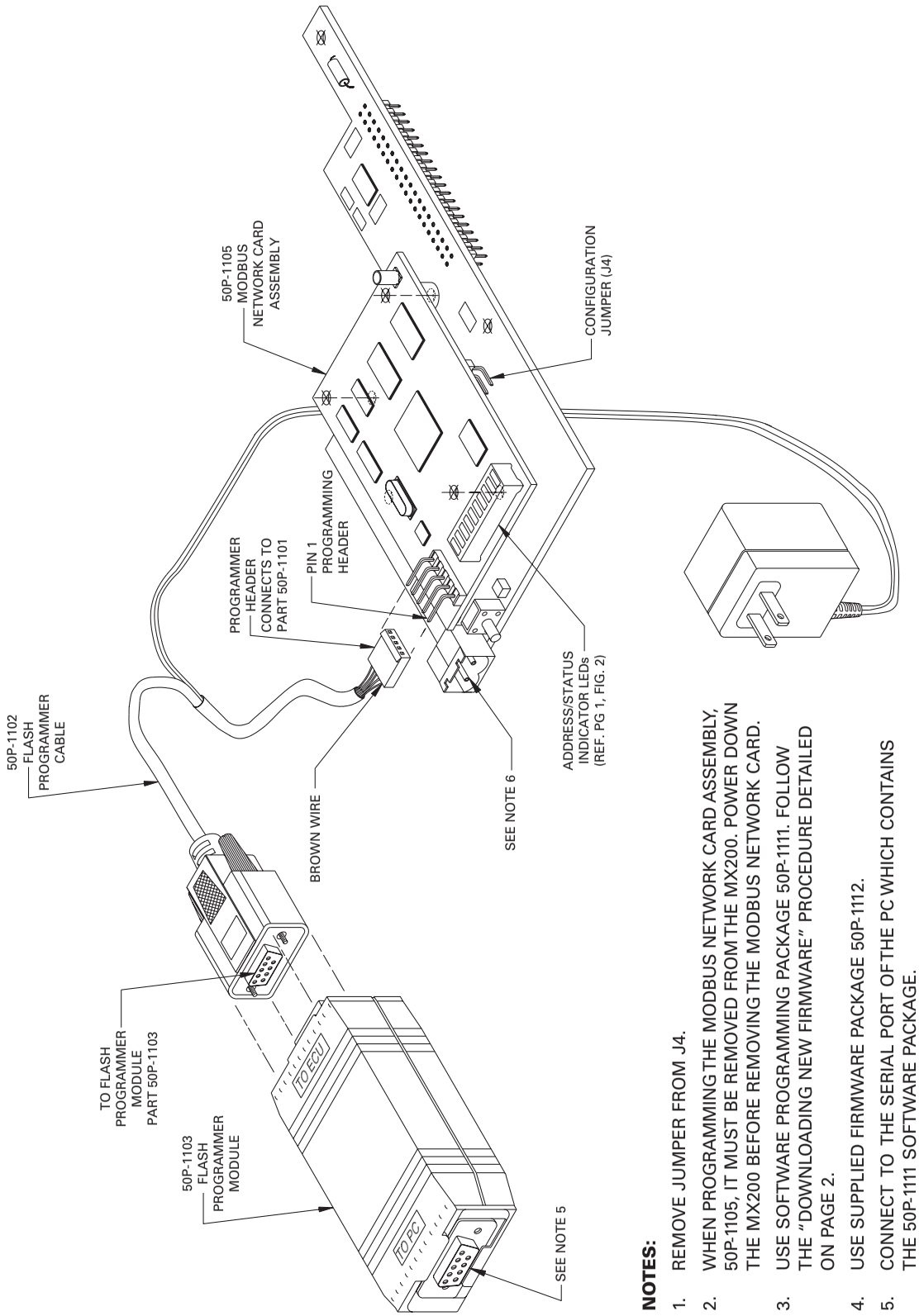


NOTES:

