Modbus Protocol

Pulse Input Series 2 Laureate Counters, Timers & Transmitters Now with Ethernet

CE RoHS c ETL LISTED us Intertek 4006497

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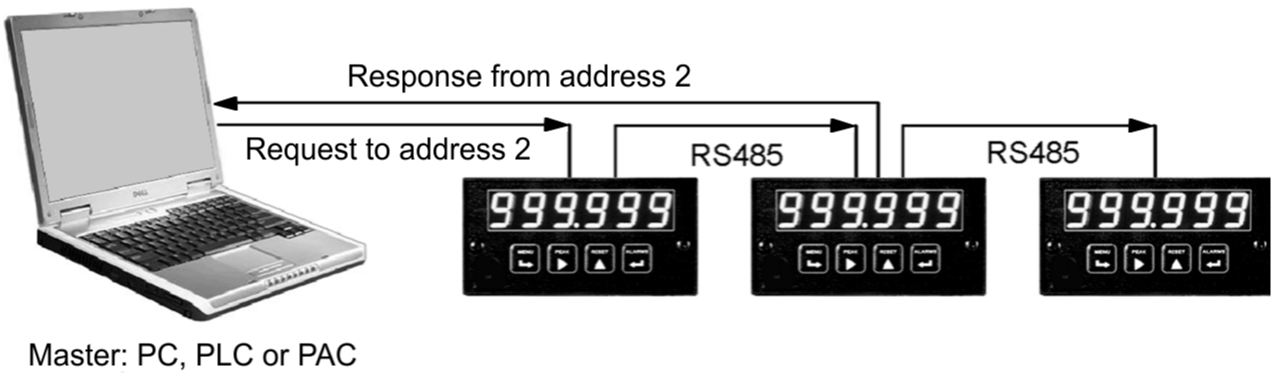
2. MODBUS CONNECTION EXAMPLES

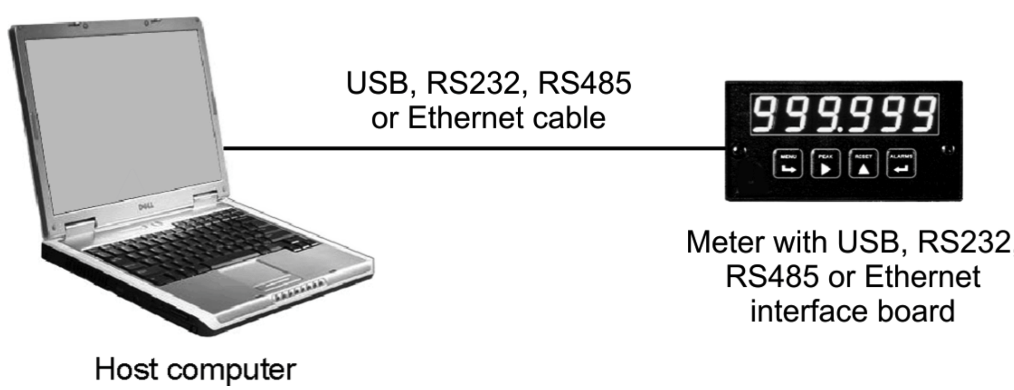
1. MASTER-SLAVE ARCHITECTURE

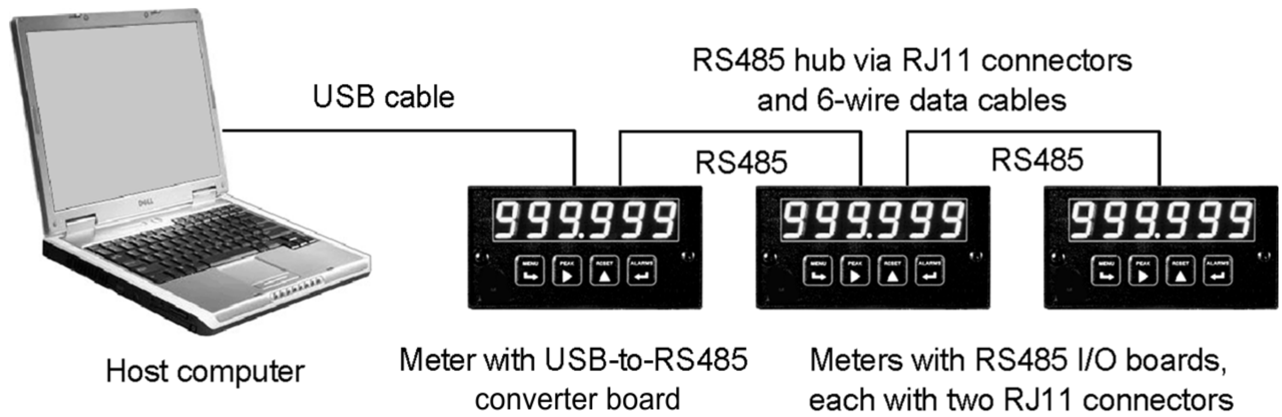
The Modbus protocol was first published by Modicon in 1979 and is now a well-established international standard. For technical details, please see Modbus over Serial Line Specification V1.0 (2002).

