

ConSensus[®] CPC-02

dual channel pulse counter

Modbus manual

Introduction:

This document describes how to connect the ConSensus CPC-02 to a Modbus network.

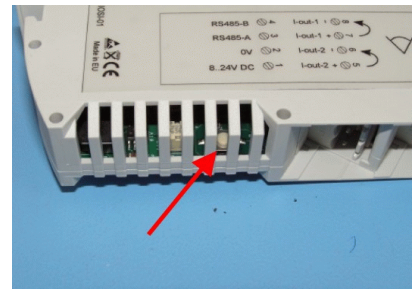
It describes:

1. Configuring the device for Modbus.
2. Selecting the communication settings.
3. Supported commands and data format.
4. Register list.
5. Tips and tricks.

1. configuring a ConSensus device for Modbus:

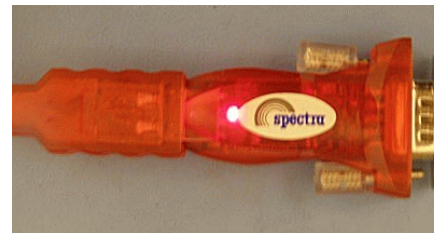
By default, ConSensus devices use a fast and efficient proprietary RS485 protocol at 115200 baud. Through configuration, devices can be instructed to start-up in Modbus mode, with specific baudrates and communication parameters. These settings take effect at the next power-up of the device.

To reconfigure a device that is running Modbus, disconnect it from power, press and hold the configuration button down and re-apply the power. This will temporarily overrule the configuration settings and force the device to start-up with the proprietary protocol and device number 1.



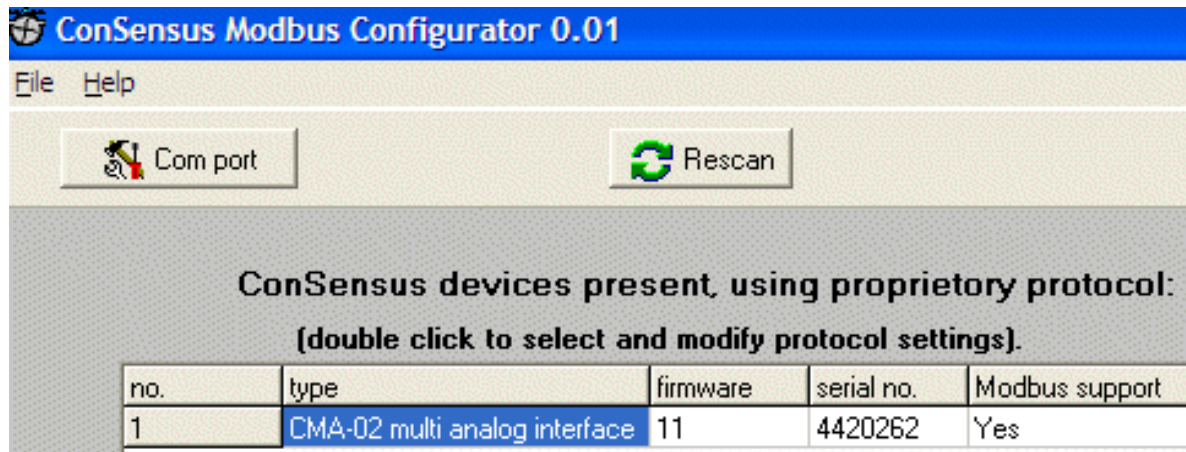
The configuration software ConSensModBus.exe runs on a Windows PC and expects a COM port with a RS485 driver to connect to the device to configure.

