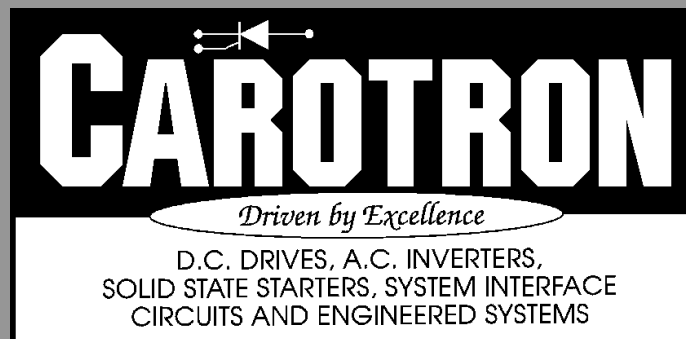


Modbus® Serial to Modbus® TCP/IP Gateway

**Instruction Manual
GTW-MB-MBTCP**



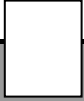


Table of Contents

1. General Description	3
2. Specifications	4
2.1 Electrical	4
2.2 Physical	4
3. Installation	5
3.1 Wiring Guidelines	5
3.2 Signal Connections.....	5
4. Description of Features	6
4.1 Hardware Settings	6
4.2 LEDs.....	6
4.3 Software Settings.....	7
5. Adjustment Procedure	16
6. Prints	18
C14068 GTW-MB-MBTCP Assembly.....	18
7. Standard Terms & Conditions of Sale	19

List of Figures

Figure 1: Physical Dimensions	4
Figure 2: General Connections.....	5
Figure 3: Network Settings	7
Figure 4: Server Settings.....	8
Figure 5: Serial Settings	10
Figure 6: Modbus/TCP Connection Settings	12
Figure 7: Configurable Pin Settings.....	15
Figure 8: Example RS422 Four Wire Connections.....	16
Figure 9: Example RS485 Four Wire Connections.....	16
Figure 10: Example RS485 Two Wire Connections	17

List of Tables

Table 1: J3 Settings.....	6
Table 2: Connection LED	6
Table 3: Activity LED	6
Table 4: J3 Settings.....	16

1

General Description

Model GTW-MB-MBTCP is designed to provide a network gateway between a Modbus® (RTU or ASCII) serial network and a Modbus® TCP/IP network. This unit will convert any existing serial Modbus RTU unit to a Modbus TCP/IP unit.

The gateway can interface with 4 wire RS422, and 2 or 4 wire RS485 networks. The module also has a provision for a terminating resistor if desired.

Features

- 10/100M Ethernet
- DHCP or Static IP Address
- Web Page Configuration
- Modbus RTU or ASCII
- Selectable Baud Rate, Stop Bits, Parity
- RS422 (4 wire), RS485 (2 or 4 wire modes)

