INSTALLATION INSTRUCTIONS

Original Issue Date: **3/04**
Model: **Closed-Transition Transfer Switches**
Market: **ATS**
Subject: **Modbus® Interface Card GM30429-KA1 and Modbus® Development Kit GM30430-KA1**

Introduction

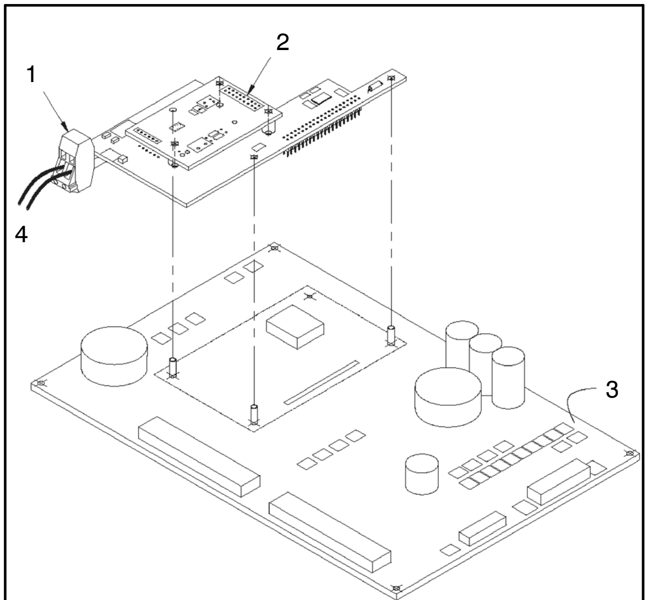
This publication provides operating instructions for the following kits:

- GM30429-KA1, factory-installed Modbus® interface card for closed-transition automatic transfer switches and bypass/isolation switches with microprocessor-based electrical controls.
- GM30430-KA1, Modbus® development kit for the Modbus® interface card.

The Modbus® interface card is a network card designed for the controller on the closed-transition transfer switch. If the switch is ordered with the Modbus® option, the Modbus® card will reside on the back of the control board and it will be part of the controller assembly. See Figure 1. The purpose of this card is to allow the transfer switch 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 transfer switch and have that information available for control, data acquisition, and monitoring.

Note: Always conduct a full test of the programming software with the ATS system to ensure proper operation. The manufacturer disclaims any and all responsibility for use of third-party application software that will be used to control the automatic transfer switches.

Modbus® development kit GM30430-KA1 is required for the initial setup of the Modbus® interface card. The Modbus® development kit contains the configuration software required to set up the communication parameters on the card.



1. RS-485 network connection (verify polarity connections)
2. Modbus® network card assembly
3. Back of controller
4. Connection (see Figure 2)

Figure 1 Location of Modbus® Card on Controller

Information in this publication represents data available at the time of print. The manufacturer reserves the right to change this literature and the products represented without notice and without any obligation or liability whatsoever.

Read this publication and carefully follow all procedures and safety precautions to ensure proper equipment operation and to avoid bodily injury. Read and follow the Safety Precautions. Keep this publication with the equipment for future reference.

Modbus® is a registered trademark of Schneider Electric

Safety Precautions

Observe the following safety precautions while connecting the hardware.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

Grounding electrical equipment. Hazardous voltage can cause severe injury or death. Electrocution is possible whenever electricity is present. Open the main circuit breakers of all power sources before servicing the equipment. Configure the installation to electrically ground the generator set, transfer switch, and related equipment and electrical circuits to comply with applicable codes and standards. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

Short circuits. Hazardous voltage/current can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while making adjustments or repairs. Remove all jewelry before servicing the equipment.

Electrostatic discharge damage. Electrostatic discharge (ESD) damages electronic circuit boards. Prevent electrostatic discharge damage by wearing an approved grounding wrist strap when handling electronic circuit boards or integrated circuits. An approved grounding wrist strap provides a high resistance (about 1 megohm), *not a direct short*, to ground.

1 Overview

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 Figure 2). Each slave device is assigned a unique address (factory default 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. The tables in Sections 8 and 9 list the Modbus® commands that the Modbus® network card supports. See Section 7, Modbus® Protocol Illustration, for a more detailed description of the Modbus® commands.

