FT-3200

Inline Electromagnetic Flow Meter
MODBUS TCP/IP Supplement

ONICON
Flow and Energy Measurement

DOC-0003399 Rev.F

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SECTION 1.0 INTRODUCTION

1.1 PURPOSE OF THIS GUIDE

The purpose of this guide is to provide installation and operating instructions for the ONICON FT-3200 MODBUS TCP/IP serial interface.

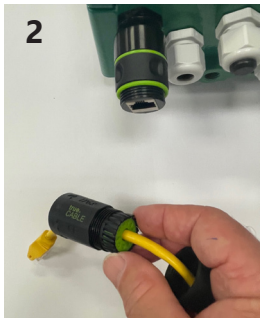
1.2 SPECIFICATIONS

Output Signal	
Protocol	MODBUS RTU
Transceiver	TCP/IP, 10/100 Mbps, RJ45 Connection
Port	502
Baud Rate	38400
Parity	None
IP Address	192.168.255.1
Mask	255.255.0.0
Gateway	192.168.0.1

1.3 NETWORK SIGNAL CONNECTIONS

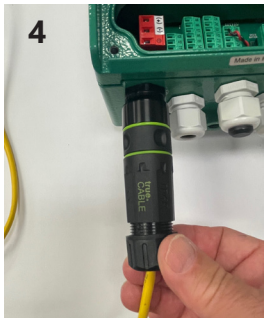
NOTE: Meters shipped prior to September 2023 had an internal RJ-45 coupler - see next page.

Instructions for External RG-45 coupler for FT-32XX Meters with MODBUS TCP/IP Option



1. When ready to connect the TCP/IP network, first thread the nut, then slip the green cable seal over the cable, then the connection cover as shown.

2. Carefully insert the green cable seal into the end of the connection cover as shown - use caution to avoid damaging the flexible fingers on the end.

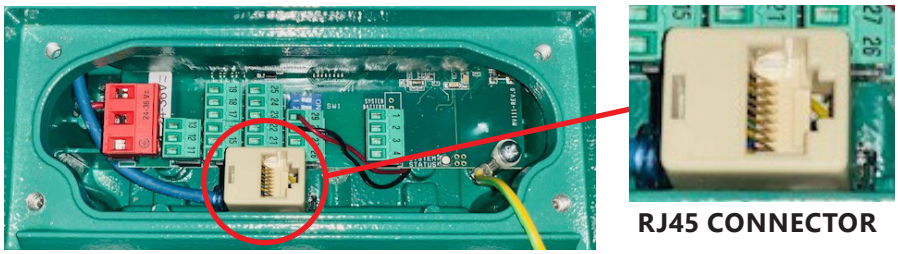


3. Connect the field cable to the RJ-45 coupler, then carefully thread the connection cover on the coupler until it is finger tight against the green o-ring. Use caution to avoid twisting the cable.

4. Thread the nut completely onto the connection cover to seal the cable gland - use caution to avoid twisting the cable.

1.3 NETWORK SIGNAL CONNECTIONS (Continued)

MODBUS TCP, 10/100 Base-TX output connection are made as shown. Requires 10/100 Base-TX cable and RJ45 connector.



RJ45 CONNECTOR

Important Note
When configured for MODBUS TCP/IP output, the FT-3200 is shipped with an additional NPT conduit adapter.

Important Note
The FT-3200 enclosure's conduit holes are not large enough to accommodate all sizes of RJ45 cable jacks. Test the conduit size before pulling pre-terminated RJ45 cable through the conduit to the meter. If the jack does not fit, you will need to pull un-terminated Ethernet cable, and terminate the jack inside the FT-3200 enclosure.

1.4 NETWORK ADDRESSING

Before the FT-3200 can communicate on the MODBUS network:
- The appropriate device ID must be programmed into the meter.
- An IP address must also be assigned to the meter.