1. CONNECT TO MODBUS CARD NETWORK PLUG CONNECTOR VIA TWISTED PAIR CABLE (BELDEN 8471, 16 AWG) (GE ZENITH PART # WMW-453).
2. CONFIGURATION JUMPER (J4) MUST BE INSTALLED TO CHANGE MODBUS ADDRESS AND MODE. REMOVE TO PLACE UNIT IN RUN MODE.
3. MODBUS NETWORK CARD ASSEMBLY MUST BE INSTALLED ON THE MX200. POWER DOWN THE MX200 AND INSTALL THE MODBUS CARD (REFER TO APPENDIX G).
4. USE SOFTWARE PROGRAMMING PACKAGE 50P-1111. FOLLOW THE "CONFIGURING A MODBUS NETWORK CARD" PROCEDURE DETAILED ON PAGE 2.
5. TO TEST THE MODBUS NETWORK, FOLLOW THE "TESTING A MODBUS NETWORK" PROCEDURE.
6. ANY MX200 WITH SOFTWARE VERSION 3.4 AND BELOW WILL REQUIRE A SERVICE CALL TO ENABLE THIS OPTION.
7. CONNECT TO THE SERIAL PORT OF THE PC WHICH HAS THE 50P-1111 SOFTWARE PACKAGE.

