



MODBUS MESSAGE PROTOCOL

FOR

MODEL FT2

THERMAL MASS FLOWMETER & TEMPERATURE TRANSMITTER

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101479 Revision E

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Scope

This document describes the MODBUS implementation for the Fox Thermal Instruments FT2 Mass flow meter.

MODBUS is an application layer messaging protocol that provides client/server communications between devices. MODBUS is a request/reply protocol and offers services specified by function codes.

The size of the MODBUS Protocol Data Unit is limited by the size constraint inherited from the first MODBUS implementation on Serial Line network (max. RS485 Application Data Unit = 256 bytes).

Therefore, MODBUS PDU for serial line communication = 256 – Server address (1 byte) – CRC (2 bytes) = 253 bytes.

RS485 ADU = 253 + Server address (1 byte) + CRC (2 bytes) = 256 bytes.

For more information on MODBUS go to the web site <http://www.modbus.org/>.

MODBUS Protocol:

Command Request:

<Meter Address> <Function code> <Register start address high> <Register start address low> <Register count high> <Register count low> <CRC low> <CRC high>

Command Response:

<Meter Address> <Function code> <Data byte count> <data register low> <data register high> ...
<data register low> <data register high> <CRC low> <CRC high>

Note: The data in shown in brackets < > represents one byte of data.

FT2 Commands supported:

The FT2 supports the following commands:

- 1) Function 03: Read holding registers
- 2) Function 04: Read input register.
- 3) Function 06: Preset single register

Read Holding Registers (command 03)

This command reads the basic variable from the FT2 and has the following format:

Request:

<Meter Address> <Function code=03> <Register start address high> <Register start address low>
<Register count high> <Register count low> <CRC low> <CRC high>

Response:

<Meter Address> <Function code=03> <Byte count> <Data high><Data low>...
<Data high><Data low> <CRC low> <CRC high>

FT2 Modbus register assignments for command 0x03

Register Address	Modbus Address	Data type	Scaling	Comment
0x00	40001	Flow in Eng unit (low)	No	Mass flow in selected unit
0x01	40002	Flow in Eng unit (high)	No	
0x02	40003	Total (low)	No	Total in selected unit
0x03	40004	Total (High)	No	
0x04	40005	Temperature (low)	*10	Temperature in selected unit * 10
0x05	40006	Temperature (high)	*10	
0x06	40007	Elapsed time (low)	*10	Elapsed time in hours * 10
0x07	40008	Elapsed time (high)	*10	
0x08	40009	Velocity (Low)	No	Velocity in nm/hr
0x09	40010	Velocity (high)	No	
0x0A	40011	Flow in Eng unit * 10	10	Mass flow in selected unit * 10
0x0B	40012	Flow in Eng unit *100	100	Mass flow in selected unit * 100
0x0C	40013	Total *100	100	Total in selected unit * 100
0x0D	40014	Total2 (low, 2 gas curves only)	No	Total #2 for 2 gas curves
0x0E	40015	Total2 (high, 2 gas curves only)	No	Total #2 for 2 gas curves
0x0F	40016	Status	No	Status
0x10	40017	Spare/ Not used		
0x11	40018	Spare/ Not used		
0x12	40019	Spare/ Not used		
0x13	40020	Flow in Eng Unit (float, upper 16 bits)	No	Mass flow in selected unit
0x14	40021	Flow in Eng Unit (float, lower 16 bits)	No	Mass flow in selected unit
0x15	40022	Total in Eng Unit (float, upper 16 bits)	No	Total in selected unit
0x16	40023	Total in Eng Unit (float, lower 16 bits)	No	Total in selected unit
0x17	40024	Total#2 for 2 gas curve (float, upper 16 bits)	No	Total in selected unit
0x18	40025	Total#2 for 2 gas curve (float, lower 16 bits)	No	Total in selected unit
0x19	40026	Temperature in selected unit (float, upper 16 bits)	No	Temperature in selected unit
0x1A	40027	Temperature in selected unit (float, lower 16 bits)	No	Temperature in selected unit
0x1B	40028	Elapsed time in hours (float, upper 16 bits)	No	Elapsed time in hours
0x1C	40029	Elapsed time in hours (float, lower 16 bits)	No	Elapsed time in hours
0x1D	40030	Velocity in selected unit (float, upper 16 bits)	No	Velocity in selected unit
0x1E	40031	Velocity in selected unit (float, lower 16 bits)	No	Velocity in selected unit
0x1F	40032	Spare/ Not used		
0x20	40033	Spare/ Not used		
0x21	40034	Spare/ Not used		
0x22	40035	Spare/ Not used		
0x23	40036	Spare/ Not used		

Note: Register A, B & C are provided to get more resolution for low flow and total. When value exceeds the 16 bit registers, they will be frozen with all 16 bits set. It is also possible to use the velocity to calculate the flow in engineering units by using the pipe area and conversion factor for the selected unit.