2

Specifications

2.1 Electrical

D.C. Power Input

- 24 VDC $\pm 10\%$, 60mA max, internally fused

Network Interface

- RJ45
- 10/100M Ethernet

Serial Interface

- Terminal Blocks
- RS422/RS485
- 115Kbaud max

Temperature Range

- 0-55° C

2.2 Physical

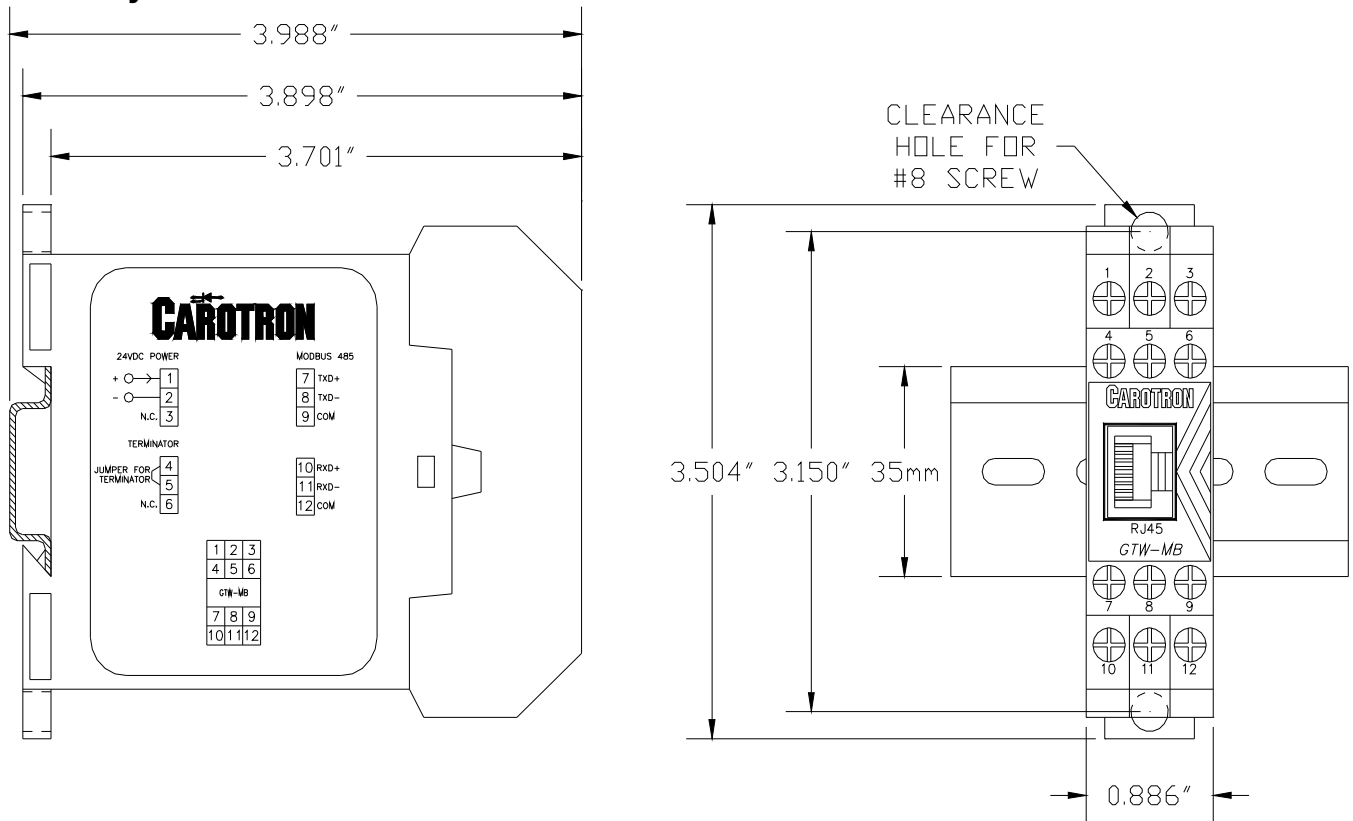


Figure 1: Physical Dimensions

3

Installation

3.1 Wiring Guidelines

To prevent electrical interference and to minimize start-up problems, adhere to the following guidelines:

Use fully insulated and shielded cable for all signal wiring. The shield should be connected to circuit common at one end only. The other end of the shield should be clipped and insulated to prevent the possibility of accidental grounding.

Signal level wiring such as listed above should be routed separately from high level power wiring (such as the A.C. line, motor, operator control, and relay control wiring). When these two types of wire must cross, they should cross at right angles to each other.

Any relay, contactor, starter, solenoid or other electro-mechanical device located in close proximity to or on the same line supply as the GTW-MB-MBTCP should have a transient suppression device such as an MOV or R-C snubber connected in parallel with its coil. The suppressor should have short leads and be connected as close to the coil as possible.

3.2 Signal Connections

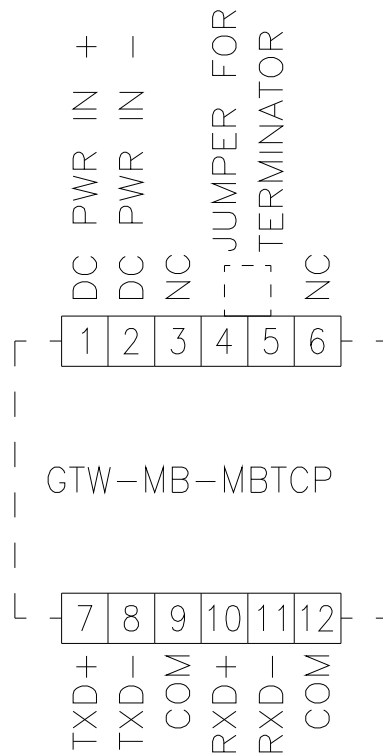


Figure 2: General Connections

4.1 Hardware Settings

The following are hardware selectable settings. The jumpers are accessible by squeezing the sides near the top and removing the enclosure bottom.

JUMPERS J1/J2 Biasing

On some RS485 networks, it is necessary to bias the bus for proper operation. This biasing can be applied by jumpers J1 and J2. Biasing is typically not required on RS422 networks. On 485 networks, typically only one device on the network should provide the biasing.

JUMPERS J3 Echo

When J3 is set to OFF, the RS422/485 receiver is disabled during a serial transmission. When set to ON, the receiver is always enabled. Refer to the table below for typical jumper settings based on the serial operating mode.

<i>Mode</i>	<i>J3 Echo</i>
RS422 (4 wire)	ON
RS485 (4 wire)	ON
RS485 (2 wire)	OFF

Table 1: J3 Settings

TERMINATOR

It is recommended to install a terminating resistor at the beginning and end of the RS422/485 network. Placing a jumper between terminals 4 & 5 includes a 120 ohm terminating resistor across the units serial receiver.

4.2 LEDs

<i>Top LED</i>	<i>State</i>
Solid Amber	10BASE-T
Solid Green	100BASE-T
Off	No Connection

Table 2: Connection LED

<i>Bottom LED</i>	<i>State</i>
Blinking Amber	Half Duplex Activity
Blinking Green	Full Duplex Activity

Table 3: Activity LED

4.3 Software Settings

The following are software selectable settings that are available via the web interface. Please refer to Adjustment Procedure on page 16 for instructions on how to access the web interface.

When changes are made on a page, the OK button must be clicked and then Apply Settings (on the left) must then be clicked. This must be done for each page. Multiple pages cannot be edited and then applied.