A suitable convertor is the Spectra USB to RS485 adapter, available from Exatech by



2. Modbus communication settings.

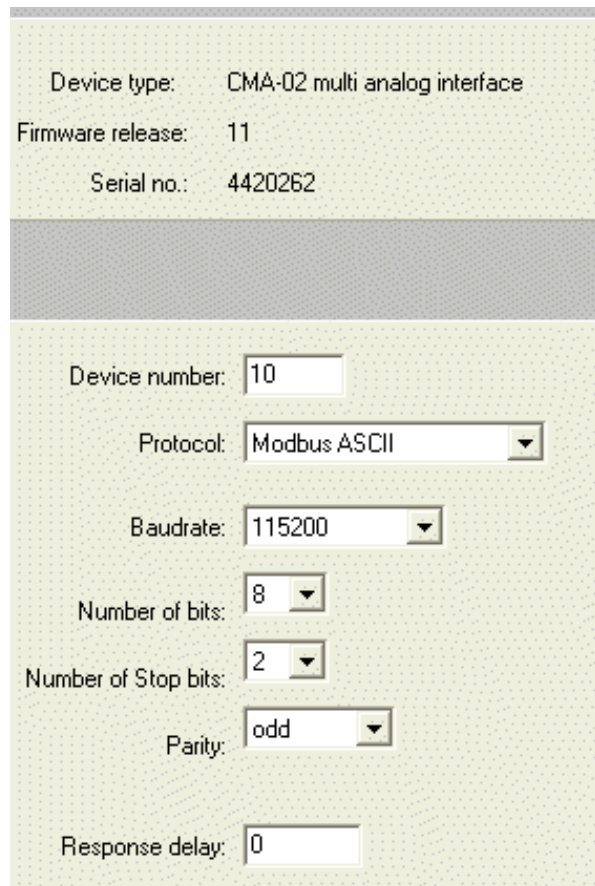
Run the ConSensModBus.exe program and select the COM port to which the device is connected. The device will appear in the list of connected devices, with its type, serial number and firmware release.



Click on the Modbus button and set:

- Device number (1-149).
- Modbus type (RTU or ASCII).
- baudrate (1200 - 115200).
- bits (8 for RTU, 7 or 8 for ASCII).
- parity (none, odd or even).
- stopbits (1 or 2).
- response delay: ASCII: extra milliseconds, or RTU: extra bits after 3 bytes, before the device switches on its transmitter).

If all settings are made, click the OK button to store the settings in the device and return to the overview screen. Note that the changes will only take effect after resetting the device through a power cycle.



3. supported commands and data formats:

ConSensus devices support a subset of the modbus protocol. Commands supported are:

Function	Code	Remarks
Read Holding registers	0x03	16 bits registers. LongInts ^(*) occupy 2 registers.
Read Input register	0x04	same as 0x03.
Preset Single register	0x06	16 bits registers. LongInts ^(*) occupy 2 registers
Write Multiple registers	0x10	16 bits registers. LongInts ^(*) occupy 2 registers
Report slave ID	0x11	5 chars device type ("CMA02") followed by "--", 3 chars firmware version, followed by '#' spacer, 8 chars serial number, 0xFF run indicator, 1 byte protocol version number

The device makes no distinction between holding and input registers: there is just one list of registers and both types of commands are valid and working on the same data..

Protocol errors return the command code logically OR-ed by 0x80, and one databyte indicating:

Error code	Meaning
0x01	illegal function
0x02	illegal address
0x03	illegal value

^(*) LongInt registers of 32 bits occupy two 16 bits registers in big endian format. To read a LongInt, it is essential to read the even numbered register with the MSB first, and the odd numbered register with the LSB immediately afterwards within the same read command. This ensures an "atomic" read of the two registers.

The ConSensus CPC-02 device does not support floating point values. In stead, all values are scaled to an appropriate integer format.

Broadcasts are not supported..

4. Register list.

No.	Type	R/W	Remark	Note
0x0000	Word	R	device status: bit 0: configured bit 1: pulse fault bit 2: timebase fault bit 4: pulse A bit 5: pulse B bit 8: channel A active bit 9: channel B active	1
0x0010	Word	R/W	Configuration bit 0: device outputs timebase bit 1: use pulse fault detector bit 4: use channel A bit 5: use channel B bit 6: channel A is master bit 7: channel B is master bit 8: inverse polarity channel A bit 9: inverse polarity channel B	2,3
0x0011	Word	R/W	Channel A threshold (2500-15000mV)	
0x0012	Word	R/W	Channel B threshold (2500-15000mV)	
0x0013	Word	R/W	Channel A debounce (1-50000 periods)	4
0x0014	Word	R/W	Channel B debounce (1-50000 periods)	
0x0015	Word	R/W	Count Till time [1-36000s]	5
0x0016+0x0017	Longint	R/W	Count Till pulses	5
0x0018	Word	W	Count command: 0 = reset counters 1 = start counting 2 = stop counting	6
0x0020	Word	R	device status (same as 0x0000)	
0x0022+0x0023	Longint	R	channel A pulse count	7
0x0024+0x0025	Longint	R	channel B pulse count	7
0x0026+0x0027	Longint	R	channel A elapsed periods	8