Example:

Request data register at starting address 0x0000 and specifying only 1 register

<0x01> <0x03> <0x00> <0x00> <0x00> <0x01> <0x0a> <0x84>

Response:

<0x01> <0x03> <0x02> <xx> <xx> <CRC low> <CRC high>

Where xx xx is the data register value.

Read Input Register (FT2 status, command 04)

This command is used to report the FT2 status information. It is a **READ ONLY** command.

Request:

<Meter Address> <Function code=04> <Register address =0> <Register address =0>
<Register count =0> <Register count =1> <CRC low> <CRC high>

Response:

<Meter Address> <Function code=04> <Byte count=2> <Status High><Status Low>
<CRC low> <CRC high>

The FT2 supports only reading of the FT2 status. The register address must be set to zero and the register count must be set to 1.

Status bits definitions

Bit	Definition	Comment
0	Power up indication	Reset when out of the power up sequence
1	Flow rate reached high limit threshold	Set limit to zero to disable
2	Flow rate reached low limit threshold	Set limit to zero to disable
3	Temperature reached high limit threshold	Set limit to zero to disable
4	Temperature reached low limit threshold	Set limit to zero to disable
5	Sensor reading is out of range	Check sensor wiring
6	Velocity flow rate outside of calibration table	Check sensor wiring
7	Incorrect Settings	Check settings
8	In simulation mode	Set simulation value to 0 to disable
9	Frequency output is out of range	Check frequency output settings
10	Analog 4-20 mA for flow is out of range	Check analog output settings
11	Analog 4-20 mA for temperature is out of range	Check analog output settings
12	Anybus error	Check wiring from RS485 to Anybus IC
13	RTC error (only for FT2 with RTC)	Check RTC
14	CRC error	Check parameters and reset CRC
15	Tot Error	Reset total

Preset Single register (command 06)

This command is used to clear the Totalizer and elapsed time registers. The register address is 0x0a (10 decimal, Modbus=40011) and the data to write must be 0x02.

Request:

<Meter Address> <Function code=06> <Register address high=0x00> <Register address low=0x0a>
<Register data high=0x00> <Register data low =0x02> <CRC low> <CRC high>

Response:

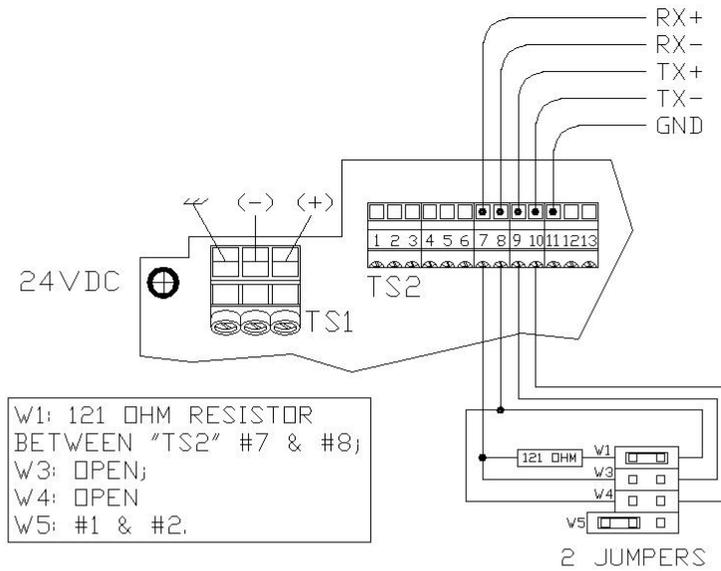
<Meter Address> <Function code=06> <Register address =0x00> <Register address =0x0a>
<Register data=0x00> <Register data =0x02> <CRC low> <CRC high>

RS485 wiring

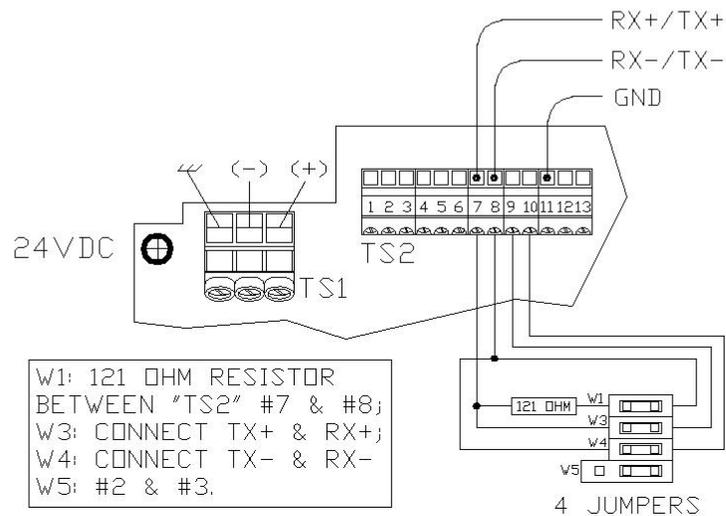
W1 jumper is to terminate the bus with a 121-ohm resistor. W3 and W4 are used for half duplex operation. (W3 connects TX+ & RX+ , W4 connects TX- & RX-).