Appendix E

Connections for Downloading New Firmware

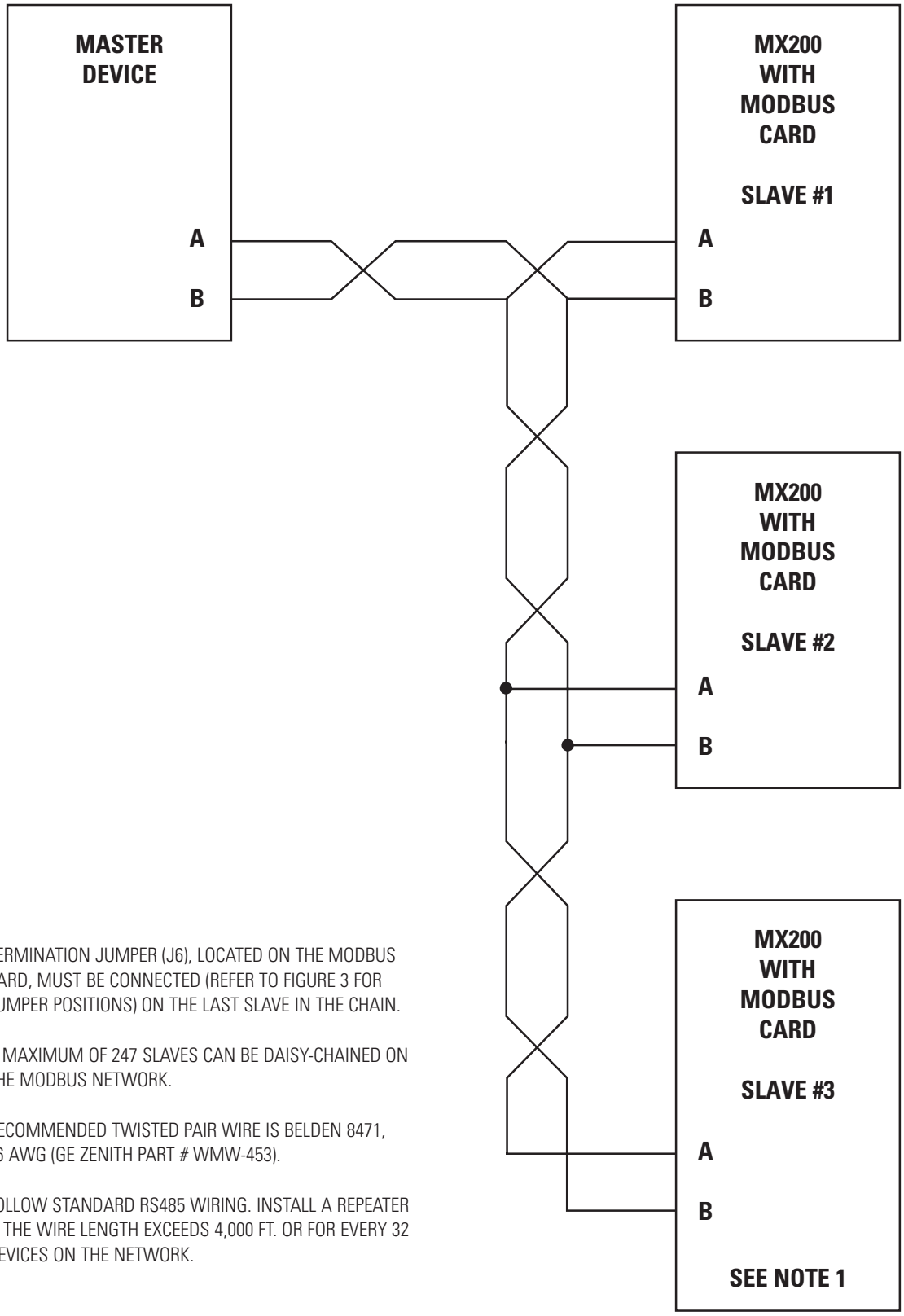


NOTES:

1. REMOVE JUMPER FROM J4.
2. WHEN PROGRAMMING THE MODBUS NETWORK CARD ASSEMBLY, 50P-1105, IT MUST BE REMOVED FROM THE MX200. POWER DOWN THE MX200 BEFORE REMOVING THE MODBUS NETWORK CARD.
3. USE SOFTWARE PROGRAMMING PACKAGE 50P-1111. FOLLOW THE "DOWNLOADING NEW FIRMWARE" PROCEDURE DETAILED ON PAGE 2.
4. USE SUPPLIED FIRMWARE PACKAGE 50P-1112.
5. CONNECT TO THE SERIAL PORT OF THE PC WHICH CONTAINS THE 50P-1111 SOFTWARE PACKAGE.
6. DISCONNECT THE MX200 FROM THE NETWORK BY REMOVING THE NETWORK PLUG CONNECTOR FROM ASSEMBLY.