0x0028+0x0029	Longint	R	channel B elapsed periods	8
0x002A+0x002B	Longint	R	channel A pulse period *20µs	9
0x002C+0x002D	Longint	R	channel B pulse period *20µs	9
0x002E	Word	R	channel A frequency	10
0x002F	Word	R	channel B frequency	10

Reading undefined registers will return 0x0000.

Notes:

- Any valid Write Register command in the range 0x0010 - 0x0030 will change the device status from unconfigured to configured, causing the red LED to go off. Pulse A and B indicate the current level of the input. Active A and Active B indicate if a channel has started its measurement and has not yet stopped.
- CPC-02 devices use a common timebase of approx. 51.2kHz. Typically, one and only one of the CPC-02 devices must be programmed to output this timebase.
- One and only one of all CPC-02 channels in the system should act as master. This channel synchronously starts and stops all other channels, and is typically the meter with the lowest frequency. Of course, the master channel must also be enabled by setting “use channel X”.
- If the input signal bounces, enter a time in which the input must be stable before accepting it as a pulse. Choose the value based on the expected bounce and expected frequency: a high frequency does not allow a large debouncing value, for that will filter the input signal completely out. Bounce time is in units of 20 µs.
- The measurement will automatically stop after a certain number of seconds or after a certain number of pulses. Set these values to 0 if not in use, and for any channel that is not the master.
- To start a measurement, first start all CPC-02 devices that do not have the master channel. Then issue the start command to the master device. The measurement will run until the amount of time or pulses has been counted, or by issuing a stop command. This stop command needs only to be sent to the master device. Subsequently, scan the status of all CPC-02 devices until all channels are no longer active. Finally, reset the counters at each device to prepare for the next measurement.
- Number of pulses counted since start of the measurement.
- Elapsed periods is the total time of the measurement for each channel separately, based on the common clock, in units of approx. 20 µs.
- Pulse period is derived from the 51.2kHz timebase, so approx 20 µs. At low pulse rates, the pulse period gives a better indication of the speed than the frequency, that only indicates pulses per second.
- CPC-02 is designed as a pulse-counter, and is not a frequency meter. It estimates the input frequency from the number of pulses per second. At very low frequencies pulses will be counted and timed correctly, but the frequency indication will be incorrect: the frequency measurement of the CPC-02 will wait for a maximum of 10 seconds for the next pulse, and if this does not occur, it will output the period time since the last pulse.

5. Tips and tricks:

- After power-up, the device is not configured and does not measure anything. At least one of the registers in the range 0x0010 - 0x0030 must be written to start any action on the device and make the red configuration LED go off.
- Select one CPC-02 to output the timebase, and select one channel to be the master, typically the meter with the lowest frequency in the system.
- Do not change the configuration registers while a measurement is taking place, since the values may change unexpectedly.
- If the CPC-02 system is used for calibration of flow meters, the average flow can be calculated as: $\text{average flow} = (\text{pulsecount} / \text{elapsedtime}) / \text{factor}$.
The deviation of the MUT (meter under test) from the Standard meter is calculated by dividing:

$$\text{deviation} = \text{MUT average flow} / \text{Standard average flow}.$$

Since both meters use the same timebase, any deviation in the elapsedtime will automatically be cancelled out in the division. Therefore, the timebase does not have to be precisely 50kHz or be extremely stable and accurate. CPC-02 uses a timebase of 51.2kHz, derived from a crystal oscillator.

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