The Modbus® commands allow the master device to read data from and write data to specific memory locations in the controller. These memory locations, which are listed in Section 8 and 9, make up the Modbus® network variables for the controller. These variables allow the reading of the following parameters:

- Status
- Configuration
- Voltage
- Frequency
- Serial number
- Time on emergency
- Number of transfers
- Timer values
- Pickup/dropout settings

The variables, which can be written to (reference Section 9), include timer values, pickup/dropout settings, and control variables. Section 8 lists the Read Only memory locations and Section 9 lists the Read/Write memory locations in the controller.

Both lists contain the Parameter Name column that displays the name of the memory locations. The nonindented 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 nonindented 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

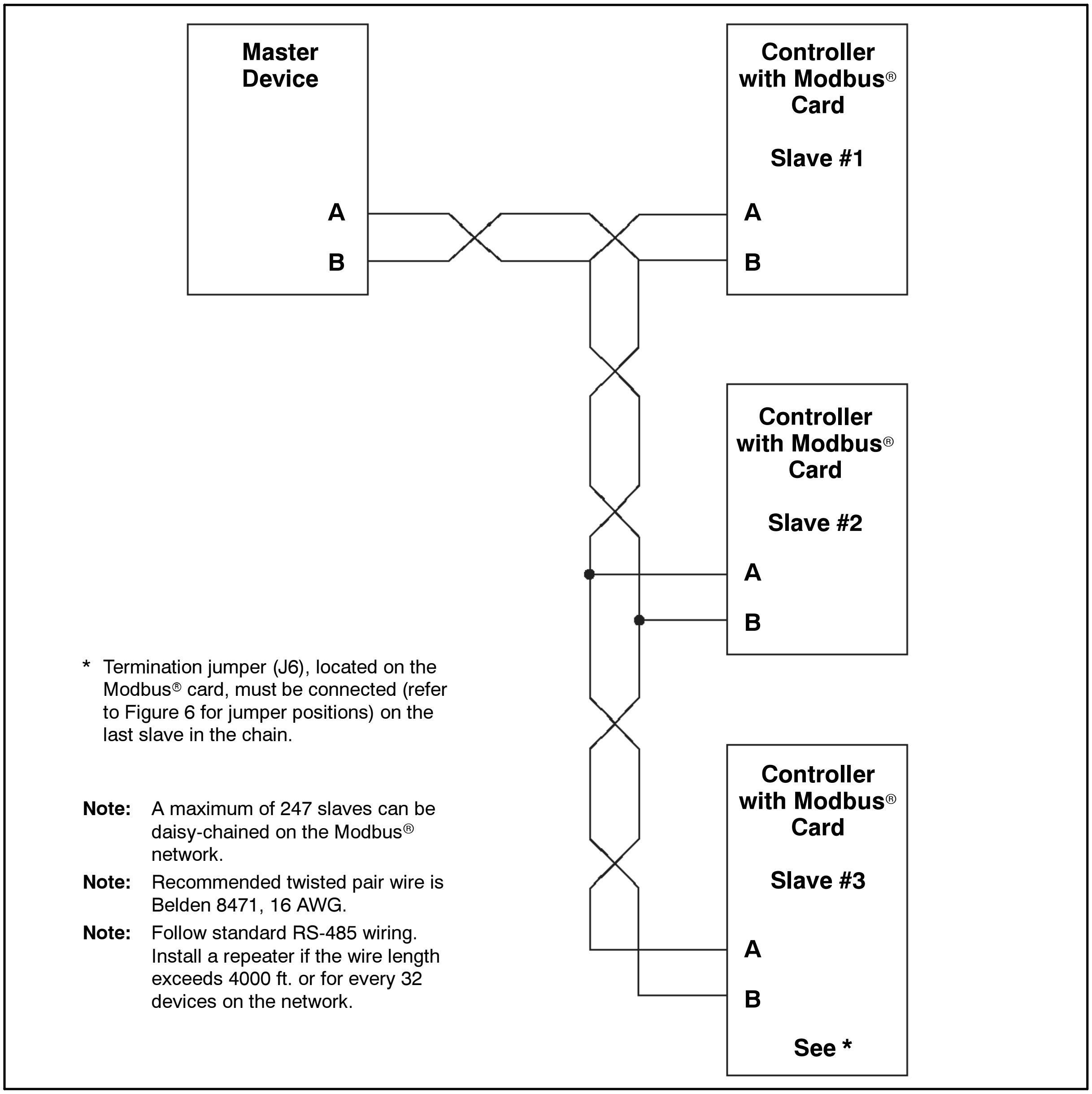


Figure 2 RS-485 Multi-Drop Connection

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 3 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 Status 0, allowing 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 register). The third column contains addresses used when the master is reading a Coil (individual bit). The remaining columns show the values, ranges (only in Section 9), and register types for the network variables.

