FT-3000 SERIES

Inline Electromagnetic Flow Meter
MODBUS Supplement



ONICON
Flow and Energy Measurement

DOC-0001665 Rev.G

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SECTION 1.0: INTRODUCTION

1.1 PURPOSE OF THIS GUIDE

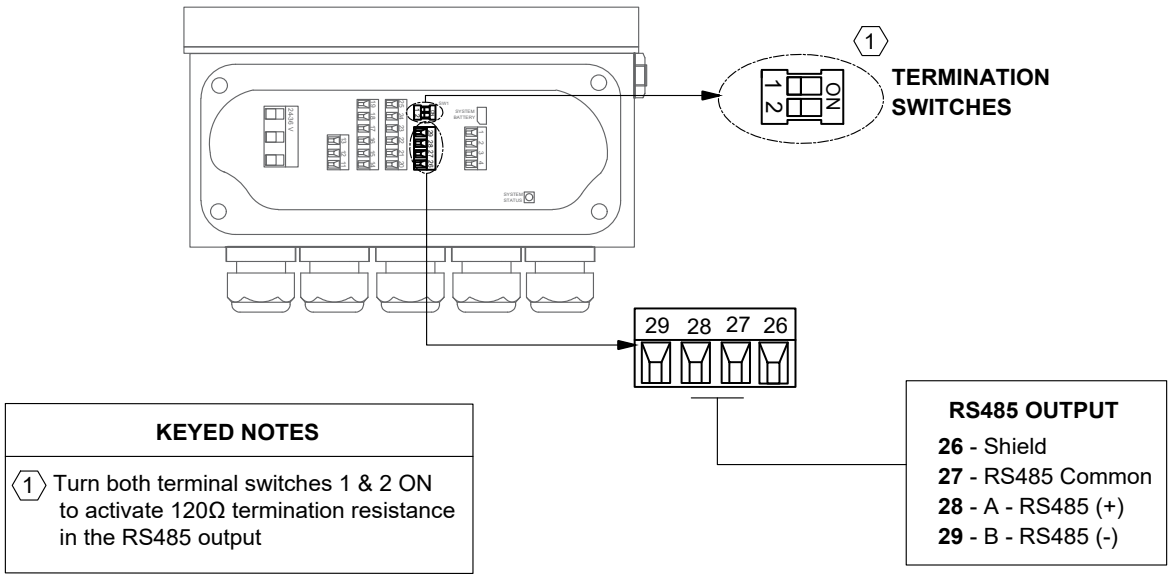
The purpose of this guide is to provide installation and operating instructions for the ONICON FT-3000 Series MODBUS RTU serial interface.

1.2 SPECIFICATIONS

RS485 (IEA-485)	
Transceiver	3-wire, half-duplex, ⅛ unit load
Data format	1 start bit, 8 data bits and 1 stop bit
Max # of devices per segment	32
Parity	Even, None or Odd
Device address range	1 – 255
Baud rate	4800, 9600, 19200, 38400, 57600 and 115200
Termination	Field settable 120Ω resistor
Biasing	None

1.3 NETWORK SIGNAL CONNECTIONS

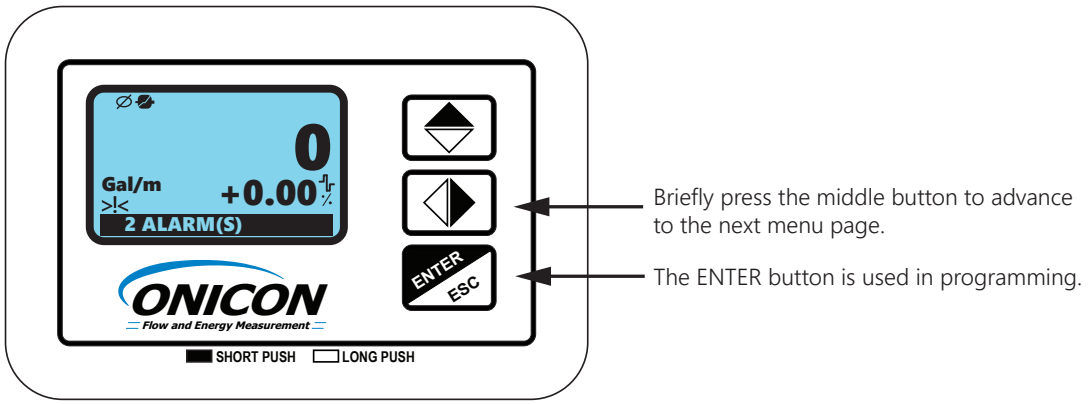
MODBUS RTU network signal connections are shown below. To apply end of line termination, set switches 1 and 2 to the ON position.



