technical manual

ConSensus®*CMA-02*

multi analog interface

Introduction:

The ConSensus CMA-02 is a combined analog input and output module in the ConSensus range of calibration equipment. It features three inputs for 0-20mA or 4-20mA, a temperature sensor connection, and one fully isolated loop powered 4-20mA analog output.

The CMA-02 communicates through RS485 with either a ConSensus system controller, or a PC through an RS232/RS485 interface.

Applications:

- industrial sensor systems.
- calibration systems.
- digital metering.

Features:

- Pt-100, Pt-1000 and thermocouple temperature measurement.
- 2, 3 and 4 wire Pt-100/Pt-1000 interface.
- T,J,K and N type thermocouples.
- 0-20mA analog inputs into 50 ohm, with 16 bits AD conversion.
- 4-20mA analog output,12..30V loop powered, galvanically insulated.
- Inputs galvanically insulated from power and communication.
- Wide power supply voltage range: 12..24V DC, low power: 6VA max.
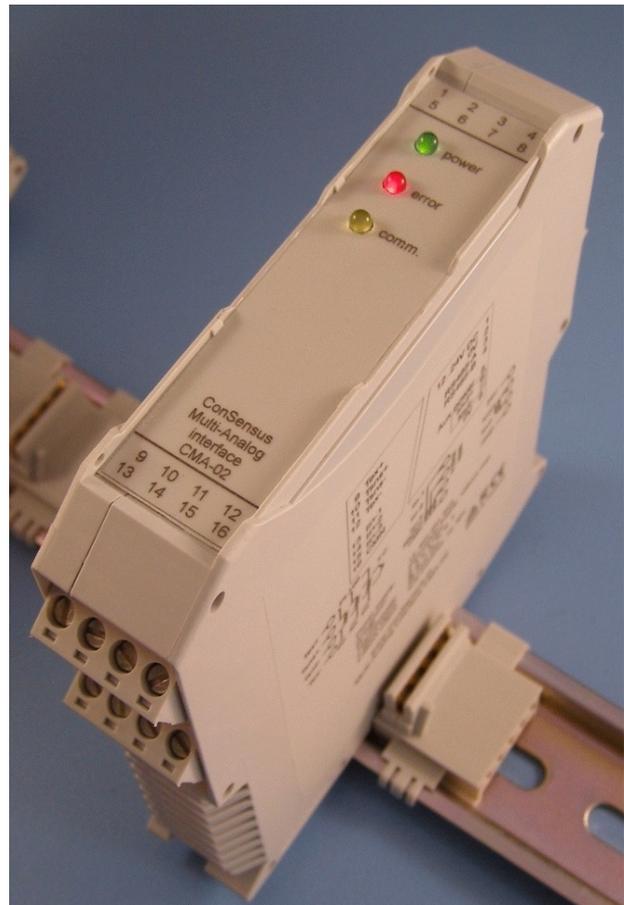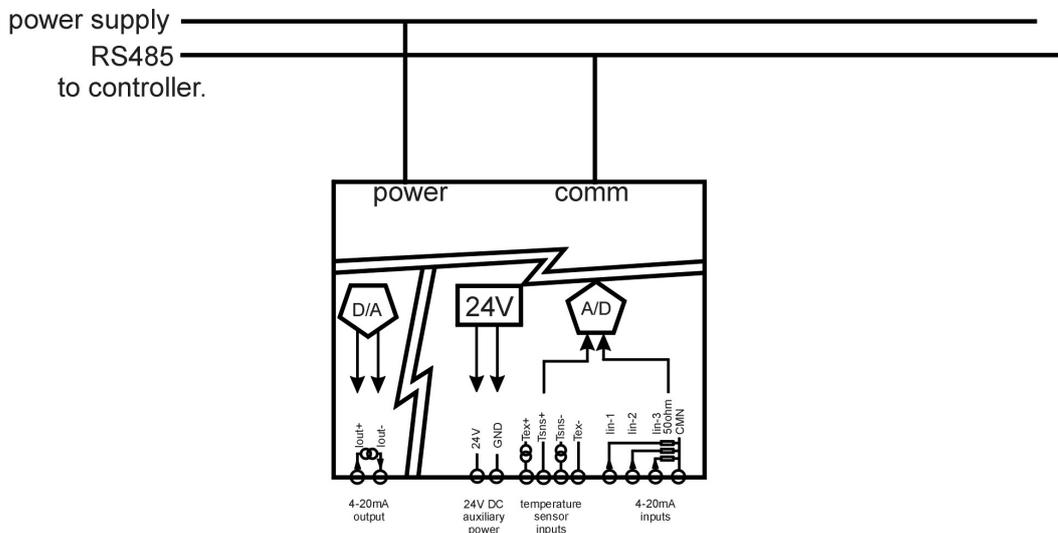- DIN rail mount.