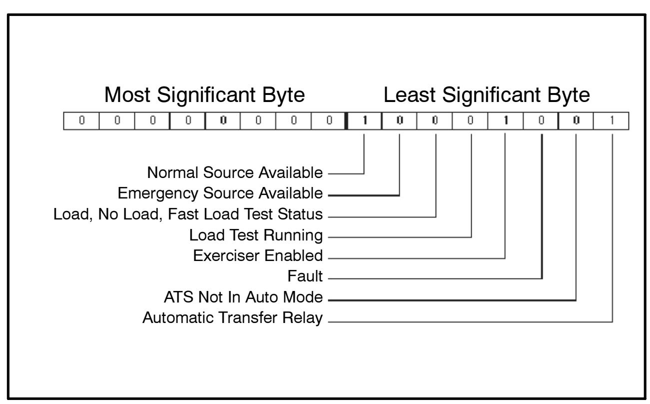


Figure 3 Status 0 Register

2 LED Indicator

The Modbus® card has a 10-segment LED module (refer to Figure 1 for location). These LEDs 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 100 ms. If another packet is sent or received before the 100 ms elapses, the LED on time will be extended by another 100 ms. LEDs 3–10 display the slave address of the controller as a binary number with each LED corresponding to a bit. Figure 4 shows the 10-segment LED module along with LEDs 3, 5, and 6 being lit. The lit LEDs correspond to slave address 13 for the controller.

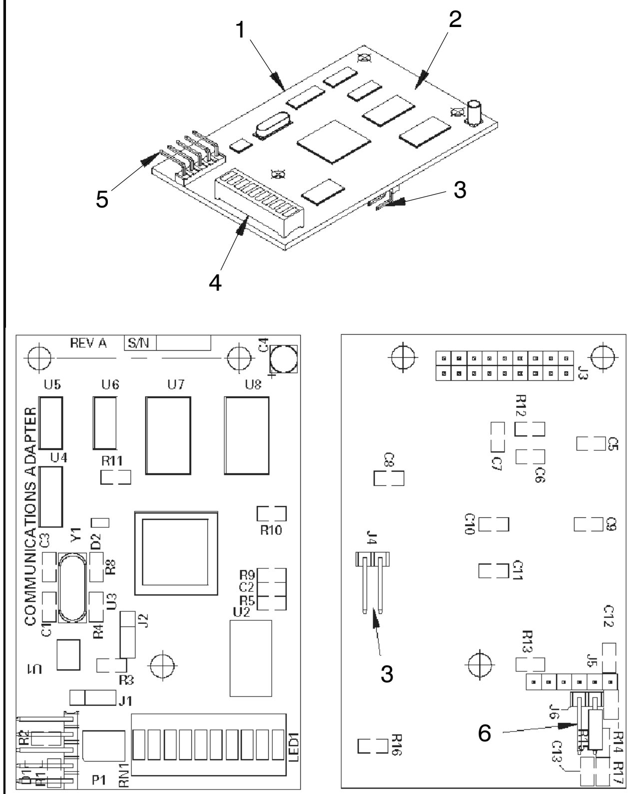
LED	Address Bit or Status
LED 10	2^7
LED 9	2^6
LED 8	2^5
LED 7	2^4
LED 6	2^3
LED 5	2^2
LED 4	2^1
LED 3	2^0
LED 2	Transmit
LED 1	Receive

Figure 4 LED Module (gray=LED lit; slave address 13 shown)

3 Termination Resistor

Located on the bottom of the Modbus® card is jumper J6 (see Figure 5), which enables or disables a termination resistor on the board (Figure 6). Jumper J6 is disabled when it comes from the factory.