Appendix F

RS485 Multi-Drop Connection

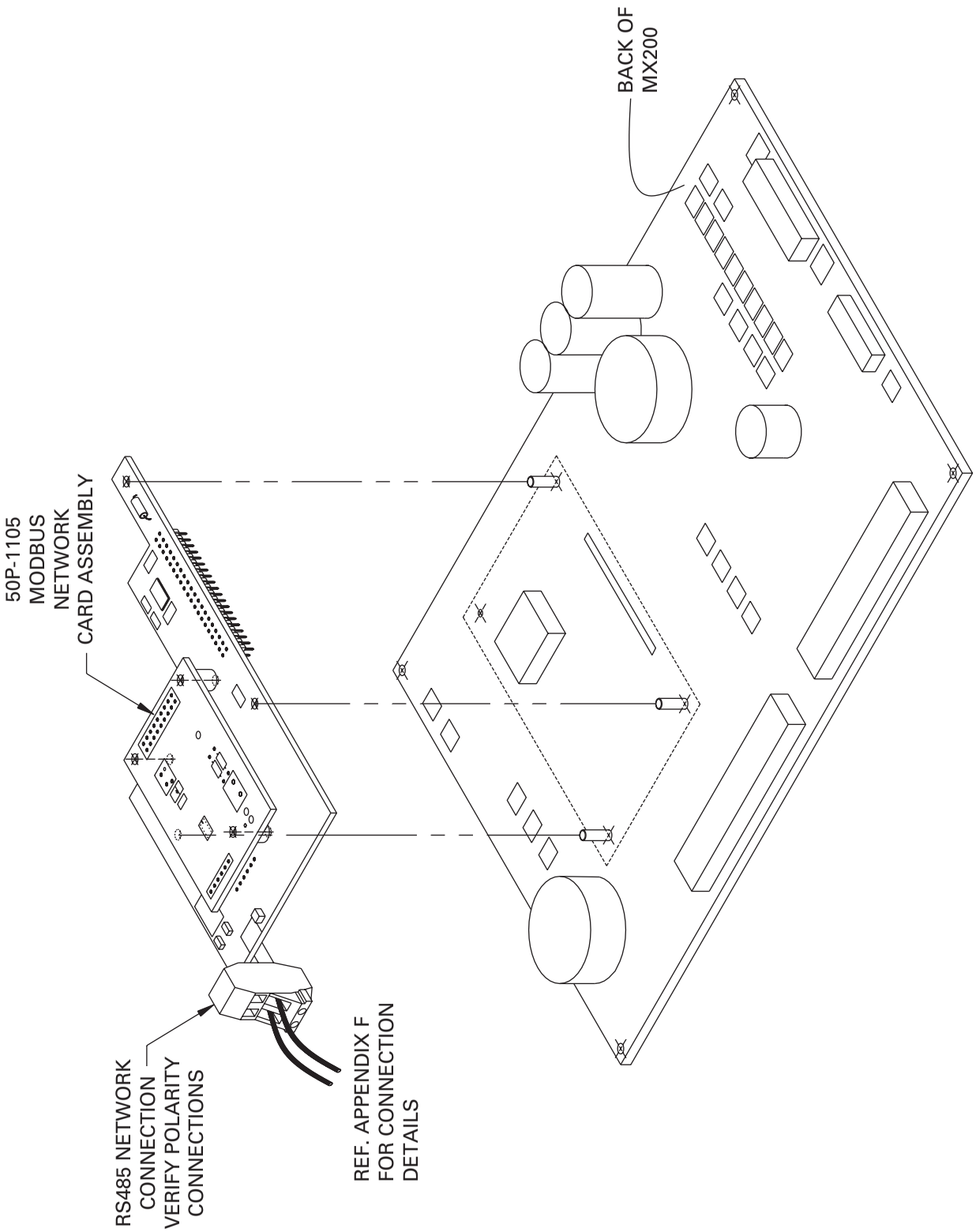


NOTE:

1. TERMINATION JUMPER (J6), LOCATED ON THE MODBUS CARD, MUST BE CONNECTED (REFER TO FIGURE 3 FOR JUMPER POSITIONS) ON THE LAST SLAVE IN THE CHAIN.
2. A MAXIMUM OF 247 SLAVES CAN BE DAISY-CHAINED ON THE MODBUS NETWORK.
3. RECOMMENDED TWISTED PAIR WIRE IS BELDEN 8471, 16 AWG (GE ZENITH PART # WMW-453).
4. FOLLOW STANDARD RS485 WIRING. INSTALL A REPEATER IF THE WIRE LENGTH EXCEEDS 4,000 FT. OR FOR EVERY 32 DEVICES ON THE NETWORK.

Appendix G

Location of Modbus Card on MX200



Appendix H

Modbus Protocol Illustration

For a detailed specification of the Modbus protocol, reference the Modicon website address **"public.modicon.com/support/Support_Pages/modbussupportpage.htm"**.

The Modbus protocol provides the internal standard for parsing messages. During communications on a Modbus network, the protocol determines how each slave will know its device address, recognize a message addressed to it, determine the kind of action to be taken, and extract any data or other information contained in the message. If a reply is required, the slave will construct the reply message and send it using Modbus protocol.

The following is a brief description of the Modbus commands supported by the Modbus Network Card. Each command consists of the following:

- a sample query message that is sent out by the master device to the designated slave
- the slave's reply message to the master device

The query and reply messages show how the information is packeted and sent out using the Modbus Protocol.

Each query message consists of the following:

- *Slave Address* – address of the slave you wish to establish communications with.
- *Function Code* – code that lets the slave know what command is being requested, e.g. read coil, write single coil.
- *Starting Address High/Low Order* – high and low byte of the address the master reads from or writes to. Coils and Registers are addressed starting at 0. For instance Coil 1 is address 0 and Register 1 is address 0.
- *Error Check Field* – contains either a CRC (RTU mode) or LRC (ASCII mode) error check value.

