



Coriolis
Mass Flow Meters

Coriolis Flow Meters

RCT1000 Modbus RTU Communication Protocol



Badger Meter

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User Manual

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COMMUNICATION SETTINGS

Configuration Procedure for All Transmitter Types

Parameters are available to configure the EIA–RS485 and USB ports. Engineer (PW3) level access is required to change the default settings. The default settings are: BMI Massmeter, address 2, baud rate 38400, 8 data bits, parity none, 1 stop bit. The stop bit is always set to 1. Parameter selection is in menu *SETUP > SYSTEM IO > COM PORTS*.

Address

Communication Address (*ComAdd, 1*) is the parameter for the network device address.

1. To change the network device address, scroll to parameter *ComAdd* then press and hold **Enter** until the cursor starts flashing under the first digit of the address.
2. Press and hold **Up** to move the cursor to the correct digit.
3. Use **Up** or **Down** to increment the address number.
4. Press and hold **Enter** for a Long Press to save the change, or press and hold **Menu/Exit** to cancel the edit(s) and return to *COM PORTS* parameter screen.

Protocol

COM1 Protocol (*ComPr1, 201*) is the parameter for the protocol selection.

1. To change the protocol selection, scroll to parameter *ComPr1* then press and hold **Enter**.
2. Press **Up** or **Down** to scroll to the *Modbus* option.
3. Press and hold **Enter** for a Long Press to save the change, or press and hold **Menu/Exit** for a Long Press to cancel the edit(s) and return to *COM PORTS* parameter screen.

Baud

Baud (*Baud, 312*) is the parameter for the baud rate setting. Valid baud rates are 1200, 2400, 4800, 9600, 19200 and 38400.

NOTE: The baud rate setting is common for all ports. If an optional HART or Ethernet communication card is used, then the baud rate must be set to 38400.

1. To change the baud rate, scroll to *Baud* then press and hold **Enter**.
2. Use **Up** or **Down** to select the baud rate.
3. Press and hold **Enter** for a Long Press to save the change, or press and hold **Menu/Exit** to cancel the edit(s) and return to *COM PORTS* parameter screen.

Parity

Parity (*Parity, 313*) is the parameter for the Modbus RTU parity setting. Valid settings are Odd, Even, None.

1. To change the parity, scroll to *Parity* then press and hold **Enter**.
2. Use **Up** or **Down** to select the parity.
3. Press and hold **Enter** for a Long Press to save the change, or press and hold **Menu/Exit** to cancel the edit(s) and return to *COM PORTS* parameter screen.

Endian

Endianness (*Endianness, 314*) is the word order setting for Modbus RTU. Select **big** for the most significant value at the lowest address, or **little** for the most significant value at the highest address.

1. To change the endianness, scroll to *Endianness* then press and hold **Enter**.
2. Use **Up** or **Down** to select the endianness.
3. Press and hold **Enter** for a Long Press to save the change, or press and hold **Menu/Exit** to cancel the edit(s) and return to *COM PORTS* parameter screen.

FUNCTION CODES

RCT1000 Coriolis transmitters support the following function codes, as applicable:

- 03 (0x03 hex) Read Holding Registers
- 16 (0x10 hex) Write Multiple Registers

MODBUS REGISTERS

Word Order/Endian

Each Modbus holding register represents a 16-bit integer value (2 bytes). The official Modbus standard defines Modbus as a 'big-endian' protocol where the most significant byte of a 16-bit value is sent before the least significant byte. For example, the 16-bit hex value of '1234' is transferred as '12'34'.

Beyond 16-bit values, the protocol itself does not specify how 32-bit (or larger) numbers that span over multiple registers should be handled. It is very common to transfer 32-bit values as pairs of two consecutive 16-bit registers in little-endian word order. For example, the 32-bit hex value of '12345678' is transferred as '56'78'12'34'. The register bytes are still sent in big-endian order per the Modbus protocol, but the 16-bit registers are sent in little-endian order. Alternatively, some devices store and transfer the Modbus registers in big-endian word order. For example, the 32-bit hex value of '12345678' is transferred as '12'34'56'78'.

As long as the transferring and receiving device transmit the data in the same manner, it does not matter in which order the words are sent. The word order is selectable in the RCT1000 Coriolis meter. This option is useful in applications where the Modbus master cannot be configured for endianness.

Display Registers

With firmware M2.13 or later, measurements displayed on the screen of the transmitter are assigned to a block of registers. The units for the Modbus registers match the units of the parameters assigned to the screen display.

Register Blocks

The following registers can be read individually or as a block of registers.