1.4.1 MODBUS DEVICE ADDRESS SETTINGS

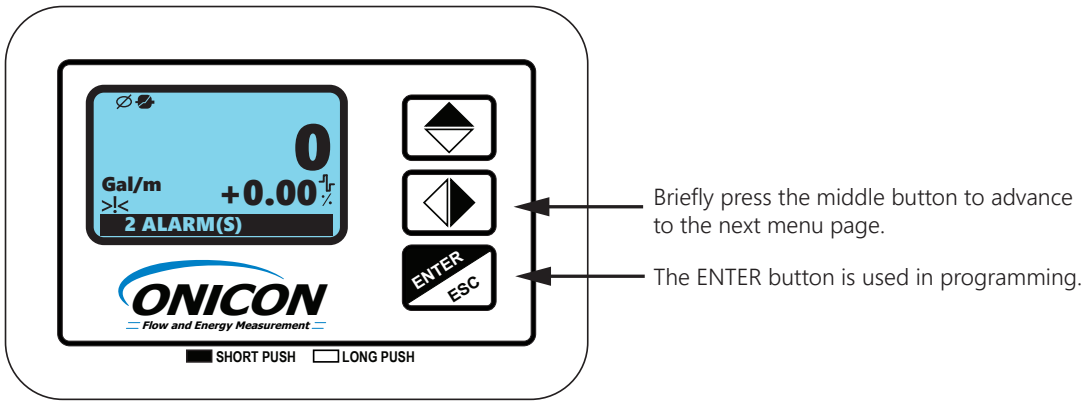
There are several MODBUS operating parameters that must be set before the meter can communicate over the network. These settings are made through the meter display/user interface and through the web browser network interface.

These operating parameters include the following:
- Protocol (set to RTU)
- Device address (01-247)
- Baud rate (set to 38400)
- Parity (set to none)
- Data bits (set to 8)
- Stop bits (set to 1)
- TCP port number (set to 502)

Refer to the information on the following pages and in the FT-3000 Installation and Operation Guide on how to change these settings.

1.5 DISPLAY AND USER INTERFACE

The FT-3200 transmitter is equipped with a lighted graphic display and 3-button user interface as shown below.



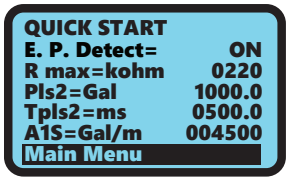
1.6 ACCESSING THE MODBUS SETTINGS

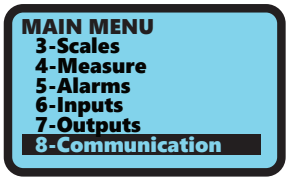
In order to change the MODBUS settings, you must first enter the programming mode. Access to the programming menus is password protected. The factory default access code is: 4********. The 3-user interface pushbutton functions change when operating in the program mode. The functions are described below.

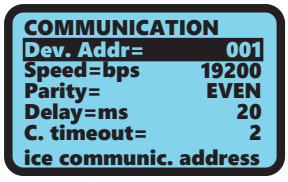
Push Button	Short Press (<1 second)	Long Press (>1 second)
	• Moves the cursor to the right on input fields • Advances to the next menu item • Changes the process data display	• Moves the cursor to the left on input fields • Returns to the previous menu item
	• Increments the numeric value or selected parameter • Return to the previous menu item	• Decrements the numeric value • Advances to the next menu item
ENTER ESC	• Enters or leaves the selected function • Enters the program mode	• Exits the current menu

The menu can be accessed by briefly pressing the ENTER ESC key and entering the access code 4*******.

1. From Quick Start menu, push repeatedly until Main Menu is highlighted.
2. Enter into the Main Menu.
3. From the Main Menu repeatedly press until 8-Communication is highlighted and then press enter.