NETWORK SETTINGS

The screenshot displays the 'Network Settings' page. On the left is a vertical navigation menu with the following items: 'Network' (highlighted in yellow), 'Server', 'Modbus Bridge', 'Serial Settings', 'Modbus/TCP', 'Configurable Pins', 'Apply Settings', and 'Apply Defaults'. The main content area is titled 'Network Settings' and features a 'Network Mode' dropdown menu set to 'Wired Only'. Below this is the 'IP Configuration' section, which has two radio button options. The first option, 'Obtain IP address automatically', is selected. Underneath it are 'Auto Configuration Methods' with three sub-options: 'BOOTP' (Enable selected), 'DHCP' (Enable selected), and 'AutoIP' (Enable selected). A 'DHCP Host Name' text input field is located below these options. The second radio button option is 'Use the following IP configuration:', which is currently unselected. This option includes three text input fields for 'IP Address', 'Subnet Mask', and 'Default Gateway'. An 'OK' button is positioned at the bottom center of the settings area.

Figure 3: Network Settings

Obtain an IP Address Automatically

Select this option if you want the IP address to be assigned automatically via BOOTP, DHCP, or AutoIP methods.

DHCP Host Name

Enter the desired host name for the GTW-MB unit. This is optional.

Use the following IP Configuration

Select this option if you want to manually assign the network settings. When this option is selected, you must enter the appropriate IP Address, Subnet Mask, and Default Gateway settings.

SEVER SETTINGS

Server Settings

Server Configuration

Enhanced Password: Enable Disable

Telnet/Web Manager Password:

Retype Password:

Advanced

ARP Cache Timeout (secs):

TCP Keepalive (secs):

Monitor Mode @ Bootup: Enable Disable

CPU Performance Mode: Low Regular High

HTTP Server Port:

MTU Size:

TCP Re-transmission timeout (ms):

OK

Figure 4: Server Settings

Enhanced Password

When set to enabled, passwords up to 16 bytes in length can be created. When disabled, passwords up to 4 bytes in length must be used.

Telnet/Web Manager Password

Enter the password for the Telnet configuration and Web Manager access.

Retype Password

Re-enter the password required for Telnet configuration and Web Manager access.

ARP Cache Timeout

When the unit communicates with another device on the network, it adds an entry into its ARP table. ARP Cache timeout defines the number of seconds (1-600) before it refreshes this table.

TCP Keepalive

This setting defines how many seconds the unit waits during an inactive connection before checking its status. If the unit does not receive a response, it drops that connection. Enter a value between 0 and 60 seconds. 0 disables keepalive. The default setting is 45.

Monitor Mode @ Bootup

Select Disable to disable entry into the monitor mode using the 'yyy' or 'xx1' key sequence at startup. This field prevents the unit from entering monitor mode by interpreting the stream of characters that are received during the device server's initialization at startup.

HTTP Server Port

This option allows the configuration of the web server port number. The valid range is 1-65535. The default port is 80.

MTU Size

The Maximum Transmission Unit (MTU) is the largest physical packet size a network can transmit for TCP and UDP. Enter between 512 and 1400 bytes. The default is 1400 bytes.

TCP Re-transmission Timeout

The desired TCP re-transmission timeout value. If the ACK is not received for a packet sent from the device, then the unit will retransmit the data. The valid range is 500-4000ms. The default is 500ms.

SERIAL SETTINGS

Serial Settings

Port Settings

Channel: 1 ▾ Interface: RS422/RS485 - 4 wire ▾

Baud Rate: 38400 ▾ Data Bits: 8 ▾ Parity: None ▾ Stop Bits: 2 ▾

Flow Control Out: Active Always ▾ Delay before Transmit (1): ms Hold after Transmit(4): ms

Flow Control In: Wait til Active (2): No ▾ Delay after Active (3): ms

Modem Control Out: Active Always ▾

Modbus

Protocol: RTU ASCII Character Timeout: 50 ms (0=auto)

Tx Delay after Rx: 0 ms Message Timeout: 5000 ms

OK

Figure 5: Serial Settings

Interface

Select the type of serial interface that will be used. Valid selections are RS422/RS485 4 WIRE and RS485 2 Wire. Do not select RS232.

Baud Rate

The unit and all attached serial devices must agree on a speed or baud rate to use for the serial connection. Valid baud rates are 300, 600, 1200, 2400, 4800, 9600 (default), 19200, 38400, 57600, 115200.

Data Bits

Indicates the number of bits in a transmitted data package. The default is 8.

Parity

Checks for the parity bit. The default is None.

Stop Bits

The stop bit follows the data and parity bits in serial communication. It indicates the end of transmission. The default is 1.

Flow Control Out

This setting is not used.

Modem Control Out

This setting is not used.

Protocol

Select the desired Modbus protocol to be used: RTU (binary) or ASCII. Default is RTU.

Tx Delay after Rx

This feature inserts a delay between the Modbus/TCP master requests. The first request is sent out of the serial port of the device to the Modbus slave. When the slave responds, it triggers this timer. After the specified delay is reached, the next master request is allowed to pass through the serial port, and the timer is reset. This feature is particularly useful when using RS485 2-wired serial protocol. The delay gives ample time for the RS485 slave devices to turn their transmitters off and their receivers back on. Default is 0ms.

Character Timeout

This sets the timeout between characters received. Official Modbus/RTU defines a 3.5 character time-out, but complex devices have various interrupts that can cause 5 to 10 character “pauses” during transmission. A safe value for general use with Modbus is 50ms. Note: Setting this value lower than 50ms will not improve performance and may even make performance worse. Default is 50ms.