Parameter Name	Parameter Description	Network Access	Floating Point Single Precision 32-bit	Long Integer 32-bit	Units/Selection
Display Parameter #1	Value of the #1 reading on the home screen (parameter 700, symbol Param1)	Read	44711 – 44712	44727 – 44728	units on the display
Display Parameter #2	Value of the #2 reading on the home screen (parameter 701, symbol Param2)	Read	44713 – 44714	44729 – 44730	units on the display
Display Parameter #3	Value of the #3 reading on the home screen (parameter 702, symbol Param3)	Read	44715 – 44716	44731 – 44732	units on the display
Display Parameter #4	Value of the #4 reading on the home screen (parameter 703, symbol Param4)	Read	44717 – 44718	44733 – 44734	units on the display
Display Parameter #5	Value of the #5 reading on the home screen (parameter 704, symbol Param5)	Read	44719 – 44720	44735 – 44736	units on the display
Display Parameter #6	Value of the #6 reading on the home screen (parameter 705, symbol Param6)	Read	44721 – 44722	44737 – 44738	units on the display
Display Parameter #7	Value of the #7 reading on the home screen (parameter 706, symbol Param7)	Read	44723 – 44724	44739 – 44740	units on the display
Display Parameter #8	Value of the #8 reading on the home screen (parameter 707, symbol Param8)	Read	44725 – 44726	44741 – 44742	units on the display

Individual Registers

RCT1000 transmitters support reading and writing of a **single** parameter through function codes.

- The starting address is the same as the parameter number.
- A single parameter may consist of up to 4 bytes of data.
- Only one parameter at a time may be requested.

The register corresponds to the parameter number +40001. For example, to read the mass flow rate (mFlo), which is parameter 59 (3B hex) and is a 32-bit floating point, the register is 40060-40061.

Slave Address	01
Function	03
Starting Address Hi	00
Starting Address Lo	3B
No. of Points Hi	00
No. of Points Lo	02
CRC Hi	B5
CRC Lo	C6

The following table lists the registers of commonly used parameters. Parameters can only be read individually.

Parameter Name	Register	# of 16-bit Registers	Data Type	Values / Units / Format	Modbus RTU Access
About					
Transmitter Serial	40006	12	String	--	Read
Time	40217	8	String	hh:mm:ss	Read Write (Engineer)
Date	40218	8	String	mm:dd:yy	Read Write (Engineer)
Tag	40224	8	String	--	Read Write (Operator)
Descriptor	40225	16	String	--	Read Write (Operator)
Measurements					
Percentage Mass Flow	40059	2	Float	0.00 - 1.00 1.00 is maximum mass flow rate of meter	Read
Mass Flow Rate	40060	2	Float	kilograms/second	Read
Temperature #1 (sensor)	40066	2	Float	Celsius (°C)	Read
Temperature #2 (RCTN only)	40137	2	Float	Celsius (°C)	Read
Density	40071	2	Float	grams/cubic centimeter	Read
Specific Gravity	40072	2	Float	--	Read
Mass Totalizer	40081	2	Float	kilograms	Read
Mass Totalizer Forward	40240	2	Float	kilograms	Read
Mass Totalizer Reverse	40241	2	Float	kilograms	Read
Reset Mass Totalizer	40082	1	Unsigned Integer	0 = Idle 1 = Active (momentary)	Read Write (Operator)
Overall Mass Totalizer (not resettable)	40083	2	Float	kilograms	Read
Totalizer Wrap Count	40032	1	Unsigned Integer	--	Read
Mass Totalizer Wrap Limit	40084	2	Float	kilograms	Read Write (Engineer)
Volumetric Flow Rate	40101	2	Float	liters/second	Read
Volumetric Total	40102	2	Float	liters	Read