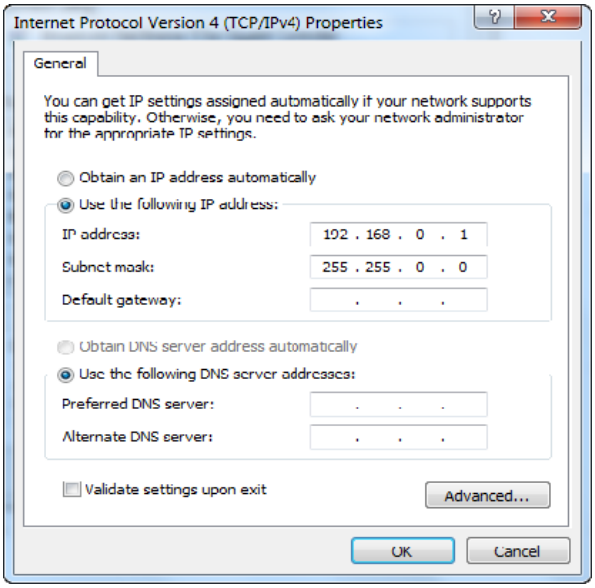


1.7 IP ADDRESS SETTING (IPv4)

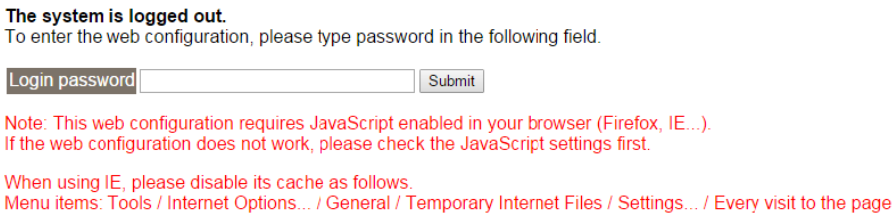
Changing the IP address of the FT-3200 requires the use of a PC with an Ethernet card and an available port. The default IP configuration of the FT-3200 is as follows:

IP Address 192.168.255.1
Mask 255.255.0.0
Gateway 192.168.0.1
To change these IP address settings:

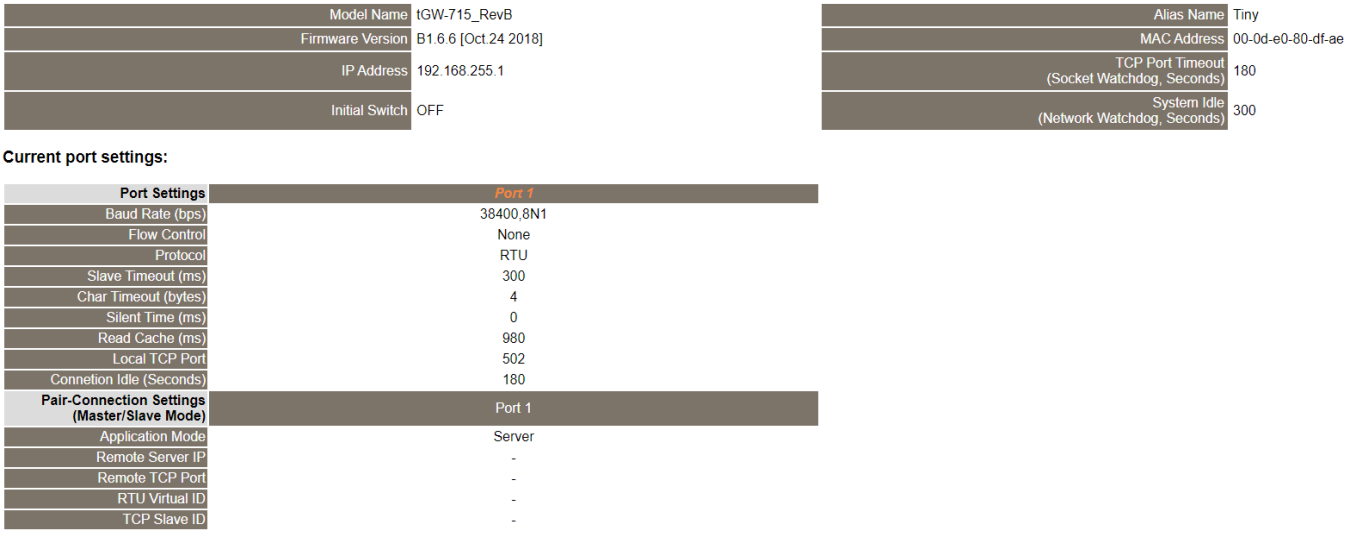
- Connect the Ethernet cable to the RJ45 connector in the transmitter.
- Change the adapter settings in your PC as shown:



Next, open a web browser, and navigate to IP address 192.168.255.1. The following page will appear:



The interface shown above is used to configure the IP settings on the FT-3200. The Login Password is **admin** (case sensitive). Press Submit after entering the password, and the following page appears:



Model Name	tGW-715_RevB
Firmware Version	B1.6.6 [Oct.24 2018]
IP Address	192.168.255.1
Initial Switch	OFF

Alias Name	Tiny
MAC Address	00-0d-e0-80-df-ae
TCP Port Timeout (Socket Watchdog, Seconds)	180
System Idle (Network Watchdog, Seconds)	300

Current port settings:

Port Settings	Port 1
Baud Rate (bps)	38400,8N1
Flow Control	None
Protocol	RTU
Slave Timeout (ms)	300
Char Timeout (bytes)	4
Silent Time (ms)	0
Read Cache (ms)	980
Local TCP Port	502
Connetion Idle (Seconds)	180
Pair-Connection Settings (Master/Slave Mode)	Port 1
Application Mode	Server
Remote Server IP	-
Remote TCP Port	-
RTU Virtual ID	-
TCP Slave ID	-

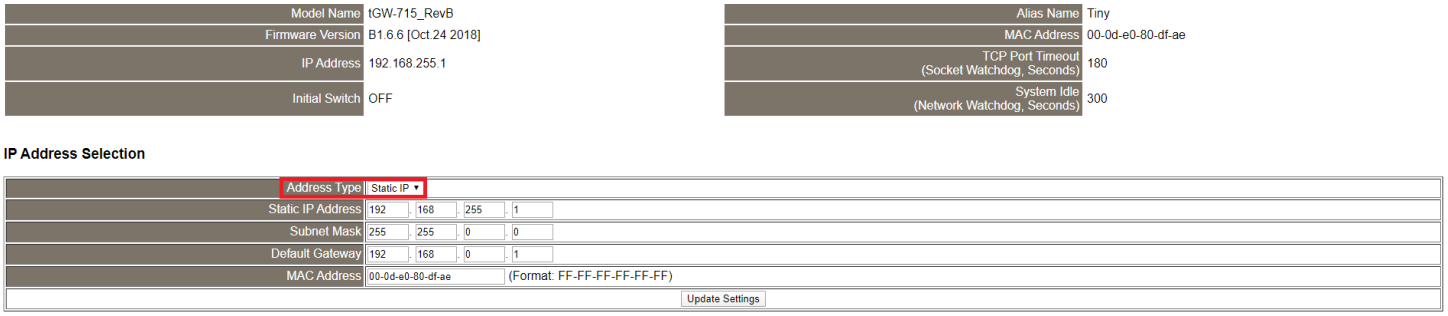
1.7 IP ADDRESS SETTING (IPv4) (CONTINUED)

Seven pages are available from the main menu:

Home – The page you currently see. This page is not used to configure the IP address.
Port1 – Not used.
Network – This page allows you to change the IP address settings.
Filter – Not used.
Monitor – Not used.
Password – This page can be used to change the password from the default admin.
Logout – Press this button to logout of the FT-3200 IP configurator.

Press the **Network** button to arrive at the following page:

Within the **IP Address Selection** section, you can configure the IP settings for the FT-3200's MODBUS communications.