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General description:

Many industrial sensors are equipped with 0-20 or 4-20mA outputs, and many actuators can be controlled with 4-20mA as well.

The CMA-02 offers a combination of analog inputs and output, plus an accurate temperature measurement input, in a single DIN rail mounted enclosure.

Block diagram:

The CMA-02 offers a galvanic isolation barrier between the bus side with power and communication, and the analog connections. This barrier consists of magnetically coupled isolators, and a DC/DC convertor to pass the auxiliary power to the input circuitry. The DC/DC convertor supplies power to the analog inputs that measure 0-20mA and temperature.

The analog 0-20mA inputs are referenced to CMN, which is approximately 2.5 Volts higher than the GND connection of the auxiliary power supply. This allows for accurate current measurements down to zero mA.

The temperature circuitry will supply excitation current to an external Pt-100 or Pt-1000, in various configurations of wiring: 2-wire, 3-wire and 4-wire. It can also measure various types of thermocouple sensors.

The analog output is completely isolated from all other electronics, and is loop powered: it uses the 4mA minimum current of the loop for its internal power. Note that the minimum voltage across the analog output is 12V.

A minimum interface system consists of a single CMA-02, a DC power supply and a controller such as a PC with RS485 adapter, or a ConSensus system controller.
If more analog I/O is required, up to 31 CMA-02's can be connected in parallel.

LED indicators:
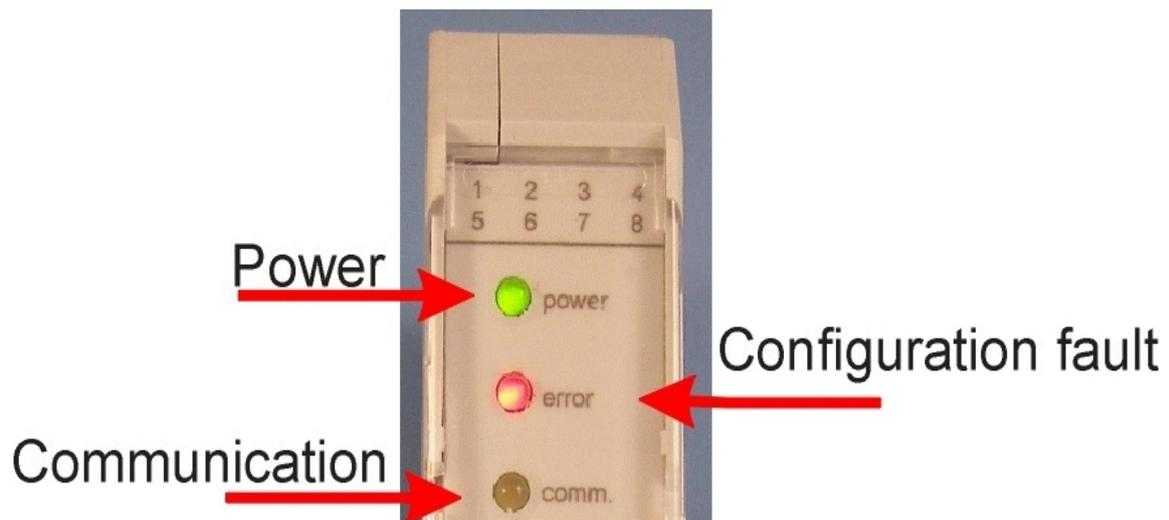
LED	color	function
Power	green	Steady: power is OK, system is running. Interrupted: power is low, or internal failure.
Error	red	Device has been powered on, but not yet received its configuration data from the master.
Comm	yellow	Indicates active communication with PC or system controller.