Parameter Name	Register	# of 16-bit Registers	Data Type	Values / Units / Format	Modbus RTU Access
Inputs and Outputs					
Status Inputs	40015	1	Unsigned Integer	Bit 0: Digital Input #1 Bit 1: Digital Input #2 Bit 2: Digital Input #3 Bit 3: Digital Input #4	Read
Status Outputs	40016	1	Unsigned Integer	Bit 8: Digital Output #1 Bit 9: Digital Output #2 Bit 10: Digital Output #3 Bit 11: Digital Output #4	Read
Current #1 Output	40121	2	Float	mA	Read
Current #2 Output	40122	2	Float	mA	Read
Current #3 Output	40230	2	Float	mA	Read
Enable Alternate Current #1	40127	1	Unsigned Integer	0 = On 1 = Off	Read Write (Technician)
Enable Alternate Current #2	40128	1	Unsigned Integer	0 = On 1 = Off	Read Write (Technician)
Enable Alternate Current #3 (RCTX with HART or RCTN only)	40232	1	Unsigned Integer	0 = On 1 = Off	Read Write (Technician)
Frequency #1 Output	40123	2	Float	Hertz (Hz)	Read
Enable Alternate Frequency #1	40129	1	Unsigned Integer	0 = On 1 = Off	Read Write (Technician)
Analog Input #1	40227	2	Float	Volts (V)	Read
Analog Input #2 (RCTN only)	40136	2	Float	Volts (V)	Read
RTD1 Resistance (sensor)	40284	2	Float	Ohms	Read
RTD2 Resistance (RCTN only)	40285	2	Float	Ohms	Read
PID					
PID Setpoint	40152	2	Float	Units are based on parameter assigned to PID	Read Write (Operator)
PID Output Percentage	40153	2	Float	0.00 -1.00	Read
Sensor					
Tube Frequency	40061	2	Float	Hertz (Hz)	Read
Coil A Voltage	40184	2	Float	Volts (V)	Read
Driver Output Percentage	40185	2	Float	0.00 -1.00	Read
Coil B Voltage	40186	2	Float	Volts (V)	Read
Normalized Tube Frequency	40248	2	Float	Hertz (Hz)	Read
Setup					
Maximum Mass Flow Rate	40048	2	Float	kilograms/second	Read Write (Engineer)
Zero Mass Flow Limit (Cutoff)	40049	2	Float	kilograms/second	Read Write (Engineer)
Batch					
Suspend Batch	40033	1	Unsigned Integer	0 = On 1 = Off	Read Write (Operator)
Batch Totalizer	40091	2	Float	kilograms	Read
Start Batch	40092	1	Unsigned Integer	0 = Idle 1 = Active (momentary)	Read Write (Operator)
Stop Batch	40093	1	Unsigned Integer	0 = Idle 1 = Active (momentary)	Read Write (Operator)
Batch Setpoint	40094	2	Float	kilograms	Read Write (Operator)
Concentration					
Mass Flow Rate A	40105	2	Float	kilograms/second	Read
Mass Flow Rate B	40106	2	Float	kilograms/second	Read
Mass Totalizer A	40107	2	Float	kilograms	Read
Mass Totalizer B	40108	2	Float	kilograms	Read
Mass Percentage A	40109	2	Float	0.00 -1.00	Read
Mass Percentage B	40110	2	Float	0.00 -1.00	Read

TROUBLESHOOTING

Symptoms	Possible Causes	Recommended Action
No communication	Transmit and receive are wired incorrectly.	Check the network wiring from the meter.
	Baud rate does not match master.	Check the baud rate of the master and ensure the baud rate of the meter matches the master. The master is often a PLC or BAS. If it does not match, change the Baud Rate setting in the Modbus RTU Communication menu.
	Parity and stop bits do not match the master.	Check that the settings are compatible with the master. If it does not match, change the Parity or Stop Bit setting in the Modbus RTU Communication menu. Stop Bits should always be set to 1.
	Slave address is not unique. Another device is on the network with the same address.	Check the addresses of the other devices on the network. Check that the slave address is not 1.
	Cable is not terminated properly.	For Modbus RTU on EIA-485 network, devices can be daisy chained together. The two devices on the end of the chain need to have terminated resistors. Terminating resistors can be enabled through the jumper on the RCTX board.
	Cable or chain longer than 4000 feet.	For Modbus RTU on EIA-485 network, the full length of the network cannot exceed 4000 feet. Check the length of the cabling.
Intermittent communication	Cable is not properly shielded.	Communication cables must have shielding to protect the quality of the communication signals from electromagnetic interference (EMI). Check that the cable has a shield. Typically, one end of the shield drain is connected to a clean ground to dissipate EMI and prevent ground loops. However, depending on the ground quality, cable length and type of interference, other methods can be employed.
	Cable routed near power cables such a variable frequency drives.	Cables carrying high currents cause a high degree of electromagnetic interference that can interfere with the quality of the communication signals. Route signal cables away from power cables.
	Cable is not terminated properly.	For Modbus RTU on EIA-485 network, devices can be daisy chained together. The two devices on the end of the chain need to have terminated resistors. Terminating resistors can be enabled through the jumper on the RCTX board.
	Cable or chain longer than 4000 feet.	For Modbus RTU on EIA-485 network, the full length of the network cannot exceed 4000 feet. Check the length of the cabling.
Unable to read specific parameters correctly	Word order (endian) or data type/format	In Modbus RTU, floating point, long integers and string character registers may have the word order (endian) swapped. Check the data type and endian of the master and verify that the register in the meter matches the matches. If it does not match, change the <i>Endianness</i> setting in the Com Ports.
Unable to write specific parameters	Password level is not authorized to write to the parameter	These settings are commonly used to prevent accidental or unauthorized changes to the a device over a network. Check the Password level (<i>PWLVl</i> , 140).
	Word order (endian) or data type/format	In Modbus RTU, floating point, long integers and string character registers may have the word order (endian) swapped. Check the data type and endian of the master and verify that the register in the meter matches the matches. If it does not match, change the <i>Endianness</i> setting in the Com Ports.

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