The query message for specific functions requires some of the following information:

- *Number of Data Points High/Low Order* – high and low byte of the number of addresses the master wants to read.
- *Data High/Low Order* – high and low byte of the data that will be written to the slave device.
- Number of Coils High/Low Order – high and low byte for the number of coils to force ON or OFF.
- *Number of Regs High/Low Order* – high and low byte for the number of registers to preset.
- *Byte Count* – is the number of data bytes which are sent to the slave.

These query and reply messages are for both RTU and ASCII modes depending on whether the Error Check Field contains a CRC or LRC respectively. Each value in the query message is a hexadecimal value.

Read Coil Status (Function Code 01)

Query

This function allows the master device to obtain the ON/OFF bit status of various coils from the addressed slave.

Figure H1 is a sample read coil status request to read coils 9-24 (MX200 status bits) from slave device 5.

Slave Address	Function Code	Starting Address *High* Order	Starting Address *Low* Order	No. of Data Points *High* Order	No. of Data Points *Low* Order	Error Check Field (LRC or CRC)
5	01	00	08	00	10	—

Figure H1 – Read Coil Status Query Message

Response

An example response to the Read Coil Satus is shown in *Figure H2*. The response includes the slave address, function code, number of data bytes sent, the data, and error checking.

Slave Address	Function Code	Byte Count	Data Coil Status 9-16	Data Coil Status 17-24	Error Check Field (LRC or CRC)
5	01	02	C1	A2	—

Figure H2 – Read Coil Status Response Message

The data consists of one bit per coil (1=ON, 0=OFF). The status of coils 9-16 is C1 (hex) or 1100 0001 (binary). Reading left to right, coils 16, 15, and 9 are ON and the remainder is OFF. The other data byte is decoded similarly.

Read Holding Register (Function Code 03)

Read holding registers allows the master device to obtain the binary contents of holding registers 4xxxx in the addressed slave.

Query

Figure H3 is an example that reads registers 40006-40007 from slave 8.

Slave Address	Function Code	Starting Address *High* Order	Starting Address *Low* Order	No. of Data Points *High* Order	No. of Data Points *Low* Order	Error Check Field (LRC or CRC)
8	03	00	05	00	02	—

Figure H3 – Read Holding Register Query Message

Modbus Protocol Illustration *(cont'd)*

Response

The slave responds with its address, function code, number of data bytes, and the data. The contents of the registers requested (data) are two bytes each. The first byte includes the high order bits and the second, the low order bits.

Slave Address	Function Code	Byte Count	*High* Order Data	*Low* Order Data	*High* Order Data	*Low* Order Data	Error Check Field (LRC or CRC)
8	03	04	00	76	00	78	—

Figure H4 – Read Holding Register Response Message

Register 40006 , Normal Voltage Ph1-Ph2, has a value of 118 (76 hex) and register 40007, Normal Voltage Ph2-Ph3 has a value of 120 (78 hex).

Write Single Coil (Function Code 05)

This function forces a single coil either ON or OFF. A value of 65,280 (FF00 Hex) will set the coil ON and the value zero will turn it OFF; all other values are illegal and will not affect that coil.

Query

Figure H5 is an example of a request to slave number 3 to turn ON coil 71.

Slave Address	Function Code	Starting Address *High* Order	Starting Address *Low* Order	Data *High* Order	Data *Low* Order	Error Check Field (LRC or CRC)
3	05	00	46	FF	00	—

Figure H5 – Write Single Coil Query Message

Response

The slave's normal response to the Write Single Coil query is to return the original message after the coil state has been altered.

Slave Address	Function Code	Starting Address *High* Order	Starting Address *Low* Order	Data *High* Order	Data *Low* Order	Error Check Field (LRC or CRC)
3	05	00	46	FF	00	—

Figure H6 – Write Single Coil Response Message

Write Single Holding Register (Function Code 06)

This function allows the master to modify the contents of one holding register.

Query

Figure H7 is an example of a request to preset register 40041 (Normal Pickup Voltage) to 92 (00 5C hex) in slave device 17.