Message Timeout

This sets the timeout for a response from a connected slave both serially and by TCP/IP. Default is 5000ms.

MODBUS/TCP CONNECTION SETTINGS

- Network
- Server
- Modbus Bridge
- Serial Settings
- Modbus/TCP
- Configurable Pins
- Apply Settings
- Apply Defaults

Connection Settings

Connect Protocol
 Protocol: Modbus/TCP Server attached to slave(s) ▼

Advanced Server Settings

Modbus/TCP Port: 502 Queue Multiple Modbus/TCP Requests: Yes No

Fixed Slave Address: 0 (0=MB/TCP header) Allow Modbus Broadcast: Yes No

Use Bridge Error Codes (0AH/0BH): Yes No

Swap 4x/0x access to get 3x/1x: Yes No

Swap Holding Reg (4x) access to Input Reg (3x) after offset: 0 (0 to disable)

Swap Coil Status (0x) access to Input Status (1x) after offset: 0 (0 to disable)

(Example: read of 401023 maps to 300023 if you enter 1000)

Preset Automated Scan Table (optional)

No.	Unit Id (1-255)	Register Type	Offset	Count (1-124)	Frequency (ms)	
0	<input type="text"/>	<input style="text-align: right; border-bottom: none; border-top: none; border-left: none; border-right: none; width: 100px;" type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="Remove"/>
1	<input type="text"/>	<input style="text-align: right; border-bottom: none; border-top: none; border-left: none; border-right: none; width: 100px;" type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="Remove"/>
2	<input type="text"/>	<input style="text-align: right; border-bottom: none; border-top: none; border-left: none; border-right: none; width: 100px;" type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="Remove"/>
3	<input type="text"/>	<input style="text-align: right; border-bottom: none; border-top: none; border-left: none; border-right: none; width: 100px;" type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="Remove"/>
4	<input type="text"/>	<input style="text-align: right; border-bottom: none; border-top: none; border-left: none; border-right: none; width: 100px;" type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="Remove"/>
5	<input type="text"/>	<input style="text-align: right; border-bottom: none; border-top: none; border-left: none; border-right: none; width: 100px;" type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="Remove"/>
6	<input type="text"/>	<input style="text-align: right; border-bottom: none; border-top: none; border-left: none; border-right: none; width: 100px;" type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="Remove"/>
7	<input type="text"/>	<input style="text-align: right; border-bottom: none; border-top: none; border-left: none; border-right: none; width: 100px;" type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="Remove"/>
8	<input type="text"/>	<input style="text-align: right; border-bottom: none; border-top: none; border-left: none; border-right: none; width: 100px;" type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="Remove"/>
9	<input type="text"/>	<input style="text-align: right; border-bottom: none; border-top: none; border-left: none; border-right: none; width: 100px;" type="text"/> ▼	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="Remove"/>

Close Idle TCP Sockets after: 10 secs (3-60 secs, 0=disable)

Redundant Entry Retries after: 0 secs (15-60 secs, 0=disable)

Unit ID to IP Address Mapping

No.	Start Id	End Id	Host Address	
1	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="Remove"/>
2	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="Remove"/>
3	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="Remove"/>
4	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="Remove"/>
5	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="Remove"/>
6	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="Remove"/>
7	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="Remove"/>
8	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="Remove"/>

Figure 6: Modbus/TCP Connection Settings

Connect Protocol

When Modbus/TCP Server attached to slave(s) is selected, the unit functions as a Modbus/TCP server. The attached serial devices function as Modbus slaves.

When Modbus/TCP Client attached to master is selected, the unit functions as a Modbus/TCP client. The attached serial device is a Modbus master.

Modbus/TCP Port

Defines the Modbus port. Default is 502.

Fixed Slave Address

Modbus/TCP includes a Unit ID field, which is used to address multiple Modbus slaves at a single IP address. Unfortunately, some first generation software drivers assumed a single slave at each IP and always set the Unit ID field to 0. This can sometimes causes problems because the device requires the Unit ID for the Modbus/RTU "Slave Address." To support these older applications, the device allows you to force a fixed address. However, be aware that this restricts you to a single serial slave device per unit. Setting this value to 0 causes the device to use the Modbus/TCP Unit ID as received. Setting it to any other address causes the device to always use the set value as a fixed address.

Queue Multiple Modbus/TCP Requests

While the Modbus/TCP standard specification requires Modbus/TCP masters/clients to only issue one poll at a time, the full-duplex flow-controlled nature of TCP/IP allows them to issue more than one at a time, and the TCP socket will buffer them. When set to Yes, the device will fetch the requests one at a time and answer each in turn. This is the safest default setting – only change this if you are having problems. Setting this to No causes the device to always fetch the newest request from the TCP buffer – all older requests are discarded. This allows a Modbus/TCP master/client to retry old requests without risking building up a stale queue of waiting requests. Default is Yes.

Allow Modbus Broadcast

Enables/disables the serial Modbus broadcast function.

Use Bridge Error Codes (0AH/0BH)

Traditional serial Modbus uses silence to signal some errors. While this works well with direct serial lines, it causes serious problems on a TCP/IP wide-area-network where delays are not so predictable. See for a full discussion. Setting this parameter to No causes the device to behave like a traditional Modbus serial slave – it answers timeouts, unconfigured slave addresses, and CRC errors with silence. Setting this to Yes causes the device to return 1 of 2 new exception codes defined in Modbus/TCP. Default is Yes.