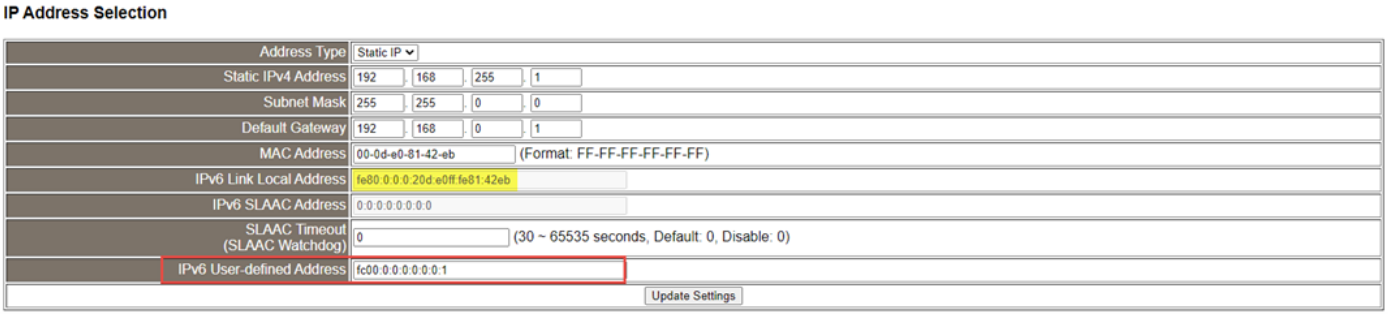
Address Type – Choose between Static IP, and DHCP. The Static IP Address, Subnet Mask, and Default Gateway will become un-editable if DHCP is selected.

After the configuration has been updated, press the **Update Settings** button to save the changes. Document the configuration chosen. After pressing the update button, if you need to access these settings again, you must go back into your PC's IP setting page and change the IP address and subnet to match the network the FT-3200 is set for.

After you are done making configuration changes, you are ready to connect the FT-3200 to the MODBUS TCP/IP network.

1.8 IP ADDRESS SETTING (IPv6)

The default meter IPv6 address is shown in the field highlighted in yellow below. This section is part of the web browser interface Network tab. Use the field outlined in red below to enter a new IPv6 address for the meter.
Press **Update Settings** button to save the change.



SECTION 2.0 MODBUS

ONICON FT-3200 Inline Electromagnetic Flow Meters provide flow rate data, totalized flow data, and operating status data via the MODBUS RTU TCP/IP serial communications interface. MODBUS data is available in the same engineering units shown on the meter's display.

2.1 MODBUS REGISTER TYPES AND DATA FORMS

- Input registers are used for all process data. All data is formatted MSB → LSB (Big Endian).
- A single coil is provided for resetting totals.

Function Codes Supported

Function Code	Description
04	Read multiple input registers
05	Write a single coil
08	Diagnostics

2.2 MEMORY MAP

Important Note
Register addresses are shown in Base 1 format. Address 0001 corresponds to memory location 0000.

Rate / Velocity Data
Data transmitted in the same engineering units shown on the transmitter display.

Function Code	Address	Description	Data Format	Comment
04	0001	Full scale flow rate (1 of 2)	Float (32-bit)	*Full scale flow rate setting (FS1)
04	0002	Full scale flow rate (2 of 2)	Float (32-bit)	
04	0003	Flow rate as % full scale (1 of 2)	Float (32-bit)	% of flow rate setting in register 0001-0002
04	0004	Flow rate as % full scale (2 of 2)	Float (32-bit)	
04	0005	Flow rate (1 of 2)	Float (32-bit)	Average flow rate. See 0022
04	0006	Flow rate (2 of 2)	Float (32-bit)	
04	0007	Flow velocity (1 of 2)	Float (32-bit)	Velocity in ft/s or m/s
04	0008	Flow velocity (2 of 2)	Float (32-bit)	

*This is FS1 the full scale flow limit setting programmed into the transmitter. It is used for setting the Full Scale Freq Output (Frq1), alarm thresholds and other operating limits. FS1 and A1S (Full Scale Analog Output) are set to the same value at the factory during initial configuration.

Caution
Changing the A1S (Full Scale Analog Output) value in the field will not change the FS1 value reported over the network.

2.2 MEMORY MAP (CONTINUED)

Totalizer Data
Data transmitted in the same engineering units shown on the transmitter display.