Slave Address	Function Code	Starting Address *High* Order	Starting Address *Low* Order	Data *High* Order	Data *Low* Order	Error Check Field (LRC or CRC)
11	06	00	28	00	5C	—

Figure H7 – Write Single Holding Register Query Message

Response

The slave's response to the Write Single Holding Register query is to return the original message after the registers have been altered.

Slave Address	Function Code	Starting Address *High* Order	Starting Address *Low* Order	Data *High* Order	Data *Low* Order	Error Check Field (LRC or CRC)
11	06	00	28	00	5C	—

Figure H8 – Write Single Holding Register Response Message

Write Multiple Coils (Function Code 15)

Forces each coil in a sequence of coils to either ON or OFF. The requested ON/OFF states are specified by contents of the query data field. A logical '1' in a bit position of the field requests the corresponding coil to be ON and a logical '0' requests it to be OFF. Coils are addressed starting at 0. For examples coil 1 is addressed as 0.

Query

The following example is a request to force a series of sixteen coils starting at coil 41 (addressed as 40, or 28 hex) in slave device 9.

The query data contents consist of two bytes: 3C 9B hex (0011 1100 1001 1011 binary). The binary bits correspond to the coils in the following way:

Bit:	0	0	1	1	1	1	0	0		1	0	0	1	1	0	1	1
Coil:	48	47	46	45	44	43	42	41		56	55	54	53	52	51	50	49

The first byte sent (3C hex) addresses coils 41-48, with the least significant bit addressing coil 41. The second byte sent (9B hex) addresses coils 49-56, with the least significant bit addressing coil 49.

Slave Address	Function Code	Starting Address *High* Order	Starting Address *Low* Order	Number of Coils *High* Order	Number of Coils *Low* Order	Byte Count	Data *High* Order	Data *Low* Order	Error Check Field (LRC or CRC)
9	15	00	28	00	10	02	3C	9B	–

Figure H9 – Write Multiple Coils Query Message

Modbus Protocol Illustration *(cont'd)*

Response

The response from the slave is an echo of the slave address, function code, starting address and number of coils forced.

Slave Address	Function Code	Starting Address *High* Order	Starting Address *Low* Order	Number of Coils *High* Order	Number of Coils *Low* Order	Error Check Field (LRC or CRC)
9	15	00	28	00	10	—

Figure H10 – Write Multiple Coils Response Message

Write Multiple Holding Registers (Function Code 16)

Presets values into a sequence of holding registers.

Query

The following is an example to preset two registers starting at 40034 (W-Time) to 9 hex (9 seconds) and 40035 (W3-time) to 32 hex (50 seconds), in slave device 17.

Slave Address	Function Code	Starting Address *High* Order	Starting Address *Low* Order	Number of Regs *High* Order	Number of Regs *Low* Order	Byte Count	Data *High* Order	Data *Low* Order	Data *High* Order	Data *Low* Order	Error Check Field (LRC or CRC)
11	16	00	21	00	02	04	00	09	00	32	–