Swap 4x/0x access to get 3x/1x

This setting will convert holding register (4x) data reads to input register (3x) data reads. It also converts coil (0x) reads to contact data (1x) reads. This feature is useful for Modicon I/O scanners that only support reads of holding registers and coils. This feature works in conjunction with the offsets defined below. Default setting is No.

Swap Holding Reg (4x) access to Input Reg (3x) after offset

Allows the above swap feature only if the request is above an offset. Example: read of 401023 maps to 300023 if you enter 1000). Default is 0.

Swap Coil Status (0x) access to Input Status (1x) after offset

Allows the above swap feature only if the request is above an offset. Example: read of 001023 maps to 100023 if you enter 1000). Default is 0.

Preset Automated Scan Table (optional)

This section is only utilized when the **Modbus/TCP Server attached to slave(s)** serial protocol is selected. The Preset Automated Scan Table contains optional settings that direct the unit to automatically access Modbus registers on the slave(s). This is useful when multiple Modbus/TCP clients are polling the same group of “interesting” registers. The scan allows the registers to be pre-fetched one time and then delivered without delay to multiple requesting clients. The auto scan operation also allows the TCP connection status and the network settings to be written to the connected slave’s registers

Unit Id

The network address of the serial Modbus device.

Register Type

Selects the type of register:

- Reads
 - Holding Register (4x)
 - Input Register (3x)
 - Input Status (1x)
 - Coil Status (0x)
- Writes
 - TCP Status (0x)
 - IP Config (4x)
 - IP + Netmask (4x)
 - IP + Net + Gateway (4x)

Offset

The starting offset of the Modbus register(s). Example: Input register offset of 10 yields address 3x00010.

Count

The number of registers to be accessed. Range is 1 to 124.

Frequency

The time in milliseconds between accesses. Range is 50-65000ms.

Unit ID to IP Address Mapping

This section is only utilized when the **Modbus/TCP Client attached to master** serial protocol is selected. Since serial Modbus network uses 8-bit slave addresses and a TCP/IP network requires 32-bit IP addresses, the unit uses this table to map an 8-bit address into an IP/Unit ID combination. The 8-bit address is used to both select the desired IP and as the Unit ID sent. The table holds 8 entries, and any Modbus slave

address not found in the table returns an exception response to the master (if enabled).

Start Id / End Id

Enter a range of 8 bit Modbus addresses. Any Modbus packet that falls within this range is forwarded to the Host Address.

Host Address

This is the IP Address of the remote Modbus/TCP slave.

Close Idle TCP Sockets after

Sockets are opened as required. Entering a 0 holds a single socket open to the last remote Modbus/TCP slave accessed. Otherwise enter values 3 to 60 to automatically close the last socket after 3 to 60 seconds of idle time.

Redundant Entry Retries after

Enter the time in seconds for redundant entry retries or set to 0 to disable the feature.

CONFIGURABLE PINS

CP	Function	Direction	Active Level
1	RS485 Tx Enable	<input checked="" type="radio"/> Input <input type="radio"/> Output	<input type="radio"/> Low <input checked="" type="radio"/> High
2	General Purpose I/O	<input checked="" type="radio"/> Input <input type="radio"/> Output	<input checked="" type="radio"/> Low <input type="radio"/> High
3	General Purpose I/O	<input checked="" type="radio"/> Input <input type="radio"/> Output	<input checked="" type="radio"/> Low <input type="radio"/> High

Figure 7: Configurable Pin Settings

No adjustment should be made to these settings. They should be left at their defaults as shown above.

5

Adjustment Procedure

Step 1: Determine serial interface

- Determine the type of serial interface that will be used: RS422 (4 wire), RS485 (4 wire), or RS485 (2 wire). Most often, this is determined by the device(s) that will be connected to the gateway. Place Jumper J3 accordingly

Mode	J3 Echo
RS422 (4 wire)	ON
RS485 (4 wire)	ON
RS485 (2 wire)	OFF

Table 4: J3 Settings

- Place Jumpers J1 & J2 to OFF if biasing is not needed. If unsure, place in the ON position.

Step 2: Connections

- Make connections per one of the examples below.