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



Modbus® Card Top Modbus® Card Bottom

1. Top
2. Modbus® network card
3. Configuration jumper J4
4. LED addr/status indicator
5. Programming port pin #1
6. Termination jumper J6

Figure 5 Modbus® Network Card

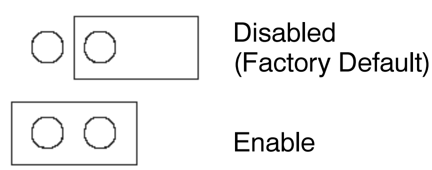


Figure 6 Jumper J6 (enable only on the last device in the network)

4 Enabling Network Option

Enable the network option through the ATS controller. See Figure 7. Select the CNFG menu. When prompted, enter the access code printed on the label on the back of the controller. Follow the instructions on the controller display to enable the network. Exit the CNFG menu when finished.

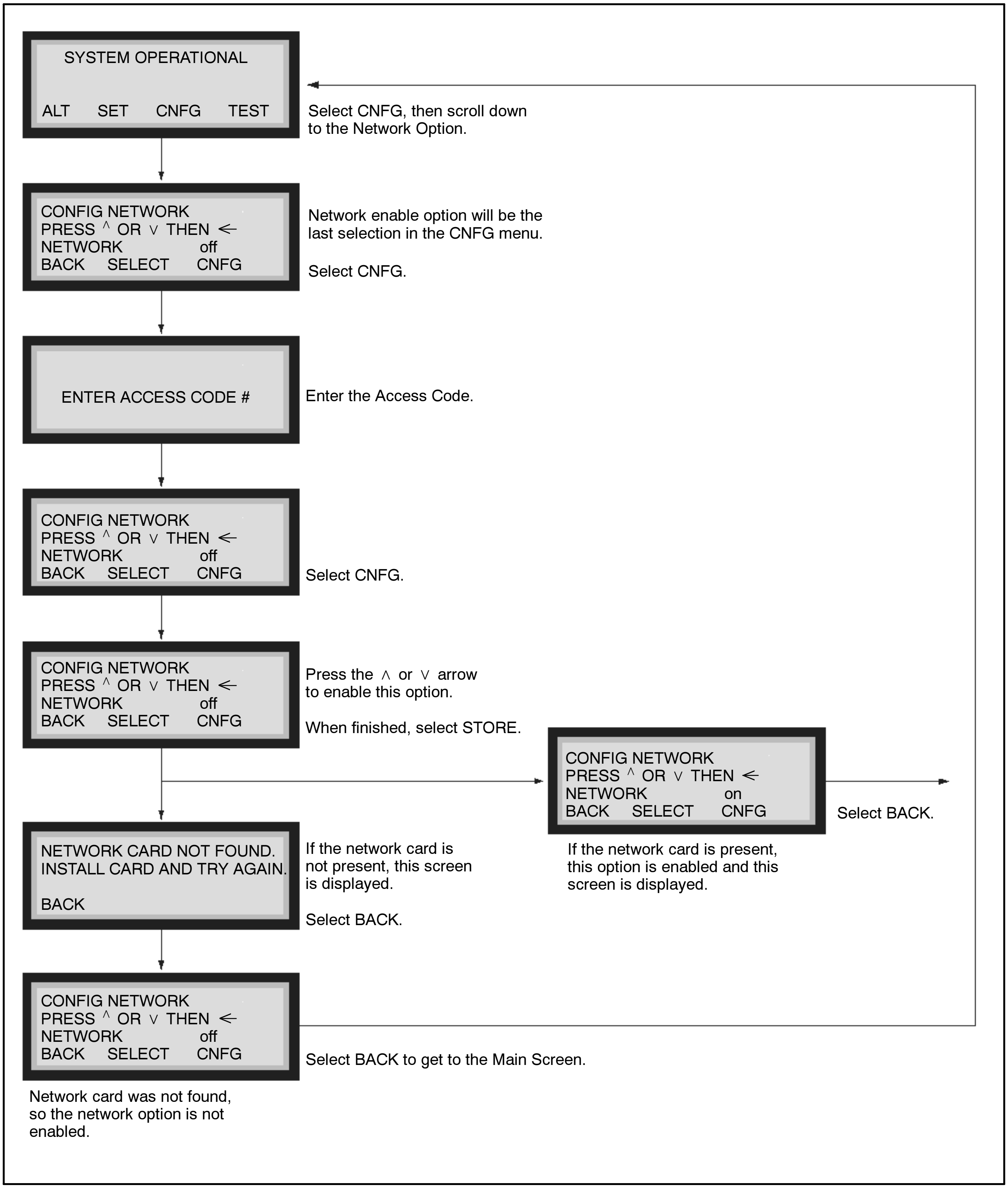


Figure 7 Controller Menus

5 Configuring 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 shown in Figure 8. These slave settings will be set up by the user and must match the master device settings for proper communications. The user configures these settings using a Modbus® configuration software package 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 Figure 9 for wiring connections).

Parameter	Default Setting
Slave address	1
RTU or ASCII mode	RTU
Data bits	8
Baud rate	9600
Parity	No parity
Stop bits	2

Figure 8 Card Configuration, Default Settings

Modbus® Network Card Configuration Procedure

1. Check that the Modbus® network card assembly is installed on the controller.