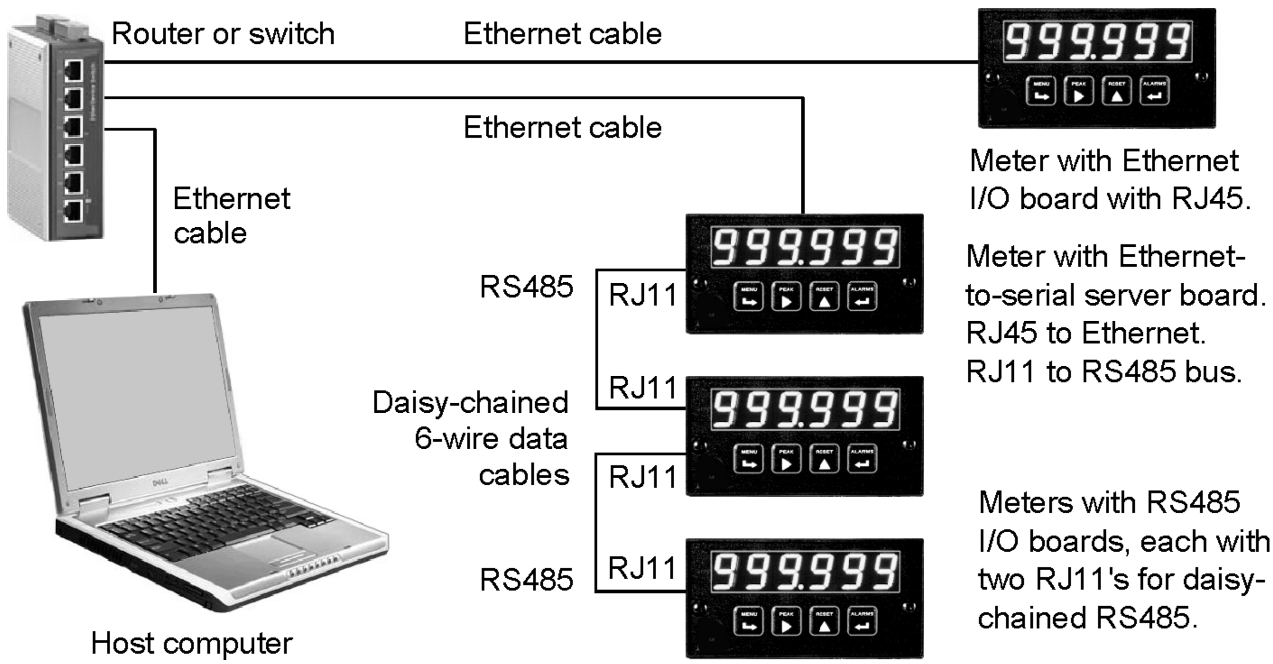


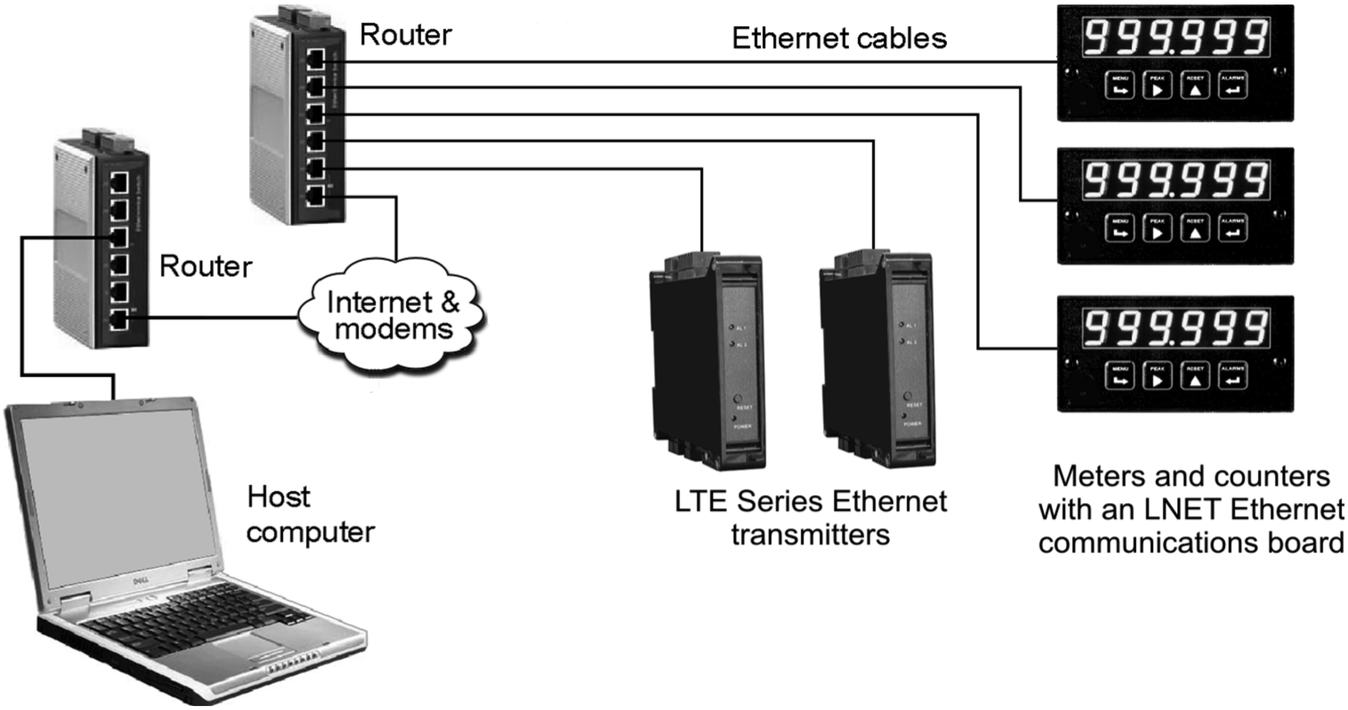
Modbus is a simple, yet flexible, request-response protocol with a master-slave architecture. The master is typically a PC, PLC or PAC, which sends out requests or commands over a serial bus or an Ethernet network and waits for a response from an addressed slave. A slave can be one of our digital panel meters, counters, timers or transmitters, or it can be an instrument from another manufacturer. Each slave needs to have an address from 1 to 247. If an addressed slave does not respond within a specified timeout, an error code is generated. There can only be up to 31 instruments on an RS485 bus for voltage loading reasons.

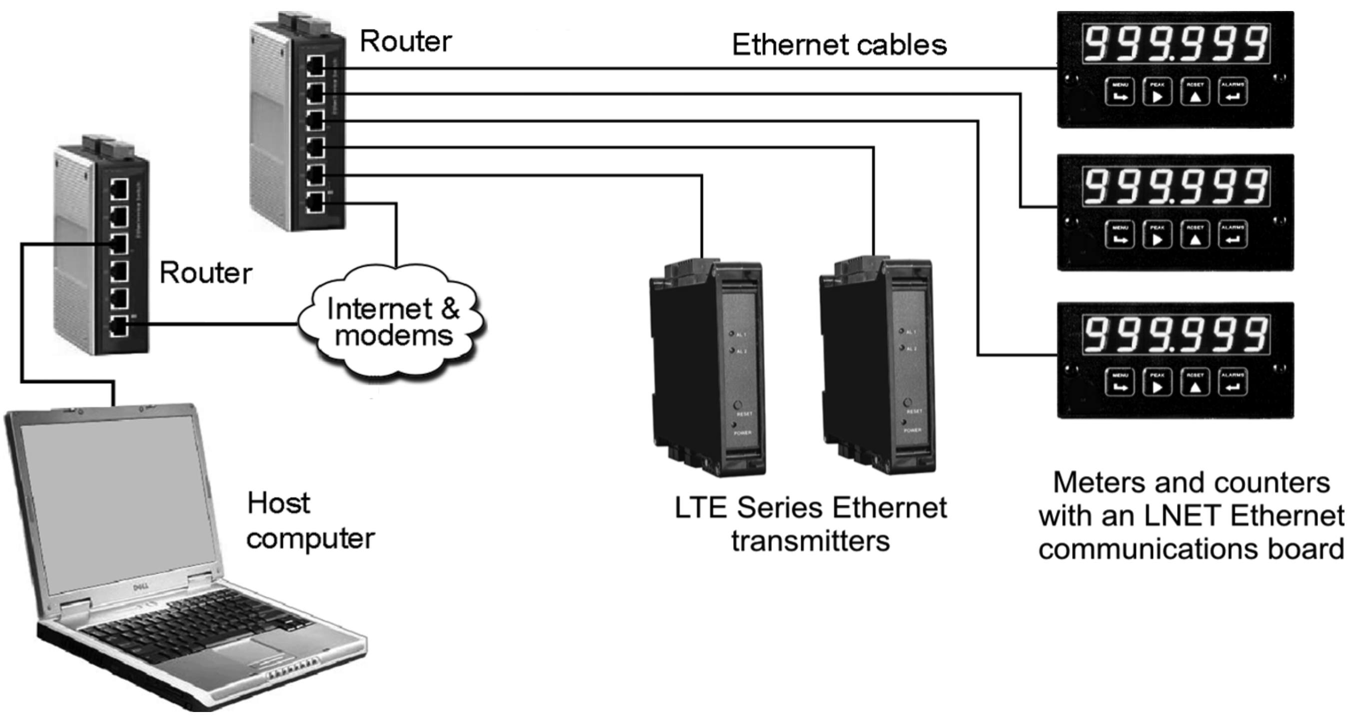
2. CONNECTION EXAMPLES




USB cable
RS485 hub via RJ11 connectors
and 6-wire data cables
RS485
RS485
Host computer
Meter with USB-to-RS485
converter board
Meters with RS485 I/O boards,
each with two RJ11 connectors


Router or switch
Ethernet cable
Ethernet cable
Ethernet
cable
Meter with Ethernet
I/O board with RJ45.
Meter with Ethernet-
to-serial server board.
RJ45 to Ethernet.
RJ11 to RS485 bus.
RS485
RJ11
RJ11
Daisy-chained
6-wire data
cables
RJ11
RJ11
RS485
Meters with RS485
I/O boards, each with
two RJ11's for daisy-
chained RS485.
Host computer


Router
Ethernet cables
Router
Internet & modems
Host computer
LTE Series Ethernet transmitters
Meters and counters with an LNET Ethernet communications board


Router
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3. MODBUS PROTOCOL IMPLEMENTATION

1. OVERVIEW

This counter Modbus manual covers our 1/8 DIN size panel-mount pulse input Laureate counter/timers and their transmitter counterparts. Included are our VF voltage-to-frequency converter models, which convert a 4-30 mA, 0-1 mA or 0-10V analog signal to pulses. A separate Modbus manual covers our analog input digital panel meters and transmitters.

The Modbus protocol is selectable with all of our communications options: Ethernet, WiFi, USB, RS485 and RS232. It is compliant with Modbus RTU or ASCII transmission modes (software selectable), as specified in Modbus over Serial Line Specification V1.0 (2002).

The Modbus protocol is embedded as a standard feature in the microcomputer firmware of Laureate counters and transmitters along with the Custom ASCII Protocol, which is a simpler text string based protocol. Laureate DIN-rail transmitters come standard with either RS232/ RS485 communications (LT series) or Ethernet communications (LTE series). Laureate 1/8 DIN size panel meters and counters require a plug-in option board for communications.

2. METER COMMUNICATION BOARDS

As of the date of this manual, available plug-in communication boards were the following:

- RS232 board (P/N L232, ordering option 1).
- RS485 board for RS485 with dual RJ11 jacks (P/N L485, ordering option 2).
- RS485 board for RS485 with dual RJ45 jacks (P/N LMOD, ordering option 4).
- USB board (P/N LUSB, ordering option 5).
- USB-to-RS485 converter board (P/N LUSB485, ordering option 6).
- Ethernet board (P/N LNET, ordering option 7).
- Ethernet-to-RS485 converter board (P/N LNET485, ordering option 8).

Our two RS485 boards (ordering options 2 and 4) use the same circuit, and both support the Modbus protocol equally. Option 2 boards with dual RJ11 jacks can be daisy-chained using our CBL03, straight-through, 6-wire data cables (not 4-wire telephone cables or crossover cables). Option 4 boards with dual RJ45 jacks cannot be daisy-chained using CBL03. With either board, the two jacks are wired in parallel to allow daisy chaining with no need for a hub.

Our USB-to-RS485 converter board allows the host counter or function as a normal counters, to be connected to a PC USB port, and also to be connected to an RS485 network with up to 31 remote meters or counters. These need to be equipped with an RS485 board with dual RJ11 connectors for daisy chaining with 6-wire CBL03 data cables.