At power-up, all three LEDs will be lit for about 1 second. Then the Comm LED will switch off until communication with the master has been established. The master will send the configuration data, and subsequently the Error LED will switch off.
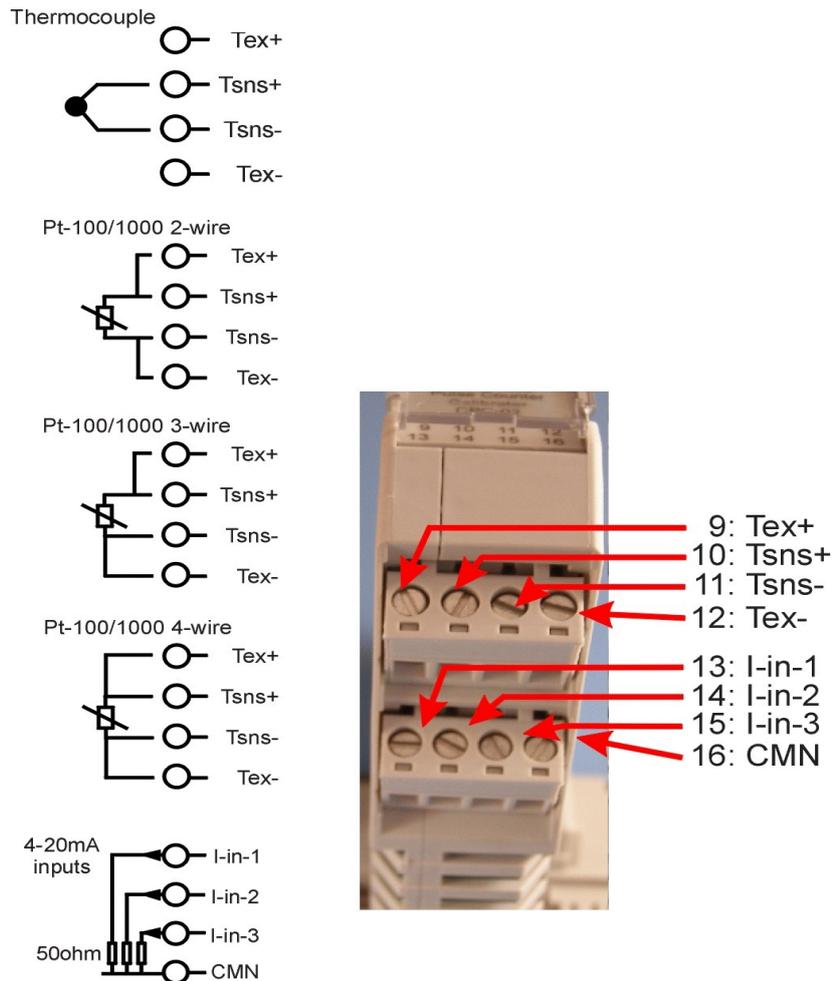
Electrical connections:

Power and communication connections:
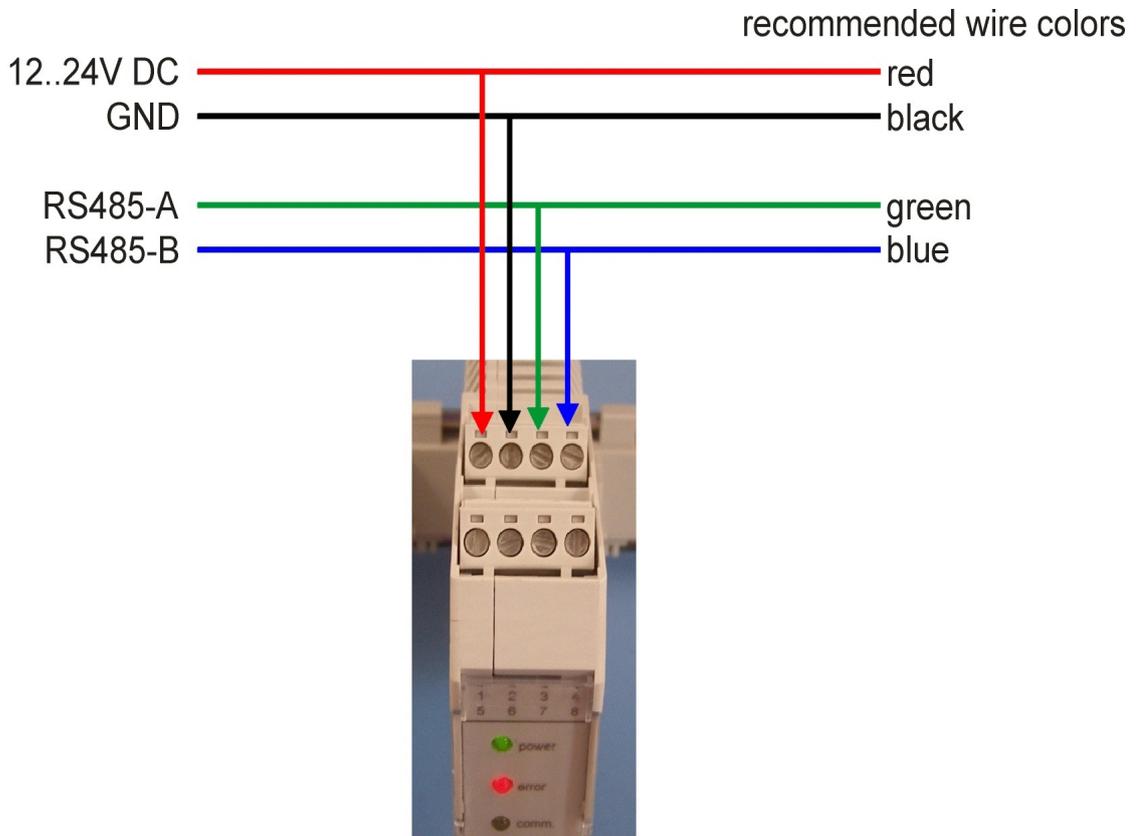
Note: if the wire length between devices is longer than just a few centimeters, it is strongly recommended to use twisted pair wire for the wire pair RS485 A/B.

Analog inputs:

Each analog input of the CMA-02 measures the 0-20mA current through a 50 ohm precision resistor. The inputs share a common connection, so take care when designing the installation to avoid current loops. If necessary, use another CMA-02 to isolate sensors that are not allowed to be connected.

The inputs are protected by a slow-blow thermal fuse of 100mA. If an overload condition has occurred, the input will shut off and remain so until the fault condition has been removed. After cooling down, the fuse will automatically reengage.
Nevertheless, the prevision current measurement resistor may be damaged by any overload greater than 50mA, or 2,5V.