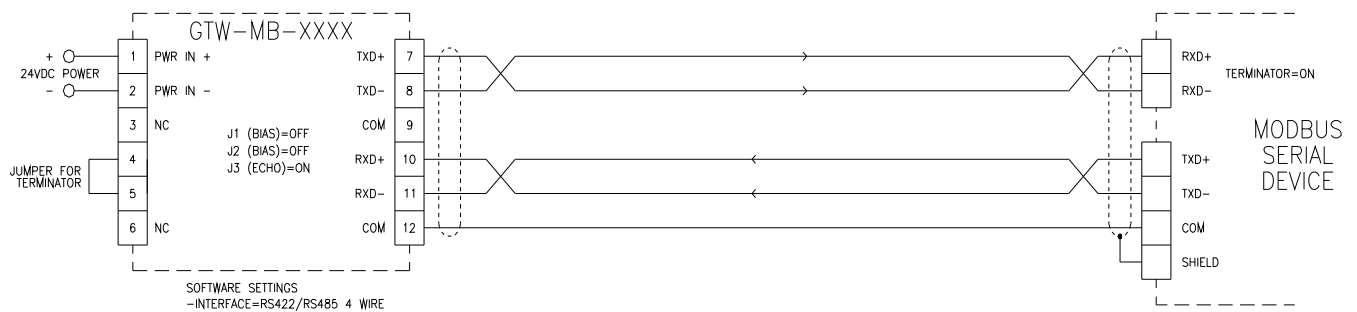


Figure 8: Example RS422 Four Wire Connections

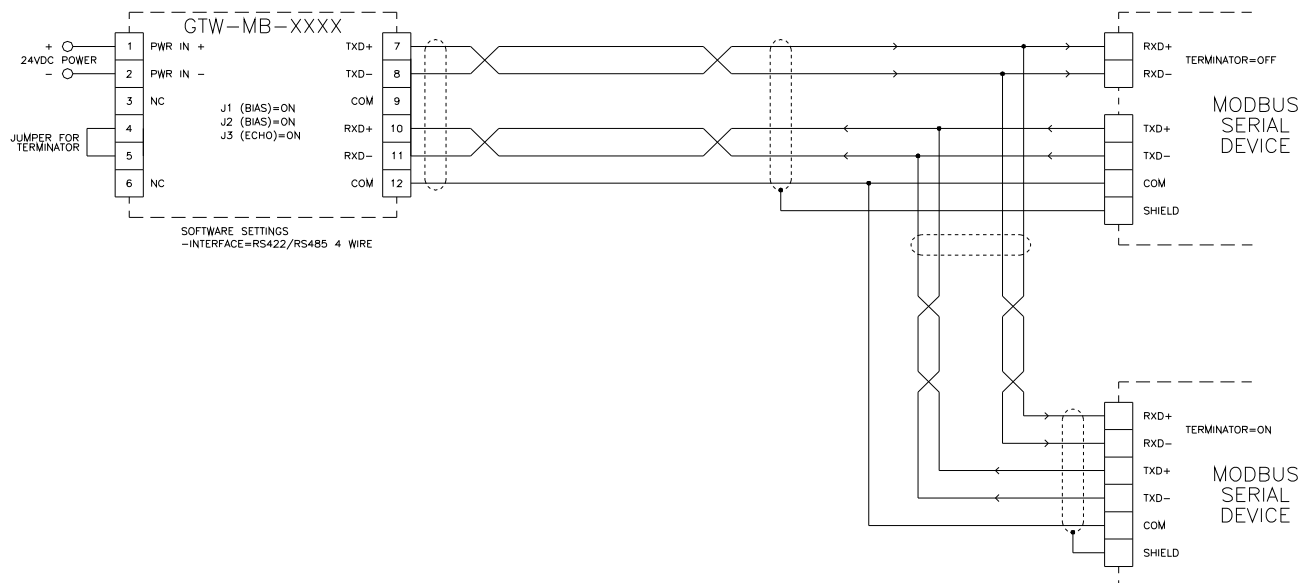


Figure 9: Example RS485 Four Wire Connections

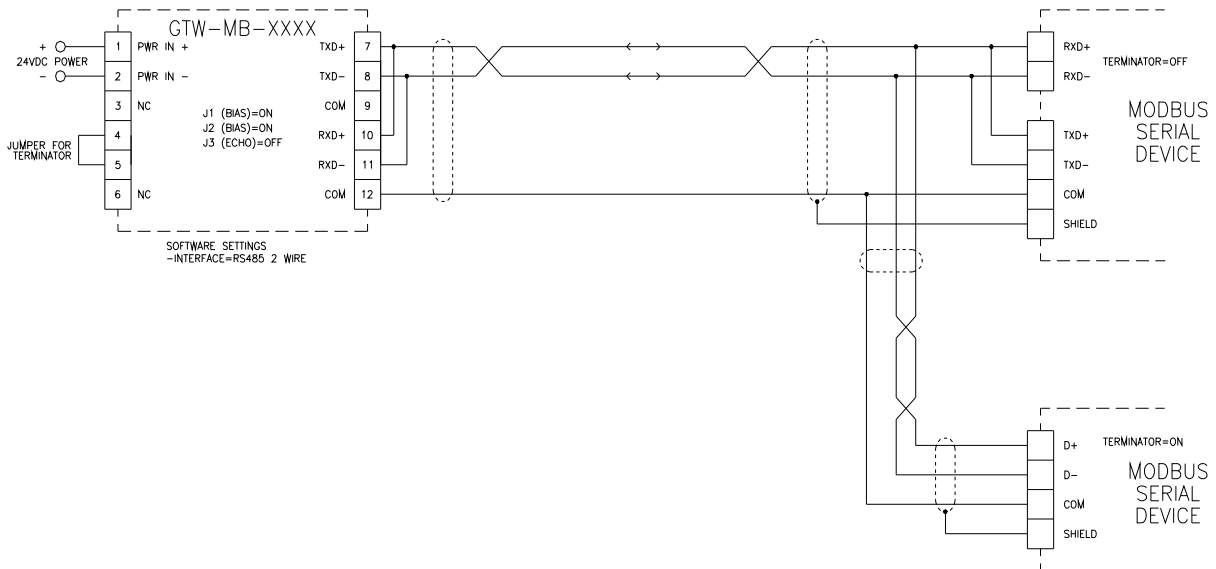


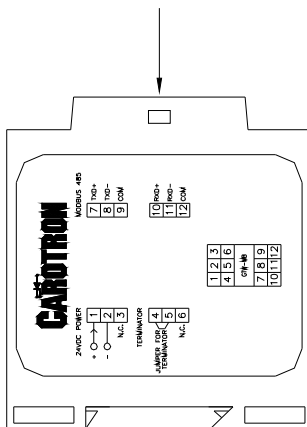
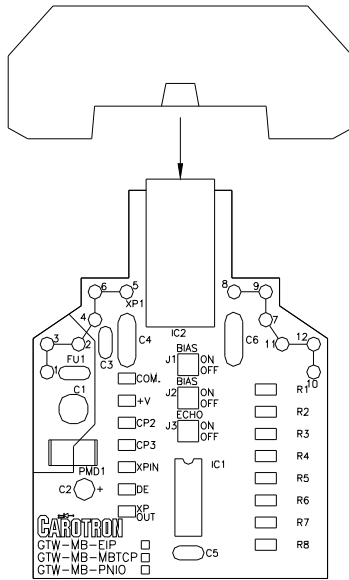
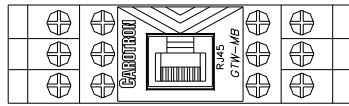
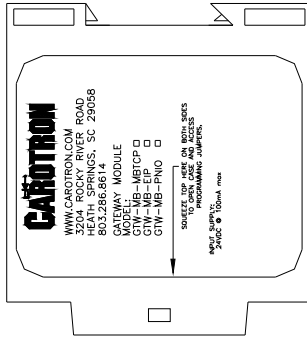
Figure 10: Example RS485 Two Wire Connections

Step 3: Initial Configuration

1. Apply power to the module.
2. If a DHCP server exists on the network, it should assign the unit an IP address. If this address is unknown or no DHCP server exists, the Lantronix DeviceInstaller utility must be used to 'find' and configure the unit's network settings. Download and install the DeviceInstaller utility from www.carotron.com.
3. When the DeviceInstaller utility initially runs, it searches the network for devices and displays the IP address when found. If this address is sufficient, proceed to Step 4. If you wish to change the IP address, expand the tree structure in the left pane. Select the device in the right pane. Click on the Assign IP button in the toolbar to change the network settings.

Step 4: Web Interface

1. Once the IP address is known, simply open a web browser and enter the IP address (i.e. 192.168.0.5) in the address bar. If a username and password have been configured, enter those when prompted. Otherwise, leave the username and password fields blank.
2. Select Serial Settings from the menu on the left.
3. Set the Interface to the desired option. This setting should match the jumper J3 selection that was made in Step 1.
4. Set the Baud Rate, Data Bits, Parity, & Stop Bits. These settings should match the serial settings in the connected device(s).
5. Set the desired protocol: RTU or ASCII. For Carotron serial devices, select RTU.
6. Click OK
7. Click Apply Settings from the menu on left. Device will re-boot.
8. Additional settings may also be set via the web interface. Refer to section 4.3 Software Settings on page 7 for additional details.



DESIGN BY	DATE	REV.
WRM	2/21/14	1
APPROVED BY:	DATE	
1. SEC. PL. * 00*		
2. SEC. PL. * 00*		
3. SEC. PL. * 00*		
SCALE:		
Driven by Excellence HEATH SPRINGS, SC 803.286.8614 FAX: 803.286.6653		
TITLE: ETHERNET TO MODBUS ASSEMBLY		
DRAWING NUMBER		SH. 1 OF 1
C14068		REV. A

- NOTES:
1. REFER TO SCHEMATIC C14066
 2. REFER TO ARTWORK C14067A

Standard Terms & Conditions of Sale

1. General

The Standard Terms and Conditions of Sale of Carotron, Inc. (hereinafter called "Company") are set forth as follows in order to give the Company and the Purchaser a clear understanding thereof. No additional or different terms and conditions of sale by the Company shall be binding upon the Company unless they are expressly consented to by the Company in writing. The acceptance by the Company of any order of the Purchaser is expressly conditioned upon the Purchaser's agreement to said Standard Terms and Conditions. The acceptance or acknowledgement, written, oral, by conduct or otherwise, by the Company of the Purchaser's order shall not constitute written consent by the Company to addition to or change in said Standard Terms and Conditions.

2. Prices

Prices, discounts, allowances, services and commissions are subject to change without notice. Prices shown on any Company published price list and other published literature issued by the Company are not offers to sell and are subject to express confirmation by written quotation and acknowledgement. All orders of the Purchaser are subject to acceptance, which shall not be effective unless made in writing by an authorized Company representative at its office in Heath Springs, S.C. The Company may refuse to accept any order for any reason whatsoever without incurring any liability to the Purchaser. The Company reserves the right to correct clerical and stenographic errors at any time.

3. Shipping dates

Quotation of a shipping date by the Company is based on conditions at the date upon which the quotation is made. Any such shipping date is subject to change occasioned by agreements entered into previous to the Company's acceptance of the Purchaser's order, governmental priorities, strikes, riots, fires, the elements, explosion, war, embargoes, epidemics, quarantines, acts of God, labor troubles, delays of vendors or of transportation, inability to obtain raw materials, containers or transportation or manufacturing facilities or any other cause beyond the reasonable control of the Company. In no event shall the Company be liable for consequential damages for failure to meet any shipping date resulting from any of the above causes or any other cause.