Our Ethernet-to-RS485 converter board allows the host counter to function as a normal counter, to be connected to PC Ethernet port or an Ethernet LAN, and also to be connected to an RS485 network with up to 31 remote meters or counters. These need to be equipped with an RS485 board with dual RJ11 connectors for daisy chaining with 6-wire CBL03 data cables.

3. SERIAL COMMUNICATIONS

For serial communications (RS232, RS485 USB) to work between a sending device and receiving device, the right pins have to be connected, jumpers may have to be set, the right PC Com port has to be chosen, and the following serial parameters have to be set: baud rate, start bits, stop bits, parity. Please refer to the appropriate instrument user manuals on how to make these settings. Our Instrument Setup Software is good tool to set up and verify serial communications. Also, the address of each Slave instrument has to be set for Modbus to work.

4. ETHERNET COMMUNICATIONS

The Modbus RTU Protocol is seamlessly converted to Modbus TCP by the Ethernet Nodes in our Ethernet meters and transmitters.

Ethernet Nodes can be an LNET Ethernet board inside a meter or counter, or be the Ethernet portion of an LTE transmitter. An Ethernet Node is normally associated with one device, namely the host meter or transmitter, but it can also be associated with up to 31 remote meters or transmitters on an RS485 bus.

Our Ethernet Nodes can be connected directly to a PC via an Ethernet cable, be connected to a local PC via a LAN to which the PC is also connected, or be connected to a remote PC via the Internet. For connection via the Internet, the PC can be plugged into a local LAN, and the remote instruments can be plugged into a remote LAN. Our Ethernet Nodes and any devices attached to them via an RS485 bus will automatically be discovered by our Instrument Setup Software or Node Manager Software when the IP address of the remote router is entered, or when the IP address of any node on the remote network is entered.

Instrument Setup Software or Node Manager Software running on the host PC will automatically discover our Nodes and the device (or devices) associated with each Node. Following discovery, Instrument Setup Software can be used to set up each device (or devices) associated with a Node, for example to scale a meter or transmitter, and set setpoints. Node Manager Software cannot be used to set up devices, but it offers advanced features like sending out emails or text messages periodically or in the event of an alarm.

Our Ethernet Nodes can also be discovered and configured by using the Web Server built into each Node. To do so, use a web browser like Internet Explorer and enter the public IP address of the router or the IP address of any Node in the network.

5. MODBUS TYPES

Three Modbus protocol versions are supported by our instruments:

- **Modbus RTU**

This is the modern and most popular Modbus version for RS232, RS485 or USB serial communications. Here message frames (or packets) are transmitted in binary format (1's and 0's) for highest speed. Message frames are separated by a silent interval of at least 3.5 character times. If a silent interval of more than 1.5 character times occurs between two characters of a frame, the frame is considered incomplete and is discarded. The accuracy of each frame is verified by a 16-bit cyclic redundancy check (CRC).

- **Modbus ASCII**

  This is an older and now seldom used Modbus version for RS232, RS485 or USB serial communications. Here message frames are encoded into two ASCII characters 0-9, A-F, per byte to represent the hexadecimal notation of the byte. Each message begins with a colon (:) and ends with a Carriage Return / Line Feed (CRLF). The allowable time interval between characters can be set to as long as 1, 3, 5 or 10 seconds. The accuracy of each frame is verified by a 1-byte longitudinal redundancy check (LRC).

- **Modbus TCP**

  Also called Modbus TCP/IP, this is the Ethernet version of Modbus RTU. It simply embeds a standard Modbus RTU frame into a TCP frame, and the CRC redundancy check is now provided by standard Ethernet TCP/IP checksum methods. Since the frame contents are the same for Modbus RTU and Modbus TCP, this Modbus manual applies equally to both.

6. COMMUNICATION PARAMETERS

Do not use data rates above 9600 baud, even though 19200 baud is selectable.

Modbus RTU

Baud Rate ....300, 600, 1200, 2400, 4800, 9600, ~~19200~~
Data Format ....1 start bit, 8 data bits, 1 parity bit, 1 stop bit (11 bits total)
Parity ....None, Odd, Even (if None, then 2 Stop bits for 11 total)
Address..0 for broadcast, 1-247 for individual meters

Modbus ASCII

Baud Rate ....300, 600, 1200, 2400, 4800, 9600, ~~19200~~
Data Format .... 1 Start bit, 7 Data bits, 1 Parity bit, 1 Stop bit (10 bits total)
Parity ....None, Odd, Even (if None, then 2 Stop bits for 10 total)
Address..0 for broadcast, 1-247 for individual meters

7. PARAMETERS SELECTABLE VIA INSTRUMENT SETUP (IS) SOFTWARE

Serial Protocol ....Custom ASCII, Modbus RTU, Modbus ASCII
Modbus ASCII Gap Timeout .... 1 sec, 3 sec, 5 sec, 10 sec
Baud Rate ....300, 600, 1200, 2400, 4800, 9600, ~~19200~~
Parity ....No parity, 2 stop bits; odd parity,1 stop bit; even parity, 1 stop bit
Device Address ....1 to 247

8. MESSAGE FRAME CONTENT OVERVIEW

The content of each request or response includes the following:

- Device Address
- Function Code (FC)
- Register Address
- Data
- Checksum (applicable to Modbus RTU and ASCII, not TCP)

Device Address is the slave ID number. This is a decimal number from 1 to 247. Note that only up to 31 devices can be multi-dropped on an RS485 line for voltage loading reasons.

Register is a memory location for a 16-bit value, which can be read or written. Each Register has a Register Address specified as a 16-bit hexadecimal number. Our Registers are either Holding Registers in non-volatile EEPROM for setup information like scale, offset, setpoints, etc., or Input Registers in volatile RAM for measurement values or alarm status.

Coil is a memory location with a 1-bit 0 or 1 value, which can be read or written. The Modbus specification defines coils for input (sense) or output (write/force). Our Modbus coils only allow output. Each Coil is characterized by a Coil Address.

Function Code (FC) is a two-digit hexadecimal number which tells the addressed slave the type of action to perform on a Modbus register. Five function codes are recognized by our devices:

- **FC03: Read Holding Register.** A Holding Register is a read/write register, which contains setup information like scale, offset, setpoints, etc. in the form of a 16-bit value. Data is returned in hexadecimal format. Reading a Holding Register causes a meter reset.
- **FC04: Read Input Register.** An Input Register is a read-only register, which contains a 16-bit measurement value or alarm status. Data is returned in hexadecimal format. Reading an Input Register does not cause a meter reset.
- **FC05: Write/Force Single Coil.** A Single Coil is a register whose value can be a 1 or a 0. Writing a Single Coil can command a specific action, like taring a meter. For historical reasons, the word “coil” refers to a relay coil, which can be energized or de-energized on command. Writing a Single Coil does not cause a meter reset.
- **FC08: Diagnostics.** Checks communication between master and slave.
- **FC10: Write/Preset Multiple Holding Registers.** This action is used to enter setup information like scale, offset, setpoints, etc. into Holding Registers. This action causes a meter reset.

9. HI WORD & LO WORD

Register values specified by Modbus are 16-bit numbers. If a value involves both Hi and Lo words, our requests require the address of the Hi Word and the number of registers, which is 02, to get both the Hi Word followed by the Lo Word. Depending on the Function Code, register values can have the following formats:

2C32 Two's Complement (4 bytes)

Hi Word (Register)	Lo Word (Register)
CCCC CCCC CCCC CCCC	CCCC CCCC CCCC CCCC

M32 Binary Magnitude (4 bytes)

Hi Word (Register)	Lo Word (Register)
MMMM MMMM MMMM MMMM	MMMM MMMM MMMM MMMM

M31 Sign + Binary Magnitude (4 bytes)

Hi Word (Register)	Lo Word (Register)
SMMM MMMM MMMM MMMM	MMMM MMMM MMMM MMMM

M48 Binary Magnitude (6 bytes

Hi Word (Register)	Mid Word (Register)	Lo Word (Register)
XXXX XXXX MMMM MMMM	MMMM MMMM MMMM MMMM	MMMM MMMM MMMM MMMM

Ignore XXXX XXXX - Use LS 5-byte result

B16 Bit Significance		**M16 Binary Magnitude**		**M15 Sign + Binary Magnitude**	
Hi Byte	Lo Byte	Hi Byte	Lo Byte	Hi Byte	Lo Byte
0000 0000	BBBB BBBB	XXXX XXXX	XXXX XXXX	SXXX XXXX	XXXX XXXX
7654 3210					

S = Sign Bit, 0 = Positive, 1 = Negative.
C = Bits of 2's Complement Binary Value
M = Bits of Positive Binary Magnitude
B = Bits of Configuration Data

Data characters are sent most significant first, least significant last. For Modbus RTU, each data character (2 hex characters) consists of 8 bits (or 1 byte). For Modbus ASCII, each data character (2 hex characters) consists of 1 byte for each hex character.

4. SPECIAL COUNTER FEATURES

For detailed information on our panel mount Counter / Timers and their DIN rail mount LT and LTE transmitter counterparts, please see the separate user manuals for these products.