Function Code	Address	Description	Data Format	Comment
04	0009	T+ Total Forward Flow Totalizer (1 of 2)	Unsigned long integer	
04	0010	T+ Total Forward Flow Totalizer (2 of 2)	Unsigned long integer	
04	0011	T+ Overflow / T+ Decimal Point Position	Two 8-bit bytes	*See below
04	0012	P+ Partial Forward Flow Totalizer (1 of 2)	Unsigned long integer	
04	0013	P+ Partial Forward Flow Totalizer (2 of 2)	Unsigned long integer	
04	0014	P+ Overflow / P+ Decimal Point Position	Two 8-bit bytes	*See below
04	0015	T- Total Reverse Flow Totalizer (1 of 2)	Unsigned long integer	
04	0016	T- Total Reverse Flow Totalizer (2 of 2)	Unsigned long integer	
04	0017	T- Overflow / T- Decimal Point Position	Two 8-bit bytes	*See below
04	0018	P- Partial Reverse Flow Totalizer (1 of 2)	Unsigned long integer	
04	0019	P- Partial Reverse Flow Totalizer (2 of 2)	Unsigned long integer	
04	0020	P- Overflow / P- Decimal Point Position	Two 8-bit bytes	*See below

*The upper (MSB) byte indicates the number of times the totalizer overflowed its maximum count and reset to zero. The lower (LSB) byte indicates the number of decimal places for the corresponding totalizer. For example:

T+ total indicated on the display – 123.45
T+ register (40009) value – 12345
T+ overflow value (40011 LSB) – 2 (0.01)
T+ totalizer value with decimal point correction – 12345 x 0.01 = 123.45

2.2 MEMORY MAP (CONTINUED)

Process Diagnostic Data
Data transmitted in the same engineering units shown on the transmitter display.

Function Code	Address	Description	Data Format	Comment
04	0021	Upper: Process flag # 1 Lower: Process flag # 2	Two 8-bit bytes	See below for details
04	0022	# of samples used to calculate average flow in register 0005	Unsigned integer	See below for details
04	0023	Equivalent resistance between E1 and common in kΩ	Unsigned integer	
04	0024	Equivalent resistance between E2 and common in kΩ	Unsigned integer	
04	0025	Voltage between E1 and common in mV	Signed integer	
04	0026	Voltage between E2 and common in mV	Signed integer	
04	0027	Voltage measured at recharging terminals in mV	Unsigned integer	
04	0028	Residual battery capacity %	Unsigned integer	
04	0029	CPU temperature	Signed integer	In units specified (F or C)
04	0030	Board temperature T1	Signed integer	In units specified (F or C)
04	0031	Board temperature T2	Signed integer	In units specified (F or C)
04	0032	Sensor coil temperature (calculated)	Signed integer	In units specified (F or C)
04	0033	Latest sensor test result code	Unsigned integer	
04	0034	# of active alarms	Unsigned integer	

Process flag 1 (Least significant byte) in register 0021
Bit 7 (MSB): Min flow rate alarm (flow below threshold setting)
Bit 6: Max flow rate alarm (flow above threshold setting)
Bit 5: Flow direction (1 = reverse flow)
Bit 4: Flow rate below low flow cutoff
Bit 3 Active measurement range (0 = range 1, 1 = range 2)
Bit 2: Flow rate measurement reset value status (1 = forcibly reset to zero)
Bit 1: Totalizers are locked (1 = counters are locked)
Bit 0: Not used

Process flag 2 (Most significant byte) in register 0021
Bit 7 (MSB): Flow rate overflow (rate > full scale flow)
Bit 6: Pulse output 2 overflow (Pulse rate > allowable rate based on current settings)
Bit 5: Pulse output 1 overflow (Pulse rate > allowable rate based on current settings)
Bit 4: Measured signal amplitude out of A/D converter range
Bit 3 Measured signal amplitude out of amplifier range
Bit 2: Input signal error
Bit 1: Coil excitation error
Bit 0: Empty pipe alarm

2.2 MEMORY MAP (CONTINUED)

Average flow rate calculation for register 0005 (see 0022)
All values relative to the flow rate are averaged. The number of samples that compose the average value varies depending on the measurement sample rate and the MODBUS reading requests.

