

FT-3100

Inline Electromagnetic Flow Meter
MODBUS Supplement



1.0 INTRODUCTION 3
1.1 PURPOSE OF THIS GUIDE3
1.2 SPECIFICATIONS3
1.3 NETWORK SIGNAL CONNECTIONS.....3
1.4 DISPLAY AND USER INTERFACE4
1.5 ACCESSING THE MODBUS SETTINGS.....4
1.6 MENU 8 - COMMUNICATION5

2.0 MODBUS 6
2.1 MODBUS REGISTER TYPES AND DATA FORMS6
2.2 MEMORY MAP6

3.0 NETWORK TROUBLESHOOTING TIPS..... 9
3.1 TROUBLESHOOTING9

SECTION 1.0: INTRODUCTION

1.1 PURPOSE OF THIS GUIDE

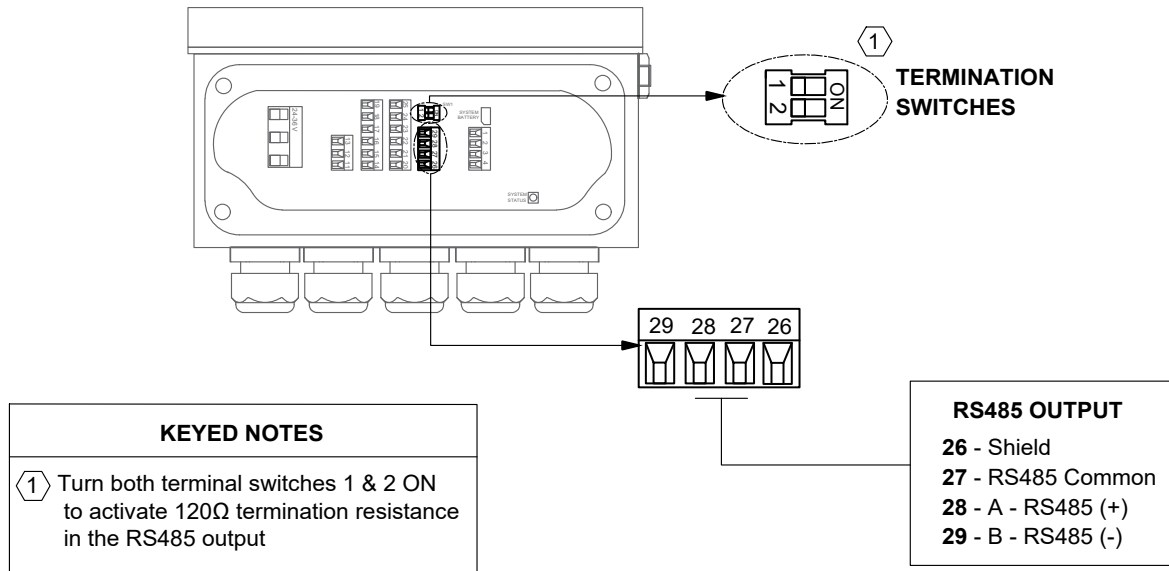
The purpose of this guide is to provide installation and operating instructions for the ONICON FT-3100 MODBUS RTU serial interface.

1.2 SPECIFICATIONS

RS495 (IEA-485)	
Transceiver	3-wire, half-duplex, 1/8 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 120 Ω resistor
Biasing	None

1.3 NETWORK SIGNAL CONNECTIONS

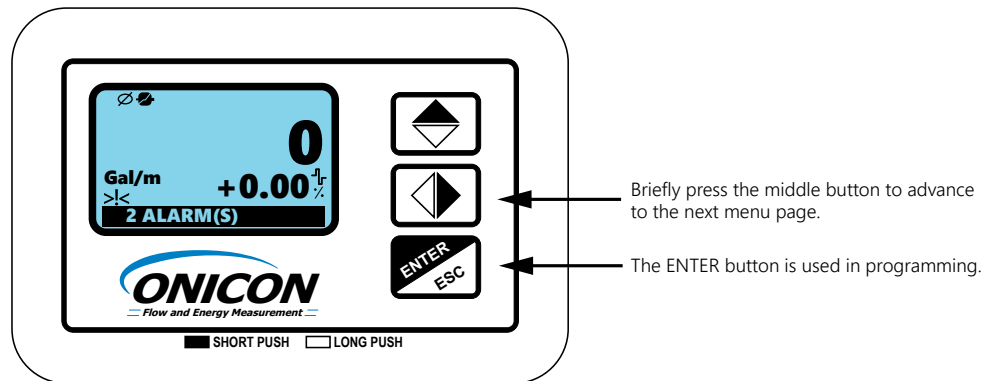
MODBUS RTU network signal connections are shown below. To apply end of line termination, set switches 1 and 2 to the ON position.