Counters with a pulse input, including VF voltage-to-frequency models, can display and transmit up to three readings called Item #1, Item #2 or Item #3. These are variables whose meaning changes based on the instrument type (Type), programmed operating mode (Mode), and sub-mode (Function). For example, in Stopwatch mode, Item #1 is event time, and Item #2 is accumulated time of all events. In A_Atot rate mode, Item #1 is rate for Channel A, and Item #2 is total for Channel A. Pulse input transmitters can only transmit, not display, Items.

As detailed in the separate Counter meter and transmitter user manuals, and as shown on the next page of this manual, the three Items can also be associated with different Scale and Offset selections (Sc/Off) and different Decimal Point (DP) selections. When an Item is the mathematical combination of two other items, such as Ratio A/B, the individual items A and B are typically scaled with Scale and Offset, but their mathematical combination can only be scaled using a Resolution multiplier R from 0.00001 to 100000 in decade steps. Extended Counters enable more programmable features than Basic Counters, but are the same otherwise.

Using the Modbus RTU protocol in command mode, a counter with or without a signal conditioner board can be used as a 6-digit Remote Display and as a serial-to-analog converter if it is equipped with an analog output board. A Counter transmitter with or without a signal conditioner board can be used as an LTS or LTSE serial-to-analog converter. First select the analog output type as 4-20 mA, 0-10 mA, 0-10V or -10V to +10V, then select the endpoints for the top and bottom of the range. For serial-to-analog operation, set the counter's "Source" to Item #3. That value will be used for analog output interpolations and for relay setpoint comparisons. It can also be used for the counter display mode (Config Dig 3 = 7). Please see our separate Remote Display and Serial-to-Analog Converter LTS and LTSE user manuals.

- Address 006A,B (Base 1) send Remote Data to the 6-digit Remote Display.
- Address 006C,D (Base 1) send Remote Data to Item 3 for Alarms and/or Analog Output.
- Address 006E,F (Base 1) send Remote Data to both the Display and Item 3.

In the tables below, * indicates that the value can be a Filtered or a Peak or Valley value. ^ indicates that the value can be an Unfiltered or a Peak or Valley value, as explained in the Counter User Manual. This normally applies to the mathematical combination of two items, such as Ratio A/B.

In the tables below, Items can correspond to # Overflows. This is the number of millions preceding large readings over 999,999. For example, 2,000,003 would be displayed as 3, and there would be 2 Overflows. Readings to be displayed are normally scaled so that they are 999,999 or less (with any decimal point), but values up to 999,999,999,999 (999,999 Overflows) + 999,999 can be transmitted serially using the # Overflows feature.

Functions with the FR Dual Pulse Input Signal Conditioner

Type	Mode	Function	Item 1	Sc/Off	DP	Item 2	Sc/Off	DP	Item 3	Sc/Off	DP
Basic	_rAtE_	A__b_	*Rate A	1	1	Rate B	2	2			
Basic	_rAtE_	A Only	*Rate A	1	1						
Extended	_rAtE_	_bAtCH	Total	1	1	Grand Total or # Batches			*Rate	2	2
Extended	_rAtE_	A_Atot	*Rate A	1	1	Total A	2	2	# Overflows		
Extended	_rAtE_	A_btot	*Rate A	1	1	Total B	2	2			
Extended	_rAtE_	_A_+_b	*SumAB	R	2	Rate A	1	1	Rate B	2	1
Extended	_rAtE_	_A_-_b	*DiffAB	R	2	Rate A	1	1	Rate B	2	1
Extended	_rAtE_	_A_x_b	*ProdAB	R	2	Rate A	1	1	Rate B	2	1
Extended	_rAtE_	_A_/_b	*RatioAB	R	2	Rate A	1	1	Rate B	2	1
Extended	_rAtE_	_A_/_b-1	*DrawAB	R	2	Rate A	1	1	Rate B	2	1
Basic	PEriod	A__b_	*Period A	1	1	Period B	2	2			
Basic	PEriod	A Only	*Period A	1	1						
Extended	PEriod	_A_+_b	*SumAB	R	2	Period A	1	1	Period B	2	1
Extended	PEriod	_A_-_b	*DiffAB	R	2	Period A	1	1	Period B	2	1
Extended	PEriod	_A_x_b	*ProdAB	R	2	Period A	1	1	Period B	2	1
Extended	PEriod	_A_/_b	*RatioAB	R	2	Period A	1	1	Period B	2	1
Basic	_totAL	A__b_	Total A	1	1	Total B	2	2			
Basic	_totAL	A Only	Total A	1	1	# Overflows					
Extended	_totAL	A-b Ud	^DiffAB	1	1						
Extended	_totAL	_burSt	Total A	2	2	*Rate A	1	1			
Extended	_totAL	b_ArAt	Total B	2	2	*Rate A	1	1			
Extended	_totAL	A_bU/d	^Total A	1	1						
Extended	_totAL	A_bInH	Total A	1	1	# Overflows					
Extended	_totAL	_A_+_b	^SumAB	R	2	Total A	1	1	Total B	2	1
Extended	_totAL	_A_-_b	^DiffAB	R	2	Total A	1	1	Total B	2	1
Extended	_totAL	_A_x_b	^ProdAB	R	2	Total A	1	1	Total B	2	1
Extended	_totAL	_A_/_b	^RatioAB	R	2	Total A	1	1	Total B	2	1
Basic	ti_Int	A__b_	*Time	1	1						
Extended	ti_Int	_1/Ab	*Time	1	1						
Basic	StoP_t	A_to_A	Time	1	1	Total Time	2	2	# Overflows		
Basic	Stop_t	A_to_b	Time	1	1	Total Time	2	2	# Overflows		
Basic	StoP_t	_1/AA	Time	1	1	Total Time	2	2	# Overflows		
Basic	StoP_t	_1/Ab	Time	1	1	Total Time	2	2	# Overflows		
Extended	_PHASE	A_to_b	*Deg360	1	1						
Extended	_PHASE	A_to_b	*Deg180	1	1						
Extended	duty_C	A_to_b	*Percent	1	1						

Counter Functions with the VF Voltage-to-Frequency Converter Signal Conditioner

Type	Mode	Function	Item 1	Sc/Off	DP	Item 2	Sc/Off	DP	Item 3	Sc/Off	DP
Basic	VF 4_20	A_Only	*Rate A	1	1						
Extended	VF 4_20	bAtCH	*Batch total	2	2	Grand Total or # Batches	R		*Rate A	1	1
Basic	VF 4_20	A_Atot	*Rate A	1	1	Total A	2	2	# Overflows		
Extended	VF 4_20	__1/A__	*1/Rate	1	1						
Basic	VF 0-1V	A_Only	*Rate A	1	1						
Extended	VF 0-1V	bAtCH	*Batch total	2	2	Grand Total or # Batches	R		*Rate A	1	1
Basic	VF 0-1V	A_Atot	*Rate A	1	1	Total A	2	2	# Overflows		
Extended	VF 0-1V	__1/A__	*1/Rate	1	1						
Basic	VF 0-10V	A_Only	*Rate A	1	1						
Extended	VF 0-10V	bAtCH	*Batch total	2	2	Grand Total or # Batches	R		*Rate A	1	1
Basic	VF 0-10V	A_Atot	*Rate A	1	1	Total A	2	2	# Overflows		
Extended	VF 0-10V	__1/A__	*1/Rate	1	1						

Counter Functions with the QD Quadrature Input Signal Conditioner

Type	Mode	Function	Item 1	Sc/Off	DP	Item 2	Sc/Off	DP	Item 3	Sc/Off	DP
Basic	_quAdr	_totAL	^Up-Dn	1	1						
Extended	_quAdr	_rAtE	*Rate	1	1						

5. FUNCTION CODE DETAILS

FC04: Read Input Registers

Function code FC04 reads measurement values, alarm status, peak and valley. It returns values in 2C32 format without a decimal point for pulse input counters and transmitters. If required for verification purposes, the decimal point setting can be read from its Holding Register by using Function Code 03 at address 0057.

Use only Hi Word Starting Register Address, and set the number of Registers to be read to an even number to capture both the Hi Word and Lo Word. The Register Addresses below are in Hex and are for Modbus numbering systems that start at 0001 (Base 1). Subtract 1 from each Register Address for Modbus numbering systems that start at 0000 (Base 0).

Most Modbus software on the market now uses Base 1, not Base 0. Base 1 Register Numbers are 1 higher than the original Base 0 Register Addresses.

Reading an Input Register does not cause a meter reset.

Register Address	Response (2C32 format)
0002	Hi word of Alarm status [1]
0003	Lo word of Alarm status [1]
0004	Hi word of Item 1 value
0005	Lo word of Item 1 value
0006	Hi word of Peak value
0007	Lo word of Peak value
0008	Hi word of Valley value
0009	Lo word of Valley value
000A	Hi word of Item 2 value
000B	Lo word of Item 2 value
000C	Hi word of Item 3 value
000D	Lo word of Item 3 value

[1] 0-F, bit 0 = alarm 1, bit 1 = alarm 2, bit 2 = alarm 3, bit 3 = alarm 4.