Figure H11 – Write Multiple Registers Query Message

Response

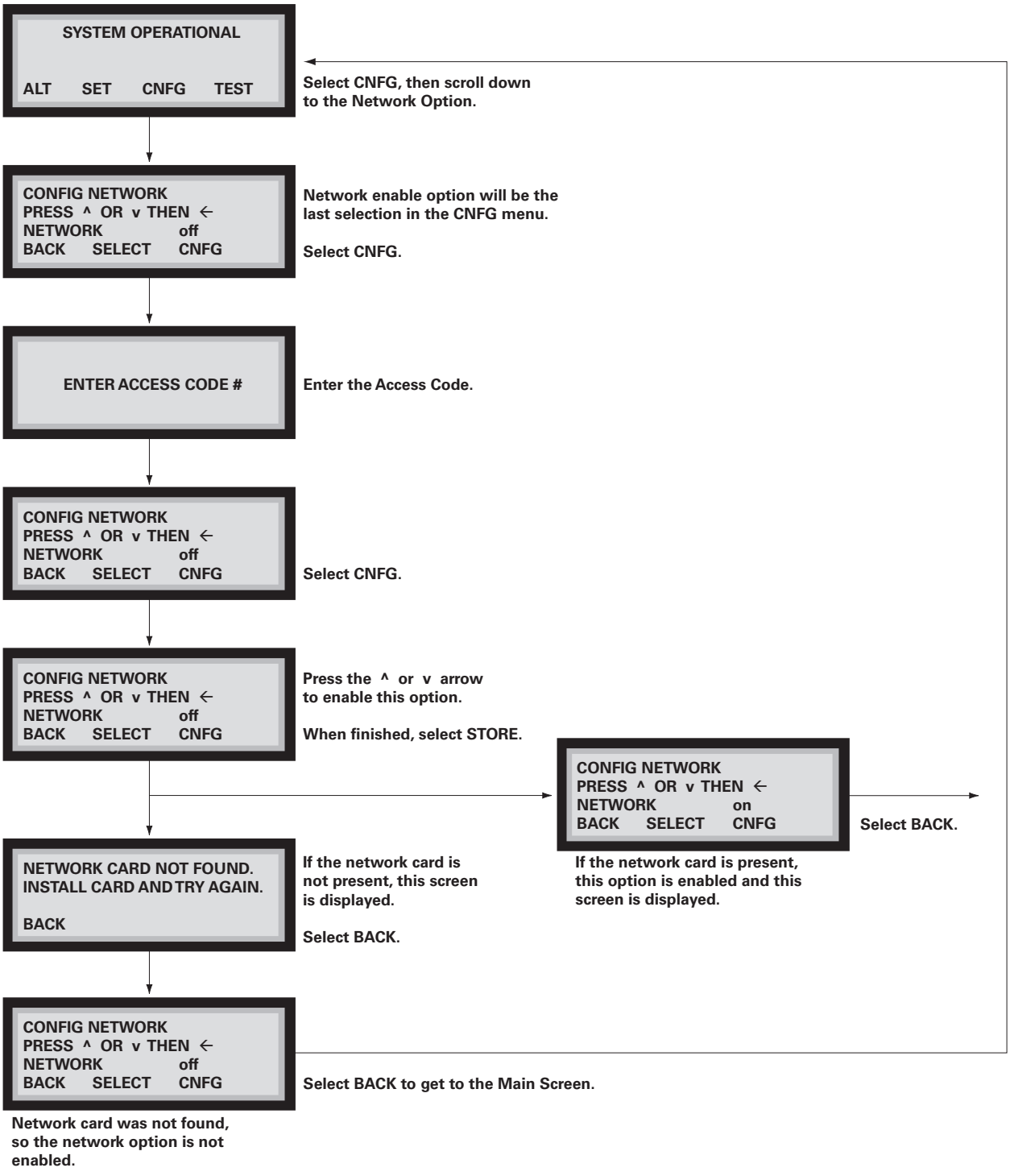
The response from the slave is an echo of the slave address, function code, starting address and number of registers to be loaded.

Slave Address	Function Code	Starting Address *High* Order	Starting Address *Low* Order	Number of Regs *High* Order	Number of Regs *Low* Order	Error Check Field (LRC or CRC)
11	16	00	21	00	02	—