2. Make sure that the power to the Modbus® card is off. 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. See Figure 5 for jumper locations.

3. Power down controller and connect one end (DB9 female) of the RS-232/485 converter to the PC that has the configuration software. Connect the other end of the cable to the RS-485 connector of the Modbus® card. Check to make sure that the polarity connections are correct.

4. Power up the controller and Modbus® card.

5. Run the configuration software on the PC.

6. When loaded, check settings in the Configure PC's Serial Port section and 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 devices current configuration.

9. Click on the MODIFY button to enable parameter changing.

10. Make necessary changes in the Device Information section of the configuration software.

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 the ATS controller to enable settings on the Modbus® card.

Note: Disconnect configuration jumper J4 after card configuration is complete. See Figure 5.

6 Testing Modbus® Network

The Modbus® network can be tested using the components in the Modbus® configuration package. See Figure 9 for connections.

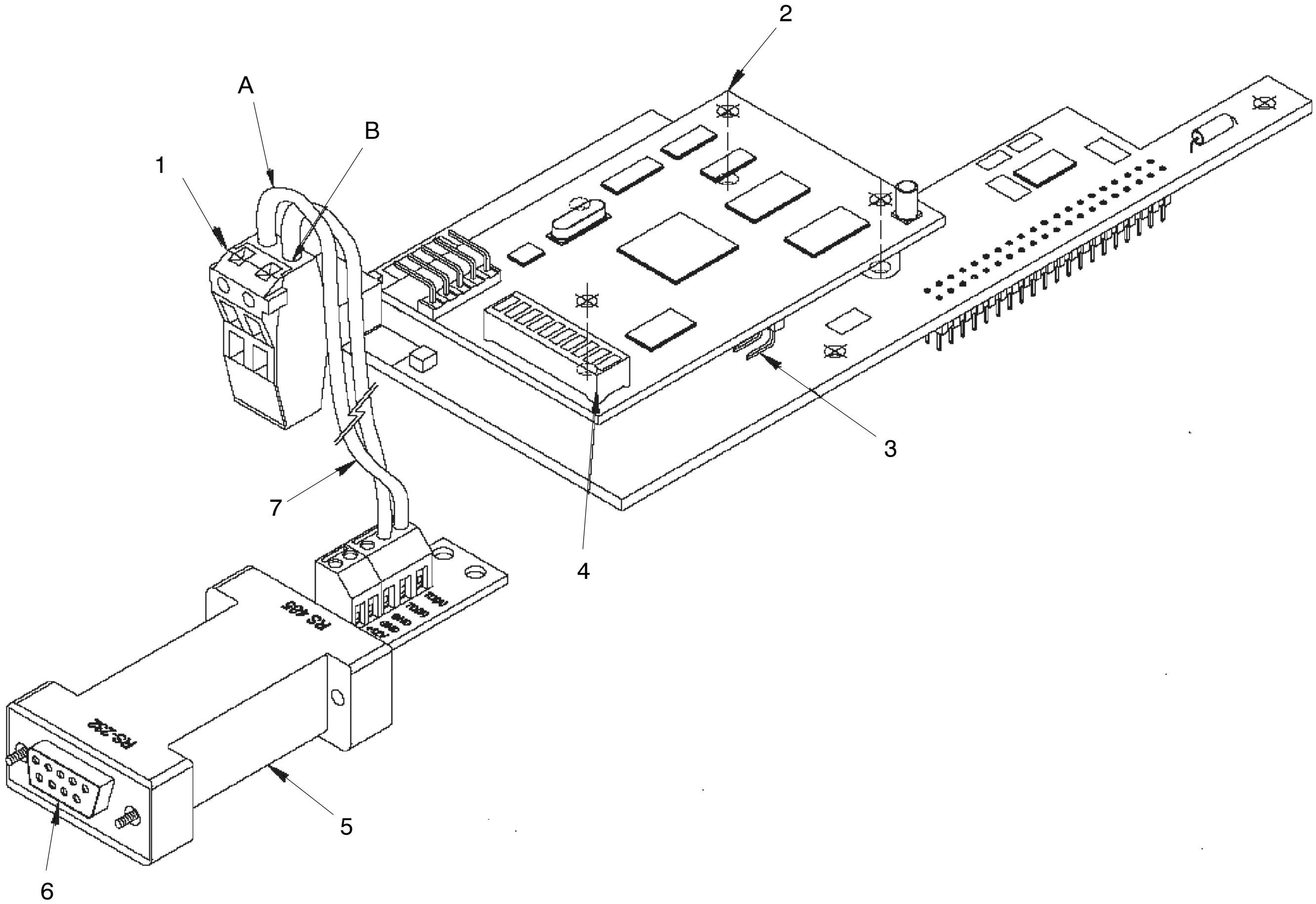
1. If testing a network consisting of more than one card, make sure that all of the cards are daisy-chained as shown in Figure 2. Verify that all Modbus® cards are in the run mode (configuration jumper J4 must not be installed). Termination jumper J6 is only installed on the last card on the network.