FC05: Write Single Coil

Single-bit action command to device. Does not return a value. The command output value is hex 00 FF to set, or 00 00 to reset or deactivate. The Register Addresses below are in Hex and are for Modbus numbering systems that start at 00 01 (Base 1). Subtract 1 from each Register Address for Modbus numbering systems that start at 00 00 (Base 0). Writing a Single Coil does not cause a meter reset.

Please refer to our separate Digital Panel Meter and Counter manuals for an explanation of Meter Reset, Function Reset, Tare, Meter Hold, Blank Display, and External Inputs A & B. Or call our Tech Support. These same terms (except Blank Display) also apply to our transmitters.

Register Address	Output Value		Action Command
	To Set	To Reset	
0002	FF00	N/A	Meter/Counter Reset (no response)
0003	FF00	N/A	Function Reset (peak, valley, latched alarms, total)
0004	FF00	N/A	Latched Alarm Reset (only)
0005	FF00	N/A	Peak Reset
0006	FF00	N/A	Valley Reset
0007	FF00	N/A	Remote Display Reset (counters in remote display mode)
0008	FF00	N/A	Display Item 1 (analog input meters, counters, timers)
0009	FF00	N/A	Display Item 2 (counters, timers)
000A	FF00	N/A	Display Item 3 (counters, timers)
000B	FF00	N/A	Display Peak (analog input meters, counters, timers)
000C	FF00	N/A	Display Valley (meters. Not weight meter, counters, timers)
000D	FF00	00 00	Tare (analog input meters, output value 00 00 resets Tare)
000E	FF00	00 00	Meter Hold (analog meters, output value 00 00 resets Hold)
000F	FF00	00 00	Blank Display (output value 00 00 resets Blank)
0010	FF00	00 00	Activate External Input A (output value 00 00 deactivates)
0011	FF00	00 00	Activate External Input B (output value 00 00 deactivates)

FC08: Diagnostics

Checks communications between the Master and Slave, and returns the count in the Modbus Slave counters (which are reset when the meter is reset).

Hex Sub Function Code	Data Sent	Response Data	Description
0001	Any	Same	Returns Query Data (N x 2 bytes). Echo Request.
0002	 FF00 0000	 FF00 0000	Restarts Communications. If in the Listen-Only mode, no response occurs. Takes Slave out of the Listen-Only mode and one of the following: - Clears communications event counters. - Does not clear communications event counters.
0005	0000	None	Forces Listen-Only. All addressed and broadcast Messages are monitored and counters are incremented, but no action is taken or response is sent. Only Sub-Function 00 02 causes removal of this Listen-Only state.
000B	0000	0000	Clears all Modbus slave counters.
000C	0000	Total Message Count	Returns total number of messages detected on the bus, including those not addressed to this Slave. Excludes bad LRC/CRC, parity error or length < 3.
000D	0000	Checksum Error Count	Returns total number of messages with bad LRC/CRC, parity or length < 3 errors detected on the bus including those not addressed to the Slave.
000E	0000	Exception Error Count	Returns total number of Exception responses returned by the Addressed Slave or that would have been returned if not a broadcast message or if the Slave was not in a Listen-Only mode.
000F	0000	Slave Message Count	Returns total number of messages, either broadcast or addressed to the Slave. Excludes bad LRC/CRC, parity or length < 3 errors.
0010	0000	No Response Count	Returns total number of messages, either broadcast or addressed to the Slave, for which Slave has returned No Response, neither a normal response nor an exception response. Excludes bad LRC/CRC, parity or length < 3 errors.
0012	0000	Slave Busy	Returns total number of Exception Code 6 (Slave Busy) responses.

SUPPORTED EXCEPTION RESPONSE CODES

Code	Name	Error Description
01	Illegal Function	Illegal Function Code for this Slave. Only hex Function Codes 03, 04, 05, 08, 10 are allowed.
02	Illegal Data Address	Illegal Register Address for this Slave or Register length.
03	Illegal Data Value	Illegal data value or data length for the Modbus protocol.
04	Slave Device Failure	Slave device failure (eg.,device set for external gate).

FC03 (READ) & FC10 (WRITE) HOLDING REGISTER ADDRESSES

Use Hi Word starting Register Addresses and an even number of Registers. The Register Addresses below apply to both FC03 and FC10, and are for Modbus numbering systems that start at 00 01 (Base 1). Subtract 1 from each Register Address for Modbus numbering systems that start at 00 00 (Base 0).

Warning: Counters and transmitters reset after any setup data in non-volatile EEPROM has been read or written.

Register Address		Register Name	Data Type	Scaling & Decimal Point
Dec*	Hex*			
2	0002	Setpoint 1 (Hi word)	2C32	Dec point same as displayed.
3	0003	Setpoint 1 (Lo word)	2C32	
4	0004	Setpoint 2 (Hi word)	2C32	Dec point same as displayed.
5	0005	Setpoint 2 (Lo word)	2C32	
6	0006	Setpoint 3 (Hi word)	2C32	Dec point same as displayed.
7	0007	Setpoint 3 (Lo word)	2C32	
8	0008	Setpoint 4 (Hi word)	2C32	Dec point same as displayed.
9	0009	Setpoint 4 (Lo word)	2C32	
10	000A	Scale 1Y (Hi word)	M32	Scale = .00001 x dec value
11	000B	Scale 1Y (Lo word)	M32	of (Hi word + Lo word)**
12	000C	Offset 1 (Hi word)	2C32	Dec point same as displayed.
13	000D	Offset 1 (Lo word)	2C32	
14	000E	Scale 2Y (Hi word)	M32	Scale = .00001 x dec value
15	000F	Scale 2Y (Lo word)	M32	of (Hi word + Lo word)**
16	0010	Offset 2 (Hi word)	2C32	Dec point same as displayed.
17	0011	Offset 2 (Lo word)	2C32	
18	0012	Lo In 1 (Hi word)	2C32	Lo In = .00001 x dec value
19	0013	Lo In 1 (Lo word)	2C32	of (Hi word + Lo word)**
20	0014	Lo Rd 1 (Hi word)	2C32	Dec point same as displayed.
21	0015	Lo Rd 1 (Lo word)	2C32	
22	0016	Hi In 1 (Hi word)	2C32	Hi In = .00001 x dec value
23	0017	Hi In 1 (Lo word)	2C32	of (Hi word + Lo word)**
24	0018	Hi Rd 1 (Hi word)	2C32	Dec point same as displayed.
25	0019	Hi Rd 1 (Lo word)	2C32	
26	001A	Lo In 2 (Hi word)	2C32	Lo In = .00001 x dec value
27	001B	Lo In 2 (Lo word)	2C32	of (Hi word + Lo word)**
28	001C	Lo Rd 2 (Hi word)	2C32	Dec point same as displayed.
29	001D	Lo Rd 2 (Lo word)	2C32	
30	001E	Hi In 2 (Hi word)	2C32	Hi In = .00001 x dec value
31	001F	Hi In 2 (Lo word)	2C32	of (Hi word + Lo word)**
32	0020	Hi Rd 2 (Hi word)	2C32	Dec point same as displayed.

33	0021	Hi Rd 2 (Lo word)	2C32	
34	0022	Deviation 1 (Hi word)	M32	Dec point same as displayed.
35	0023	Deviation 1 (Lo word)	M32	
36	0024	Deviation 2 (Hi word)	M32	Dec point same as displayed.
37	0025	Deviation 2 (Lo word)	M32	
38	0026	Deviation 3 (Hi word)	M32	Dec point same as displayed.
39	0027	Deviation 3 (Lo word)	M32	
40	0028	Deviation 4 (Hi word)	M32	Dec point same as displayed.
41	0029	Deviation 4 Lo word)	M32	
42	002A	Analog Lo 1 (Hi word)	2C32	Dec point same as displayed.
43	002B	Analog Lo 1 (Lo word)	2C32	
44	002C	Analog Hi 1 (Hi word)	2C32	Dec point same as displayed.
45	002D	Analog Hi 1 (Lo word)	2C32	
46	002E	Analog Lo 2 (Hi word)	2C32	Dec point same as displayed.
47	002F	Analog Lo 2 (Lo word)	2C32	
48	0030	Analog Hi 2 (Hi word)	2C32	Dec point same as displayed.
49	0031	Analog Hi 2 (Lo word)	2C32	

* Values are for Base 1 Standard addressing. Add 1 for Base 0 PLC addressing.
** Max Value = 21,474.1

For the following, use any starting Register Addresses and any number of Registers.