Example: measurement sample rate = 50 Hz, MODBUS polling frequency = 10 Hz, the number of samples used for average calculation is 50/10 = 5.

Sensor test results reported in register 0032
Bit 15: (MSB): Resistance of electrode E2 outside limits with respect to reference value
Bit 14: Resistance of electrode E1 outside limits with respect to reference value
Bit 13: Coil time B outside limits with respect to reference value
Bit 12: Coil time A outside limits with respect to reference value
Bit 11 Coil temperature is outside limits with respect to reference value
Bit 10: Coil leakage current is outside the limit
Bit 9: Coil driver output 2 voltage is out of tolerance during test phase 3
Bit 8: Coil driver output 1 voltage is out of tolerance during test phase 3
Bit 7 Coil driver output 2 voltage is out of tolerance during test phase 2
Bit 6: Coil driver output 1 voltage is out of tolerance during test phase 2
Bit 5: Coil driver output 2 voltage is out of tolerance during test phase 1
Bit 4: Coil driver output 1 voltage is out of tolerance during test phase 1
Bit 3: Coil driver power generator voltage is out of tolerance during test phase 2
Bit 2: Coil driver power generator voltage is out of tolerance during test phase 1
Bit 1: Coil driver generator value is out of tolerance during test phase 2
Bit 0: Coil driver generator value is out of tolerance during test phase 1

Reset All Enabled Totalizers Using Function Code 05

Function Code	Address	Description	Data Format	Comment
05	0001	1 = reset	Coil	

MODBUS Diagnostic Tools Using Function Code 08

Sub-function code	Description	Comment
00	Return query date	The data passed in the request data field is to be returned (looped back) in the response. The entire response message should be identical to the request.
01	Restart communications	Restart comms following forced listen
04	Force listen mode	Activate listen mode
10	Clear diagnostic counters	
11	Return bus message count	
12	Return bus CRC error count	
13	Return exception error count	
14	Return slave message count	
15	Return slave no response count	
16	Return slave NAK count	
17	Return slave busy count	
18	Return bus character overrun count	

SECTION 3.0 NETWORK TROUBLESHOOTING TIPS

3.1 TROUBLESHOOTING

REPORTED PROBLEM	POSSIBLE SOLUTIONS
Device will not communicate with the network controller	• A unique address is required for each device on the network. Duplicate addresses will cause some or all of the devices on the network to quit working. • The RS485 network cable connections are polarity sensitive and must be connected the same way on every device (i.e. + to + and - to -). • The Baud rate setting must match the network Baud rate. • Shield drain connections should be daisy chained in the same manner as the signal cables for RS485. The shield drain wire should be left unterminated at the end of the cable and connected to earth only at the network master controller. Shield wires must not be connected to the FT-3200. • The maximum number of devices allowed on a RS485 network segment without a repeater is 32. Adding more than 32 devices to a single segment may reduce the transceiver output voltage to a level that is too low to be distinguished from background noise on the cable. • RS485 cable impedance should be matched to a termination resistor at the end of the cable. This resistor should only be used if the meter is the last device on the network cable.
Network communications are disrupted whent he device is connected	• The RS485 network cable connections are polarity sensitive and must be connected the same way on every device (i.e. + to + and - to -). • A unique address is required for each device on the network. Duplicate addresses will cause some or all of the devices on the network to quit working. • Shield drain connections should be daisy chained in the same manner as the signal cables for RS485. The shield drain wire should be left unterminated at the end of the cable and connected to earth only at the network master controller. Shield wires must not be connected to the FT-3200.
Device will not communicate with the MODBUS TCP/IP controller	• Confirm that the network cable connector (RJ45) is fully seated in the socket. • Confirm that the IP address, subnet mask and gateway addresses are correct. • Confirm that the MODBUS network port is set to 502.