2. Connect one end (DB9 female) of the RS-232/485 converter to the PC that contains the configuration software. Connect the other end of the cable to the RS-485 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 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 numbers of all controllers that 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.



1. Network plug connector (verify polarity connections)
2. Modbus® network card assembly
3. Configuration jumper J4*
4. Address/status indicator LEDs
5. RS-232/485 converter
6. Serial port connection†
7. Twisted-pair cable

* Configuration jumper J4 must be installed to change Modbus® address and mode. Remove to place unit in run mode.
† Connect to the serial port of a PC that has the configuration software package.

Notes:

- Modbus® network card assembly must be installed on the controller.
- Modbus® network card default settings: Slave address 1, RTU mode, 8 data bits, 9600 baud, no parity, 2 stop bits.
- Connect to Modbus® card network plug connector via twisted pair cable (Belden #8471, 16 AWG).
- Use software programming package. Follow the procedure in Section 4, Configuring a Modbus® Network Card.
- To test the Modbus® network, follow the procedure in Section 6, Testing a Modbus® Network.

Figure 9 Connections to Configure and Test Modbus® Card

7 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 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 packaged and sent out using the Modbus® protocol.

Each query message consists of the following:

- *Slave Address*. Address of the selected slave.
- *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 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.

7.1 Read Coil Status (Function Code 01)

7.1.1 Query

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

Figure 10 is a sample read coil status request to read coils 9–24 (controller 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 10 Read Coil Status Query Message

7.1.2 Response

An example response to the Read Coil Status is shown in Figure 11. 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 11 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 are OFF. The other data byte is decoded similarly.

7.2 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.

7.2.1 Query

Figure 12 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 12 Read Holding Register Query Message

7.2.2 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. See Figure 13.

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 13 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).

7.3 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.

7.3.1 Query

Figure 14 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 14 Write Single Coil Query Message

7.3.2 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. See Figure 15.

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 15 Write Single Coil Response Message

7.4 Write Single Holding Register (Function Code 06)

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

7.4.1 Query

Figure 16 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 16 Write Single Holding Register Query Message

7.4.2 Response

The slave's response to the Write Single Holding Register query is to return the original message after the registers have been altered. See Figure 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 17 Write Single Holding Register Response Message

7.5 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. In the examples, coil 1 is addressed as 0.