Register Addr		Register Name	Data Type	Scaling & Decimal Point
Dec	Hex			
50	0032	GateTime	M16	1-19999 (4E1F) Dec Pt =XXX.XX
51	0033	TimeOut	M16	1-19999 (4E1F) Dec Pt =XX.XXX
52	0034	Pulses	M16	1-59999 (4E1F) Dec Pt =XXXXX.
53	0035	Total B (Hi word)	M48	
54	0036	Total B (Mid word)	M48	
55	0037	Total B (Lo word)	M48	
56	0038	Total A (Hi word)	M48	
57	0039	Total A (Mid word)	M48	
58	003A	Total A (Lo word)	M48	
59	003B	Cutoff	M16	0-65535
60	003C	Calibration	M15	SXXX XXXX XXXX XXXX Sign + Magnitude (PPM)

Data Type B16

Register Addr		Register Name	Bit Significance
Dec	Hex		
66	0042	Alarm Config 1	Bit 0 0 = AL1 Hi Active 1 = Lo Active Bit 1 0 = AL1 Enabled, 1 = Disabled Bit 2 0 = AL2 Hi Active 1 = Lo Active Bit 3 0 = AL2 Enabled 1 = Disabled Bit 4 0 = AL1 Non-Latched 1 = Latched Bit 5 0 = AL2 Non-Latched 1 = Latched Bit 6 0 = Relay1 Active On 1 = Off Bit 7 0 = Relay2 Active On 1 = Off

67	0043	Alarm Config 2	Bits 2:0 # Readings before Alarms 1 & 2.
			000 = 1, 001 = 2, 010 = 4, 011 = 8, 100 = 16,
			101 = 32, 110 = 64, 111 = 128
			Bits 4:3 Setpoint Compare Source
			Bit 3 AL1 0 = Deviation 1 = Hysteresis
			Bit 4 AL2 0 = Deviation 1 = Hysteresis
			Bit 5 0 = Deviation in Menu 1 = Omitted

68	0044	Alarm Config 3	Bit 0 0 = AL3 Hi Active 1 = Lo Active Bit 1 0 = AL3 Enabled 1 = Disabled Bit 2 0 = AL4 Hi Active 1 = Lo Active Bit 3 0 = AL4 Enabled 1 = Disabled Bit 4 0 = AL3 Non-Latched 1 = Latched Bit 5 0 = AL4 Non-Latched 1 = Latched Bit 6 0 = Relay3 Active On 1 = Off Bit 7 0 = Relay4 Active On 1 = Off

69	0045	Alarm Config 4	Bits 2:0 = # Readings before Alarms 3 & 4.
			000 = 1, 001 = 2, 010 = 4, 011 = 8, 100 = 16,
			101 = 32 110 = 64 111 = 128
			Bit 3 AL3 0 = Deviation 1 = Hysteresis
			Bit 4 AL4 0 = Deviation 1 = Hysteresis
			Bit 5 0 = Deviation in Menu 1 = Omitted

70	0046 Input Type	Rate	00-0F 00 = A&B, 01 = A_Only, 02 = Batch, 03 = A_Atot, 05 = A_Btot, 0B = A+B, 0C = A-B, 0D = A*B, 0E = A/B, 0F = A/B-1
		Period	10-1E 10 = A&B, 11 = A_Only 1B = A+B, 1C = A-B, 1D = A*B, 1E = A/B
		Total	20-2E 20 = Total A&B, 21 = A Only 24 = A-B_ud, 26 = Burst=26, 27 = B_Arat, 29 = A_Bud, 2A = A_Binh, 2B = A+B, 2C = A-B, 2D = A*B, 2E = A/B

		Time Interval	41-42	41 = Time Interval A to B 42 = 1 / (A to B)		
		Stopwatch	50-53	50 = A to A, 51 = A to B 52 = 1 / (A to A) 53 = 1 / (A to B)		
		Phase	61-62	61 = 0-360 62 = -180 to +180		
		Duty Cycle	71	A to B		
		V-to-F Signal Conditioner	XY	X = 8, 4-20 mA input X = 9, 0-1 mA input X = A, 0-10V input Y = 1, A only Y = 2, Batch Y = 3, A to A total Y = F, 1/A		
		Quadrature	C0-C1	C0 = Total C1 = Rate		
71	0047	Setup	Bits 3:0	Ctrl In 1	Ctrl In 2	Both Reset
		M = Meter	Hex 0	Meter Reset	Function Reset	MReset
		F = Function	Hex 1	Meter Reset	Meter Hold	MReset
		D = Display	Hex 2	Meter Reset	Peak or Valley	MReset
			Hex 3	Meter Reset	External Gate	MReset
			Hex 4	Function Reset	Meter Hold	MReset
			Hex 5	Valley	Peak	FRest
			Hex 6	Function Reset	External Gate	MReset
			Hex 7	Meter Hold	Peak or Valley	FReset
			Hex 8	Reset Total A	Reset Total B	FReset
			Hex 9	Force Alarm1	Force Alarm2	No Action
			Hex A	Meter Reset	Display Blank	MReset
			Hex B	Function Reset	Display Blank	MReset
			Hex C	Meter Hold	Display Blank	MReset
			Hex D	Peak or Valley	Display Blank	FReset
			Hex E	Display Blank	External Gate	MReset
			Hex F	Item2	Item3	Item 1 = Neither/Both
			Hex F	Tare Enable	Tare (Remote Display Only)	
			Bit 4	0 = Scale2 using Scale, Offset 1 = Scale2 using Coordinates of 2 Points		
			Bit 5	0 = Scale1 using Scale, Offset 1 = Scale1 using Coordinates of 2 Points		
			Bit 6	0 = Blank leading zeros 1 = Display leading zeros		

			Bit 7 0 = Zero Total upon Power-On 1 = Restore Total upon Power-On
72	0048	Filter	Bits 2:0 1 = .1S, 2 = .2S, 3 = .4S, 4=.8S, 5=1.6S, 6 = 3.2S, 7=6.4S Bit 3 0 = Low Adaptive, 1 = High Adaptive Bit 4 0 = Display Unfiltered, 1=Display Filtered Bit 5 0 = Peak, Valley of Unfiltered 1 = Peak, Valley of Filtered Bit 6 0 = Adaptive Filter 1 = Conventional Filter
73	0049	Options	Do Not Use.
74	004A	Serial Config 1	Bits 3:0 Do not use. Bits 6:4 Baud Rate 000 = 300, 001 = 600, 010 = 1200, 011 = 2400, 100 = 4800, 101 = 9600, 110 = 19200 Bit 7 0 = Send Unfiltered value, 1 = Send Filtered Val
75	004B	Serial Config 2	Do not use.
76	004C	Serial Config 3	Bits 6:0 Do not use. Bit 7 0 = Full Duplex, 1 = Half Duplex
77	004D	Serial Config 4	Bits 1:0 00 = No Parity 01 = Odd Parity 11 = Even Parity Bits 3:2 00 = Custom ASCII. Do not use. 01 = Modbus RTU, 10 = Modbus ASCII Bits 5:4 Modbus ASCII Gap Timeout 00 = 1S, 01 = 3S, 10 = 5S, 11 = 10S
78	004E	Config	Bit 0 0 = VF Batch, Atot zero cutoff 1 = Allow negative values Bit 1 0 = Calculate Rate value 1 = Calculate Square Root of Rate Bits 3:2 00 = Basic Counter, 01 = Extended Counter 10 = Custom Curve #1 11=Custom Curve #2 (if V-to-F) Bits 7:4 0 = Exponential Overload 1 = 999999 Overload 2 = One Right Hand Dummy Zero 3 = Two Right Hand Dummy Zeros 4 = Clock Time in Seconds 5 = Clock Time in HH.MM.SS Format 6 = Remote Display, HKL Command

				7 = Remote Display, Value 8 = 1st Value in String 9 = 2nd Value in String A = 3rd Value in String B = 4th Value in String C = Remote Display using Start, Stop, Skip, Show Characters
79	004F	Lockout 1		0 = Enabled, 1 = Locked out
			Bit 0	Filter
			Bit 1	Gate Time, Timeout, Batch, Preset, Pulses, Cutoff
			Bit 2	Setup, Config, Display Number
			Bit 3	Input Type
			Bit 4	Setpoint Programming
			Bit 5	Alarm Config, Deviation / Hysteresis
			Bit 6	Scale, Offset, Resolution, 2 Coordinates
			Bit 7	Slope, Decimal Points
80	0050	Lockout 2		0 = Enabled, 1 = Locked out
			Bit 0	Change Item# displayed
			Bit 1	Calibration
			Bit 2	Serial Comm Config
			Bit 3	Analog Out Scaling & Setup
			Bit 4	Front Panel Meter Reset
			Bit 5	Front Panel Function Reset
			Bit 6	View Setpoints
			Bit 7	View Peak
81	0051	Batch Operation	Bit 0	0 = Display "rEADy" after Reset 1 = Start
			Bit 1	0 = Item2 is Grand Total 1 = Item2 is Total Number of Batches
			Bit 2	0 = Gate Time resets 1 = Control Input 2 resets
			Bit 3	0 = Reset to Zero, Count Up 1 = Reset to SETPT1, Count Down
			Bits 5:4	Residual Input 0,2 = Input Discard, Grand Total Discard 1 = Input Accept, Grand Total Discard 3 = Input Accept, Grand Total Accept