Important Note: Please refer to the FT-3000 Series Installation and Operation Manual for additional information.

1.4 DISPLAY AND USER INTERFACE

The FT-3000 Series transmitter is equipped with a lighted graphic display and 3-button user interface as shown below.



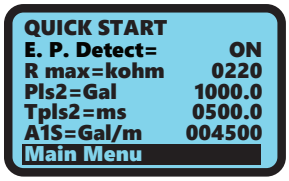
1.5 ACCESSING THE MODBUS SETTINGS

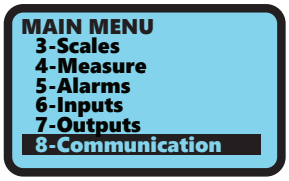
In order to change the MODBUS settings, you must first enter the programming mode. Access to the programming menus is password protected. The factory default access code is: 4********. The 3-user interface pushbutton functions change when operating in the program mode. The functions are described below.

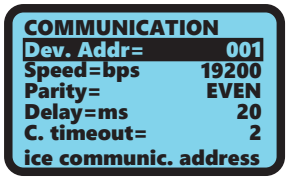
Push Button	Short Press (<1 second)	Long Press (>1 second)
	• Moves the cursor to the right on input fields • Advances to the next menu item • Changes the process data display	• Moves the cursor to the left on input fields • Returns to the previous menu item
	• Increments the numeric value or selected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

The menu can be accessed by briefly pressing the  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.







1.6 MENU 8-COMMUNICATION

Device Address	[Dev.Addr= 001]
Baud Rate	[Speed= bps 19200]
Parity	[Parity= EVEN]
MODBUS Reply Delay	[Delay=ms 20]
MODBUS Timeout Interval	[C.timeout= 2]

Device Address [Dev.Addr = 001]
This is the MODBUS slave address for the FT-3000 Series transmitter. The address range is 001 – 255.
To enter a new value, press enter to access the function. Use the right arrow key to move the cursor and the up arrow key to change the value. Press enter to accept changes and exit the function. Press escape to exit the program mode.

Baud Rate [Speed = BPS 19200]
This is the Baud rate setting for the FT-3000 Series transmitter. Valid settings are: 1200, 4800, 9600, 19200, 38400, 57600 and 115200.
To enter a new Baud rate, press enter to access the function. Use the up arrow key to change the value. Press enter to accept changes and exit the function. Press escape to exit the program mode.

Parity Setting [Parity = Even]
This is the parity setting for the FT-3000 Series transmitter. Valid settings are even, none or odd.
To change the parity setting, press enter to access the function. Use the up arrow key to change the setting. Press enter to accept changes and exit the function. Press escape to exit the program mode.

MODBUS Reply Delay [Delay = MS 20]
This is the MODBUS reply delay interval setting for the FT-3000 Series transmitter. It is entered in milliseconds and the valid range is 0 – 99 ms.
To enter a new value, press enter to access the function. Use the right arrow key to move the cursor and the up arrow key to change the value. Press enter to accept changes and exit the function. Press escape to exit the program mode.

MODBUS Timeout Interval [C.Timeout = 2]
This is the MODBUS timeout interval for the FT-3000 Series transmitter. Valid settings are: 1, 2, 3 and 5.
To change the interval, press enter to access the function. Use the up arrow key to change the setting. Press enter to accept changes and exit the function. Press escape to exit the program mode.

SECTION 2.0 MODBUS

ONICON FT-3000 Series Inline Electromagnetic Flow Meters provided with a MODBUS RTU RS485 interface report flow rate data, totalized flow data, and operating status data to the network. Process data is formatted 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-3000 Series. • 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-3000 Series.