7.5.1 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 as shown in Figure 18.

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

Figure 18 Query Data

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. See Figure 19.

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

Figure 19 Write Multiple Coils Query Message

7.5.2 Response

The response from the slave is an echo of the slave address, function code, starting address, and number of coils forced. See Figure 20.

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 20 Write Multiple Coils Response Message

7.6 Write Multiple Holding Registers (Function Code 16)

Presets values into a sequence of holding registers.

7.6.1 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. See Figure 21.

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

Figure 21 Write Multiple Holding Registers Query Message

7.6.2 Response

The response from the slave is an echo of the slave address, function code, starting address and number of registers to be loaded. See Figure 22.

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 22 Write Multiple Registers Response Message

8 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	1 = On, 0 = Off	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 Figure 23	Read-Only
Timer bit 1		26	See Figure 23	Read-Only
Timer bit 2		27	See Figure 23	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
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

* 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)

† 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)

Parameter Name	Holding Register	Coil	Value	Register Type
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
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
Emergency over frequency option		52	1 = Configured	Read-Only
Emergency over voltage option		53	1 = Configured	Read-Only
Normal over frequency option		54	1 = Configured	Read-Only
Normal under frequency option		55	1 = Configured	Read-Only
Normal 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*	Read-Only

* 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)

† 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)

Parameter Name	Holding Register	Coil	Value	Register Type
Normal voltage Ph2-Ph3	40026		A/D raw value*	Read-Only
Normal voltage Ph3-Ph1	40027		A/D raw value*	Read-Only
Emergency voltage Ph1-Ph2	40028		A/D raw value*	Read-Only
Emergency voltage Ph2-Ph3	40029		A/D raw value*	Read-Only
Emergency voltage Ph3-Ph1	40030		A/D raw value*	Read-Only
Normal period count	40031		Raw value unsigned integer †	Read-Only
Emergency period count	40032		Raw value unsigned integer †	Read-Only

* 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)

† 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

Timer Bits 0, 1, and 2 stand for the specific timer that is counting down during a transfer. Figure 23 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.

	Timer							
ATS Type	**P**	**W**	**W3**	**DW**	**T**	**T3**	**DT**	**U**
Standard	111	101	N/A	N/A	010	N/A	N/A	000
Standard with Presignal	111	110	101	N/A	011	010	N/A	000
Delay	111	100	N/A	101	001	N/A	010	000
Delay with Presignal	111	110	100	101	011	001	010	000

Figure 23 Timer Bit Combinations

9 Read/Write Register List

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

10 Troubleshooting

Symptom	Possible Cause	Corrective Action
Trouble configuring the Modbus® card	Modbus® card is not installed on the controller.	Install the Modbus® card on the controller.
	Controller does not have power.	Power up the controller.
	Configuration jumper J4 is not installed.	Install the configuration jumper J4.
	Wire between the RS-232/485 converter and Modbus® card is not connected.	See Figure 9 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.
	RS-232/485 converter is not connected to the PC.	Connect the RS-232/485 converter to the PCs serial port.
No communications between the Modbus® card and the master device	Controller does not have power.	Power up the controller.
	Communicating with the wrong addressed slave.	Verify that the address on the Modbus® card matches the address you are communicating with. See Figure 4 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).
	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 Figure 2.
	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 masters.	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 exceeds 1220 m (4000 ft.).	Install repeater if wire length exceeds 1220 m (4000 ft.).
	RS-485 multi-drop consists of more than 32 devices.	Install one repeater for every 32 devices on the network.
	Controller network option not enabled.	Contact an authorized distributor/dealer.
All LEDs on the LED module are off	Modbus® card is not installed on the controller.	Install the Modbus® card on the controller.
	Controller does not have power.	Power up the controller controller.
	The Modbus® card is damaged.	Contact an authorized distributor/dealer.

11 Parts Lists

Modbus® Interface Kit

Kit: GM30429-KA1	
Qty.	**Description**
1	Modbus® interface card assembly, factory-installed

Modbus® Development Kit

Kit: GM30430-KP1	
Qty.	**Description**
1	RS-232/RS-485 Converter
6 ft.	Twisted-pair cable
1	Network plug connector
1	Configuration software for Modbus interface card