Important Note: Please refer to the FT-3100 Installation and Operation Manual for additional information.

1.4 DISPLAY AND USER INTERFACE

The FT-3100 transmitter is equipped with a lighted graphic display and 3-button user interface as shown below.



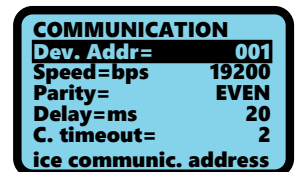
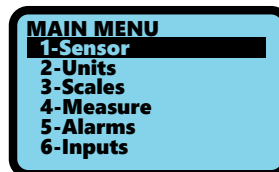
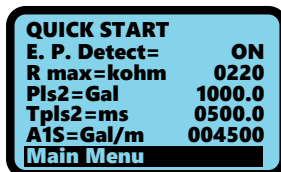
1.5 ACCESSING THE MODBUS SETTINGS

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)
	<ul style="list-style-type: none"> Moves the cursor to the right on input fields Advances to the next menu item Changes the process data display 	<ul style="list-style-type: none"> Moves the cursor to the left on input fields Returns to the previous menu item
	<ul style="list-style-type: none"> Increments the numeric value or selected parameter Return to the previous menu item 	<ul style="list-style-type: none"> Decrements the numeric value Advances to the next menu item
	<ul style="list-style-type: none"> Enters or leaves the selected function Enters the program mode 	<ul style="list-style-type: none"> Exits the current menu

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

- From Quick Start menu, push repeatedly until Main Menu is highlighted.
- Enter into the main menu.
- 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-3100 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-3100 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-3100 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-3100 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-3100 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-3100 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

Rate / Velocity Data

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

Address	Description	Data Format	Comment
0000	Full scale flow rate	Float (32-bit)	*Full scale flow rate setting
0002	Flow rate as % of full scale	Float (32-bit)	
0004	Flow rate	Float (32-bit)	Average flow rate (see 0021) on pg 7
0006	Flow velocity	Float (32-bit)	Velocity in m/s of ft/s

*This is FS1 the full scale flow limit setting programmed into the transmitter. It is used for alarm thresholds and other operating limits. It is not the full scale setting for the analog output.

Totalizer Data

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

Address	Description	Data Format	Comment
0008	Total Forward Flow Totalizer (T+)	Unsigned long integer	32-bit
0010	T+ overflow / T+ D.P. position	Two 8-bit bytes	Upper: # of totalizer overflows lower: Decimal point position for T+ total
0011	Partial Forward Flow Totalizer (P+)	Unsigned long integer	32-bit
0013	P+ overflow / P+ D.P. position	Two 8-bit bytes	Upper: # of totalizer overflows lower: Decimal point position for P+ total
0014	Total Reverse Flow Totalizer (T-)	Unsigned long integer	32-bit
0016	T- overflow / T- D.P. position	Two 8-bit bytes	Upper: # of totalizer overflows lower: Decimal point position for T- total
0017	Partial Reverse Flow Totalizer (P-)	Unsigned long integer	32-bit
0019	P- overflow / P- D.P. position	Two 8-bit bytes	Upper: # of totalizer overflows lower: Decimal point position for P- total

Process Diagnostic Data

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

Address	Description	Data Format	Comment
0020	Upper: Process flag # 1 Lower: Process flag # 2	Two 8-bit bytes	See below for details
0021	# of samples used to calculate average flow in register 0004	Unsigned integer	See below for details
0022	Equivalent resistance between E1 and common in kΩ	Unsigned integer	
0023	Equivalent resistance between E2 and common in kΩ	Unsigned integer	
0024	Voltage between E1 and common in mV	Signed integer	
0025	Voltage between E2 and common in mV	Signed integer	
0026	Voltage measured at recharging terminals in mV	Unsigned integer	
0027	Residual battery capacity %	Unsigned integer	
0028	CPU temperature	Signed integer	In units specified (F or C)
0029	Board temperature T1	Signed integer	In units specified (F or C)
0030	Board temperature T2	Signed integer	In units specified (F or C)
0031	Sensor coil temperature (calculated)	Signed integer	In units specified (F or C)
0032	Latest sensor test result code	Unsigned integer	
0033	# of active alarms	Unsigned integer	

Process flag 1 (Least significant byte) in register 0020

- 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 0020

- 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

Average flow rate calculation for register 0004 (see 0021)

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 0031

- 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

Address	Description	Data Format	Comment
0000	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
<p>Device will not communicate with the network controller</p>	<ul style="list-style-type: none"> • 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-3100. • 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.
<p>Network communications are disrupted when the device is connected</p>	<ul style="list-style-type: none"> • 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-3100.