Figure 1-1 RS485 Wiring and Configuration

4-WIRE CONFIGURATION



2-WIRE CONFIGURATION



Note: W1 jumper should only be inserted in the last meter in the RS485 daisy chain

Programming using the Local Display

Entering the programming mode

Press the F1 or the F2 key repeatedly, in the normal running mode, until the following screen is shown. This enters the programming mode:

SET PARAMETERS ?			
No			Yes
F1	F2	F3	F4

Press **YES (F4)** and then the following screen will prompt the user to enter the password if enabled:

PASWD:_			
UP	DN	NXT	OK
F1	F2	F3	F4

Enter the correct password. Default password for Level 1 is 1234.

PASWD=_			
UP	DN	NXT	OK
F1	F2	F3	F4

Press the **UP (F1) or DN (F2)** key to select a new digit or character, the cursor points to the selected digit. Press **NXT (F3)** to select the next digit and **OK (F4)** to accept the entry.

Note: If the **UP (F1) or DN (F2)** key is held down for more the 1 second, the program will progressively select new digits at increasing speed as time increases.

If the wrong password is entered, the message “Wrong Password” will be displayed for a few seconds and then return to the programming entry screen.

If the password is accepted, the following screen will be shown:

SET PARAMETERS			
I/O	FLO	DSP	EXIT
F1	F2	F3	F4

This is the base screen for the programming mode.

Press **EXIT (F4)** repeatedly until “Normal Mode” is seen briefly to exit the programming mode.

Communication Protocol and Parameters

To program the communication parameters, press **I/O (F1)** key from the base menu.

SET I/O			
I/O	FEQ	420	EXIT

F1	F2	F3	F4
----	----	----	----

Then press **I/O (F1)** again:

SET I/O			
COM	CTC		EXIT

F1	F2	F3	F4
----	----	----	----

Then press **COM (F1)** to select communication parameters

Set Bus protocol:

Bus=Modbus			OK
NXT			

F1	F2	F3	F4
----	----	----	----

Press **NXT (F1)** repeatedly until the correct selection is shown and then press **OK (F4)** to accept the setting.

Selections are: "Modbus"
 "Profibus"
 "Ethernet"
 "Devicenet"
 "None"

Set communication parameters are only available for MODBUS:

Baud=9600			OK
NXT			

F1	F2	F3	F4
----	----	----	----

Press **NXT (F1)** repeatedly until the correct selection is shown and then press **OK (F4)** to accept the setting.

Selections are: "19200"
 "9600"
 "4800"
 "2400"
 "1200"

Parity=EVEN			
NXT		OK	

F1	F2	F3	F4
----	----	----	----

Press **NXT (F1)** repeatedly until the correct selection is shown and then press **OK (F4)** to accept the setting.

Selections are: "NONE"
"ODD"
"EVEN"

Data Bits=8			
NXT		OK	

F1	F2	F3	F4
----	----	----	----

Press **NXT (F1)** repeatedly until the correct selection is shown and then press **OK (F4)** to accept the setting.

Selections are: "7"
"8"

Stop Bits=1			
NXT		OK	

F1	F2	F3	F4
----	----	----	----

Press **NXT (F1)** repeatedly until the correct selection is shown and then press **OK (F4)** to accept the setting.

Selections are: "1"
"2"

Set Unit Address:

LoopID=1			
CHG		OK	

F1	F2	F3	F4
----	----	----	----

Press **CHG (F1)** key to change the Loop ID and **OK (F4)** to accept the new value.

LoopID=1			
UP	DN	NXT	OK

F1	F2	F3	F4
----	----	----	----

Press **UP (F1)** or **DN (F2)** key to select a new digit or character, the cursor points to the selected digit. Press **NXT (F3)** to select the next digit and **OK (F4)** to accept the entry.

Note: If the **UP (F1)** or **DN (F2)** keys are held down for more the 1 second, the program will progressively select new digits at increasing speed as time increases.

It is of great importance to ensure that there are not two devices with the same address. To avoid conflicts on the MODBUS each slave must have a unique address. Range is from 1 to 247.

Note: Power cycle is required for the new settings to take effect.