In the event of any delay in the Purchaser's accepting shipment of products or parts in accordance with scheduled shipping dates, which delay has been requested by the Purchaser, or any such delay which has been caused by lack of shipping instructions, the Company shall store all products and parts involved at the Purchaser's risk and expense and shall invoice the Purchaser for the full contract price of such products and parts on the date scheduled for shipment or on the date on which the same is ready for delivery, whichever occurs later.

4. Warranty

The Company warrants to the Purchaser that products manufactured or parts repaired by the Company, will be free, under normal use and maintenance, from defects in material and workmanship for a period of one (1) year after the shipment date from the Company's factory to the Purchaser. The Company makes no warranty concerning products manufactured by other parties.

As the Purchaser's sole and exclusive remedy under said warranty in regard to such products and parts, including but not limited to remedy for consequential damages, the Company will at its option, repair or replace without charge any product manufactured or part repaired by it, which is found to the Company's satisfaction to be so defective; provided, however, that (a) the product or part involved is returned to the Company at the location designated by the Company, transportation charges prepaid by the Purchaser; or (b) at the Company's option the product or part will be repaired or replaced in the Purchaser's plant; and also provided that (c) the Company is notified of the defect within one (1) year after the shipment date from the Company's factory of the product or part so involved.

The Company warrants to the Purchaser that any system engineered by it and started up under the supervision of an authorized Company representative will, if properly installed, operated and maintained, perform in compliance with such system's written specifications for a period of one (1) year from the date of shipment of such system.

As the Purchaser's sole and exclusive remedy under said warrant in regard to such systems, including but not limited to remedy for consequential damages, the Company will, at its option, cause, without

charges any such system to so perform, which system is found to the Company's satisfaction to have failed to so perform, or refund to the Purchaser the purchase price paid by the Purchaser to the Company in regard thereto; provided, however, that (a) Company and its representatives are permitted to inspect and work upon the system involved during reasonable hours, and (b) the Company is notified of the failure within one (1) year after date of shipment of the system so involved.

The warranties hereunder of the Company specifically exclude and do not apply to the following:

- a. Products and parts damaged or abused in shipment without fault of the Company.
- b. Defects and failures due to operation, either intentional or otherwise, (1) above or beyond rated capacities, (2) in connection with equipment not recommended by the Company, or (3) in an otherwise improper manner.
- c. Defects and failures due to misapplication, abuse, improper installation or abnormal conditions of temperature, humidity, abrasives, dirt or corrosive matter.
- d. Products, parts and systems which have been in any way tampered with or altered by any party other than an authorized Company representative.
- e. Products, parts and systems designed by the Purchaser.
- f. Any party other than the Purchaser.

The Company makes no other warranties or representation, expressed or implied, of merchantability and of fitness for a particular purpose, in regard to products manufactured, parts repaired and systems engineered by it.

5. Terms of payment

Standard terms of payment are net thirty (30) days from date of the Company invoice. For invoice purposed, delivery shall be deemed to be complete at the time the products, parts and systems are shipped from the Company and shall not be conditioned upon the start up thereof. Amounts past due are subject to a service charge of 1.5% per month or fraction thereof.

6. Order cancellation

Any cancellation by the Purchaser of any order or contract between the Company and the Purchaser must be made in writing and receive written approval of an authorized Company representative at its office in Heath Springs, S.C. In the event of any cancellation of an order by either party, the Purchaser shall pay to the Company the reasonable costs, expenses, damages and loss of profit of the Company incurred there by, including but not limited to engineering expenses and expenses caused by commitments to the suppliers of the Company's subcontractors, as determined by the Company.

7. Changes

The Purchaser may, from time to time, but only with the written consent of an authorized Company representative, make a change in specifications to products, parts or systems covered by a purchase order accepted by the company. In the event of any such changes, the Company shall be entitled to revise its price and delivery schedule under such order.

8. Returned material

If the Purchaser desires to return any product or part, written authorization thereof must first be obtained from the Company which will advise the Purchaser of the credit to be allowed and restocking charges to be paid in regard to such return. No product or part shall be returned to the Company without a "RETURN TAG" attached thereon which has been issued by the Company.

9. Packing

Published prices and quotations include the Company's standard packing for domestic shipment. Additional expenses for special packing or overseas shipments shall be paid by the Purchaser. If the Purchaser does not specify packing or accepts parts unpacked, no allowance will be made to the Purchaser in lieu of packing.

10. Standard transportation policy

Unless expressly provided in writing to the contrary, products, parts and systems are sold f.o.b. first point of shipment. Partial shipments shall be permitted, and the Company may invoice each shipment separately. Claims for non-delivery of products, parts and systems, and for damages thereto must be filed with the carrier by the Purchaser. The Company's responsibility therefor shall cease when the carrier signs for and accepts the shipment.



CAROTRON

Driven by Excellence

D.C. DRIVES, A.C. INVERTERS,
SOLID STATE STARTERS, SYSTEM INTERFACE
CIRCUITS AND ENGINEERED SYSTEMS

3204 Rocky River Road
Heath Springs, SC 29058
Phone: 803.286.8614
Fax: 803.286.6063
Email: saleserv@carotron.com
Web: www.carotron.com
MAN1062-00 Rev. A
Issued 05-07-2018