Figure H12 – Write Multiple Registers Response Message

Appendix I

MX200 Menus *(for MX200 Versions 3.5 and Higher)*



Troubleshooting

Problem	Possible Cause	Corrective Action
Trouble downloading firmware	Modbus card is installed on the MX200 and it has power going to it.	Remove the Modbus card from the MX200, and make sure it has no power and retry the download.
	Configuration jumper, J4, is installed.	Remove the J4 jumper.
	Flash programmer cable is not connected correctly to the Modbus cards' programming header.	See **Appendix E** for the proper connections. Make sure when inserting the programmer cable header to the Modbus card's programming header, that the brown wire lines up with pin 1.
	Flash programmer module is not connected correctly to the Flash programmer cable.	See **Appendix E** for the proper connections. Make sure that the end labeled "TO PC" on the programmer module is connected to the PC's serial port and the other end goes to the programmer cable.
	Wrong COM port or baud rate.	Select the correct COM port and baud rate.
	Power supply for the Flash programmer cable is not connected to an AC outlet.	Connect the power supply to an AC outlet.
Trouble configuring the Modbus card	Modbus card is not installed on the MX200.	Install the Modbus card on the MX200.
	MX200 does not have power.	Power up the MX200.
	Configuration jumper, J4, is not installed.	Install the configuration jumper J4.
	Wire between the RS232/485 converter and Modbus card is not connected.	See **Appendix D** for the proper connections. Connect the twisted wire between the converter and the Modbus card.
	Polarity connections are incorrect.	Make sure that A on the Modbus card is connected to A on the converter and B is connected to B.
	Wrong COM port or baud rate.	Select the correct COM port and baud rate.
	RS232/485 converter is not connected to the PC.	Connect the RS232/485 converter to the PC's serial port.
No communications between the MX200 Modbus card and the Master device	MX200 does not have power.	Power up the MX200 controller.
	Communicating with the wrong addressed slave.	Verify that the address on the Modbus card matches the address you are communicating with. See Figure 2 for reference.
	Network wire connection from the Master to the Modbus card is broken or the wire is not connected to the Modbus card.	Check the wire connection from the Master to the Modbus card. Connect the wire to the Network card if necessary.
	Not using the twisted pair wire to make the network connection.	Make sure that the wire is a twisted pair wire (Belden 8471, 16 AWG) (GE Zenith Part # WMW-453).
	Configuration jumper, J4, is installed.	Remove the J4 configuration jumper.
	Proper polarity markings are not being followed.	Connect A to A and B to B on the network, reference Appendix F.
	Termination jumper, J6, is not installed on the last slave in the chain.	Install the termination jumper, J6, on the last slave in the chain. Make sure no other devices have jumper J6 installed.
	Modbus card communication configuration does not match the Master's.	Verify that the Master and Modbus card slave have the same baud rate, data bits, parity, stop bits and ASCII or RTU protocol selected.
	Twisted pair wire length exceeded 4,000 ft.	Install repeater if wire length exceeds 4,000 ft.
	RS485 multi-drop consists of more than 32 devices.	Install one repeater for every 32 devices on the network.
	MX200 network option not enabled.	Call **GE Zenith Controls** Technical Support.
All LED's on the LED module are off.	Modbus card is not installed on the MX200.	Install the Modbus card on the MX200.
	MX200 does not have power.	Power up the MX200 controller.
	The Modbus card is damaged.	Call **GE Zenith Controls** Technical Support.

Bill of Materials

Components for the Modbus Option (ZNET200M)

	Part Description	GE Zenith Part Number	Quantity
Assembly	Modbus Network Card Assembly	50P-1105	1
Individual Replacement Components	Modbus Network Card	50P-1101	1
	MX200 Network Adapter Card	50P-1048	1
	Network Plug Connector	PS-5140	1
	Miniature Support Post	PS-7363	3
	Operations and Maintenance Manual	50R-2200	1

Components for the Modbus Card Configuration

	Part Description	GE Zenith Part Number	Quantity
Assembly	Modbus Card Configuration Assembly	50P-1124	1
Individual Replacement Components	RS232/485 Converter	50W-1208	1
	Belden 8471 Twisted Pair Cable	WMW-453	6 Feet
	Network Plug Connector	PS-5140	1
	Configuration Software for Modbus Communications Card	50P-1111	1
	Operations and Maintenance Manual	50R-2200	1

Components for Downloading New Firmware

	Part Description	GE Zenith Part Number	Quantity
Assembly	Firmware Download Assembly	50P-1125	1
Individual Replacement Components	Flash Programmer Module	50P-1103	1
	Flash Programmer Cable	50P-1102	1
	Configuration Software for Modbus Communications Card	50P-1111	1
	Modbus Communications Card Firmware	50P-1112	1
	Operations and Maintenance Manual	50R-2200	1

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