82	0052	Alarm Source	Bits 1:0 Bits 3:2 Bits 5:4 Bits 7:6	Setpoint 2 Setpoint 1 Setpoint 4 Setpoint 3 For each Setpoint: 00 = Filtered Item, 01 = Item1, 10 = Item2, 11 = Item3
83	0053	Analog Out Setup	Bits1:0 Bit 2	0 = Filtered Item, 1 = Item1, 2 = Item2, 3 = Item3 0 = Current Output, 1 = Voltage Output
84	0054	Scale Multiplier	Bits 3:0 Bits 7:4	Scale1 Multiplier Scale2 Multiplier 0 = .00001, 1 = .0001, 2 = .001, 3 = .01, 4 = .1, 5 = 1, 6 = 10, 7 = 100, 8 = 1000, 9 = 10000, A = 100000
85	0055	Trigger Slope	Bit 0 Bit 1	0 = Positive Slope, B Input 1 = Negative Slope, B Input 0 = Positive Slope, A Input 1 = Negative Slope, A Input
86	0056	Display Item	Bits 1:0 Bits 3:2	1 = Item1, 2 = Item2, 3 =Item3 Display Response to Peak Button: 00 = Peak, 01 = Valley, 10 = Peak then Valley
87	0057	Resolution	Bits 3:0	0 = .00001, 1= .0001, 2 = .001, 3 = .01, 4 = .1, 5 = 1, 6 = 10, 7 = 100, 8 = 1000, 9 = 10000, A = 100000
88	0058	System Decimal Point	Bits 3:0 Bits 7:4	DecPt1 DecPt2 1 = dddddd., 2 = ddddd.d, 3 = dddd.dd, 4 = ddd.ddd, 5 = dd.dddd, 6 = d.ddddd

READ ONLY (FC03) – Data Type B16

101	0065	Analog Output DAC Type	0 = none, 1 = 1 output, unipolar (12-bit, pre 2009) 2 = 1 output, unipolar (16-bit, pre 2009) 3 = 1 output, uni or bipolar (16-bit, post 2009) 4 = 2 outputs, unipolar (16-bit, post 2009)
102	0066	Device Type	Bits 7:0 01 = DPM meter 03 = Counter/Timer meter 05 = DPM transmitter 07 = Counter/Timer transmitter
103	0067	Revision	Bits 7:0 Hex value of Decimal Revision number

WRITE ONLY FC10 (dec16) – Data Type 2C32

106	006A	Display Data	Hi Word Displayed
107	006B	Display Data	Lo Word Displayed
108	006C	Data to Item3	Hi Word Applied to Item3
109	006D	Data to Item3	Lo Word Applied to Item3
110	006E	Data to Both	Hi Word Displayed and Applied to Item3
111	006F	Data to Both	Lo Word Displayed and Applied to Item3

WRITE ONLY FC10 (dec16) – Data Type B16

112	0070	Force Alarms, Remote Display Mode	Bit 0 = Alarm 1 Bit 1 = Alarm 2 Bit 2 = Alarm 3 Bit 3 = Alarm 4

Please see the description at the end of Section 10 for comparing the Remote Data to the Relay Setpoints or using it as the source for setting the Analog Output.

6. SETTING YOUR INSTRUMENT TO MODBUS

1. FROM THE METER FRONT PANEL

Counter / timers with an RS232, RS485 or USB interface are shipped from the factory set to the Custom ASCII protocol. They can be set to the Modbus protocol from the front panel. They can also be reset to the Custom ASCII protocol from the front panel after they have been set to Modbus.

Press the front panel menu key repeatedly until you reach SEr_1, SEr_4 and then Addr, and make the appropriate selections. Please our Digital Panel Meter manual for all available front panel programmable features. The baud rate is set in SEr_1. The selection of Modbus RTU or Modbus ASCII in SEr_4 overrides any LF or Command Mode selections that may have been made from the front panel, since they are determined by the Modbus protocol.

MENU ⮑ ***Press Menu Select Key***	PEAK ▶ ***Press Digit Select Key***	RESET ▲ ***Press Value Select Key***
SEr 1 Fixed Parameters: No parity 8 data bits 1 stop bit	000 Output filtering	0 Send unfiltered signal 1 Send filtered signal
	000 Baud rate	0 300 baud 1 600 baud 2 1200 baud 3 2400 baud 4 4800 baud 5 9600 baud 6 19200 baud (do not use)
SEr 4 Serial Setup 4.	000 Modbus ASCII gap timeout	0 1 sec 1 3 sec 2 5 sec 3 10 sec
	000 Serial protocol	0 Custom ASCII 1 Modbus RTU 2 Modbus ASCII
	000 Parity	0 None, 2 or more stop bits 1 Odd, 1 or more stop bits 2 Even, 1 or more stop bits
Addr Modbus Address. Appears only if the Modbus protocol is selected.	000 000 000 Select digit to flash.	247 Select 0 through 9 for flashing digit. Address range is 1 to 247.

2. WITH INSTRUMENT SETUP SOFTWARE

Our transmitters, which don't have front panel buttons, can only be set to Modbus with our free Windows-based Instrument Setup (IS) software. Digital panel meters with a communications board can also be set to Modbus with IS software, as explained below.

IS software allows uploading, editing, downloading and saving of setup data, execution of commands under computer control, listing, plotting and graphing of data, and computer prompted calibration. It is also a great too verify that communications are working.

As the first step to install IS software, set User Account Control (UAC) of your version of Windows to "Never notify" so that the installation can create directories. Use Google for instructions on how to change UAC. Power down and restart your computer for the UAC change to take effect. Following installation, you may return UAC to its previous setting.

Download the file *instrument.exe* from our website, double-click on that file name to extract three files, double-click *on setup.exe*, and follow the prompts.

To launch IS software from Windows, press *Start* => *Programs* => *IS2* => *IS2*. Or click on the Windows shortcut that you may have created. Establish communications by selecting matching settings between the instrument and PC, and click on *Establish*.

Factory default communication settings are 9600 baud, Custom ASCII Protocol, no parity, 8 data bits, and 1 stop bit. You will be prompted to select a Com port. Try different selections until one works, or use *Windows Control Panel* => *Device Manager* => *Ports (COM & LPT)* => *Advanced* to assign an available Com port number to the detected meter. Once communications have been established, click on *Main Menu*.

The best way to learn IS software is to experiment with it. From the Main Menu, click on *Get Setup* to upload (or get) the existing setup data from your device. Click on *View* = > *Setup* to bring up screens which allow you to edit the setup file using pull-down menus and other selection tools. You can save your file to disk by clicking on *File* = > *Save Setup*. You can download (or put) your edited file into the device by clicking on *Put Setup*. Programmable items will only be displayed if the appropriate hardware has been detected, such as the dual relay option for meters. Pressing the *F1* key at any time will bring up detailed help information.

Once you are communication with your device using IS software, click on the *Communication* tab. In the resulting screen, select Modbus RTU, no Parity, 8 data bits, and 2 stop bits, as well as your device's desired Modbus Address, such as 1. Note the instructions on the screen on how to set up communication parameters of the Modbus Master. When done, return to the Main Menu and execute a *Put Setup* to download your setup information from the PC into your device. From that moment on, your device is a Modbus Slave.

If you wish to change instrument setup parameters with IS software after your instrument has been set to Modbus, you need to return it to the Custom ASCII protocol. If your instrument is a digital panel meter, you can do so by using front panel buttons as document above. If your instrument is a transmitter, you need to reset communications to factory defaults, which include the Custom ASCII Protocol. To do so, place jumper E1, apply power, remove power, remove the jumper, and reapply power, as documented in the section "Main Board Jumper Settings" of your transmitter user manual.

7. USING DIAGNOSTIC TOOL QMODMASTER

1. ABOUT QMODMASTER

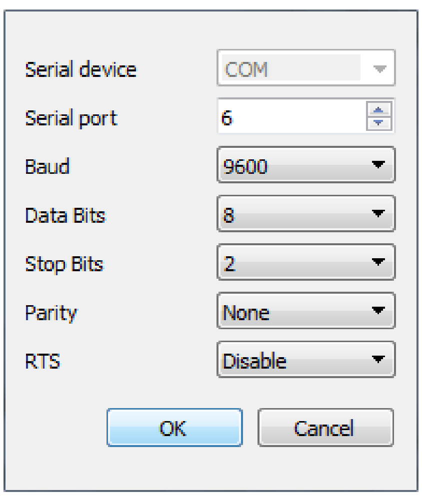
qModMaster.exe is a freeware Windows program which allows a PC to serve as a Modbus Master. It is an easy-to-use tool to verify communications, send requests to Modbus Slaves, and view their responses. It works well with Base 0, not Base 1, so use it only with Base 0 and subtract 1 from the Register addresses listed in this manual. Download qModMaster from SourceForge: https://sourceforge.net/projects/qmodmaster/files/latest/download

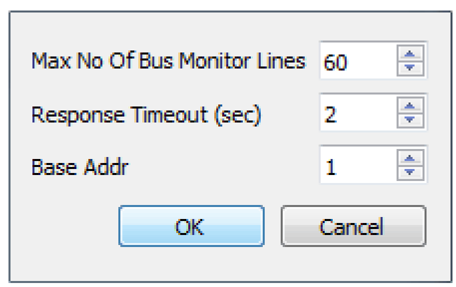
Click on the downloaded file and install it in a directory of your choice. Create a desktop icon from the installed executable. Before using qModMaster, ensure that your meter or transmitter has been set to Modbus RTU as explained in the preceding section of this manual.

2. EXAMPLE: READ A COUNTER WITH QMODMASTER

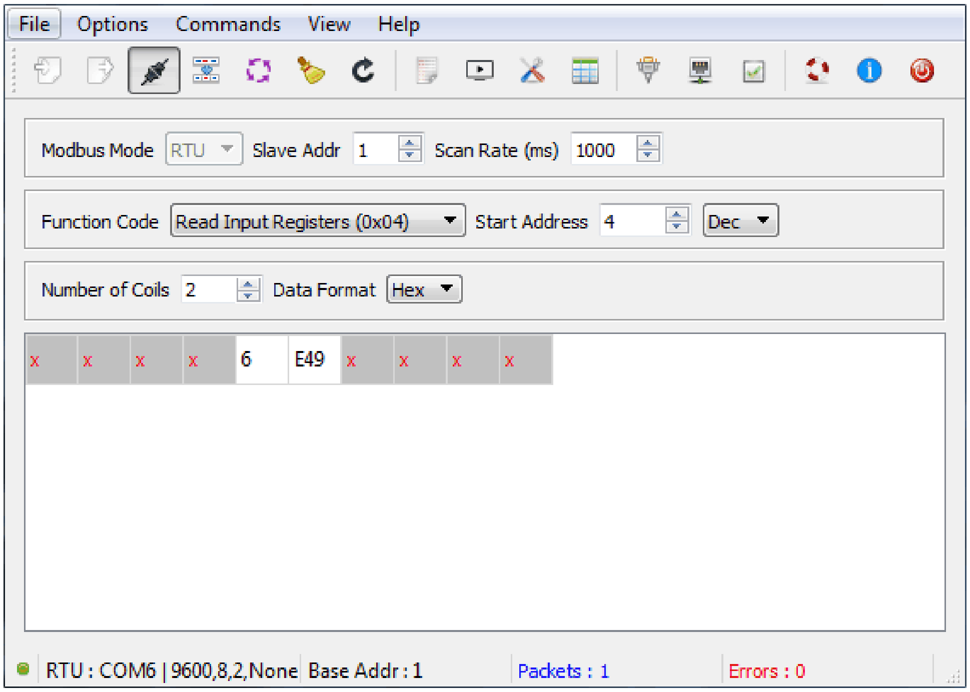
Get the reading from a counter that displays Item #1 as 39.6873 Hz. Use Modbus RTU, Base 1, Slave Address 1, and Com port 6 (as verified by Device Manager).

Step 1. Under *Options*, select *Modbus RTU*. This will open *Modbus RTU Settings*, where you can enter your Serial port. From *Options* go to *Settings*, and select *Base Addr. 1* (for Base 1).





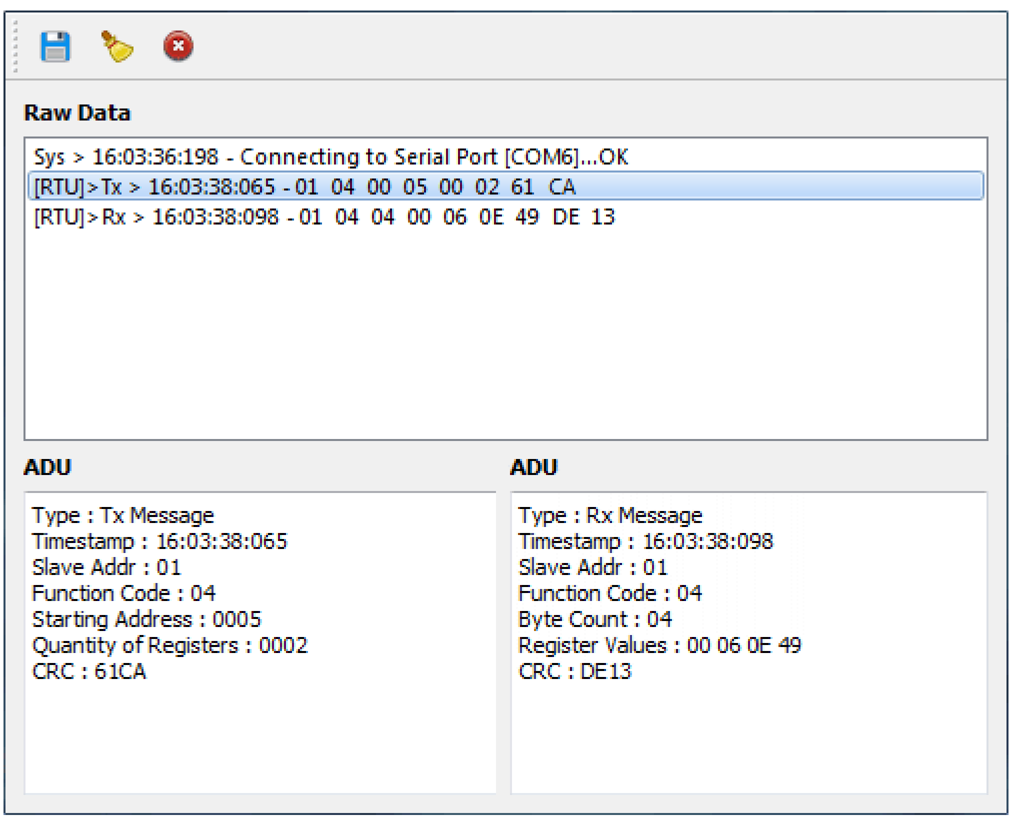
Step 2. In the main window, set *Function Code* to FC04 for Read Input Register. Set *Start Address* 00 04 (hex), which is the Hi Word of the measurement value. Set *Number of Registers* (or *Number of Coils*) to 2, since both the Hi Word and Lo Word need to be read. In this example we have specified that we want the data format to be in Hex. The main window immediately shows the Hi Word value as 00 06 and the Lo Word value as 0E 49. Hex 60E49 is the same as Decimal 396873. This is 386873 counts without a decimal point for the 38.6873 Hz displayed by the meter.



Step 3. Click on *View* => *Bus Monitor*. This will open the Bus Monitor window.

Step 4. In the main Window, click on *Commands* => *Connect* twice, and check the Bus Monitor to verify that your communication and Modbus settings are … *OK*.

Step 5. In the main Window, click on *Commands* => *Read/Write* to send your Modbus request and receive your meter's response.



The Raw Data window of the Bus Monitor shows the ASCII characters that were sent (Tx) and received (Rx). For information on each group of characters, click on the Tx and Rx rows, and details will be shown in the ADU (Application Data Unit) window for either Tx or Rx. Note that with Base 1, the Starting Address is shown too high by 1, an anomaly in qModMaster. The returned Register Values are 00 06 0E 49. Hex 60E49 is the same as Decimal 396873. This is the meter reading of 39.6873 Hz without the decimal point.

3. OTHER EXAMPLES FOR DEVICE ADDRESS 01, NO PARITY

Example	Action	Modbus RTU Ser_4 = 010 Addr = 001	Modbus ASCII Ser_4 = 020 Addr = 001
Restart Com-munications*	Request Response	010800010000**B1CB** 010800010000**B1CB**	:010800010000**F6**crlf :010800010000**F6**crlf
Meter Reset	Request Response	01050001FF00**DDFA** None	:01050001FF00**FA**crlf None
Digital Reading = +25.18	Request Response	010400030002**81CB** 010404000009D6**7C4A**	:010400030002**F6**crlf :010404000009D6**18**crlf
Write Setpoint 1 = +37.00	Request Response	01100001000204000000E74**3624** 011000010002**1008**	:01100001000204000000E74**66**crlf :011000010002**EC**crlf
Read Setpoint 1 = +37.00	Request Response	010300010002**95CB** 01030400000E74**FE74**	:010300010002**F9**crlf :01030400000E74**76**crlf
Send -12.34 to Remote Display or LTS **	First send decimal point, address 0057 as 00 03.		
	Request Response	01100069000204FFFFFB2E**F6E5** 011000690002**91D4**	:01100069000204FFFFFB2E**59**crlf :011000690002**84**crlf

* Suggested as first message after power-up. If device is in Listen-Only mode, no response is returned.

** 1234 decimal = 000004D2 Hex. -1234 = FF FF FB 2E in 4-byte 2's complement Hex. Decimal point is ignored.

RTU: Bolded last 4 characters indicate the CRC (added automatically by the device with RS232, RS485 or USB communications).

ASCII: Bolded last 2 characters indicate the LRC (added automatically by the device with RS232, RS485 or USB communications).