Analog output:
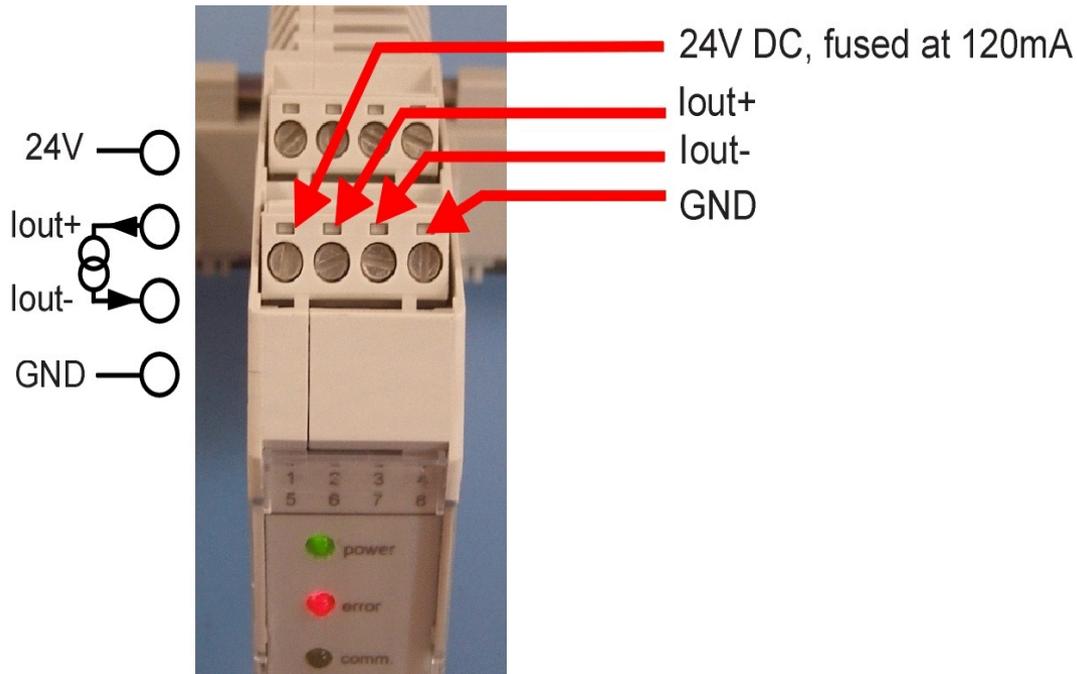
Pins 6 and 7 of the analog output are galvanically insulated from the DC power supply and communication. These pins are the only ones to be connected for passive current-loop systems.

If the output is to be active, the 24V from the power supply at pin 5 can be used to supply current to the analog output, and pin 8 serves as return to GND. Note that these pins are directly connected to the power supply, sacrificing galvanic insulation.

The analog output is loop powered, which means that the circuitry draws its power from the 4mA base current. This is also the minimum current of the output. Any output value written to the CMA-02 will be translated into an analog current from 4 to 20mA.

The analog output requires a minimum of 12V of loop voltage to operate, and may not be subjected to voltages over 30V.

The software of the CMA-02 has automatic slope limiting: the change of the output current can be programmed as a number of µA per second, with different settings for increasing and decreasing currents. This feature allows e.g. for slow up-ramping, and fast down-ramping. The output value changes 10 times per second, and the minimum rate of change is 10 [µA/s].

Another feature of the analog output is a programmable automatic shut-down in case of a communication failure: if no communication is detected for a number of seconds the CMA-02 will automatically change the output to a predetermined value.

Connecting to a PC COM port:

If the CPC-02 system is to be controlled by a PC, a convertor is required to convert the COM port RS232 signals to RS485.

Most suitable is the Spectra USB to RS485 adapter, available from Exatech bv.

Communication protocol:

The CMA-02 communicates at 115200 baud, 8 bits, 2 stop bits, odd parity. The device acts as a slave on the bus, replying to commands that address the device uniquely.

Data and commands are exchanged in frames that contain the device address of the destination device, and of the source device, typically the master (PC or controller). Each data byte is error checked using the parity bit, and the total frame is error checked using a cyclic redundancy check (CRC-16). The contents of the frames is an Exatech bv proprietary protocol. Optionally, Modbus RTU protocol is available.

As RS485 is half duplex, only one transmitter can be active at any time. Typically the PC or controller initiates a communication cycle, inviting the slave device to return a reply. The PC must disable its RS485 transmitter immediately after the last byte of the frame has been transmitted, or at least within 500μs. Windows PC's cannot meet this requirement, and need an intelligent convertor such as the Spectra USB-RS485 adapter.

Some of the commands supported are:
      Set configuration: transfer sensor types and calibration.
      Set analog output: set 4-20mA value.
      Read status: read temperature and 3 analog inputs.

Software:
For more information about the ConSensus Pulse Calibration software package, please refer to the software documentation.

Setting the device address:

Each ConSensus device should be assigned a unique
address on the RS485 communication bus. The ConSensus
devices have no dipswitches or keyboard through which a
number can be entered. There is however a single push
button, accessible from the side. The PC software will
transmit a device address during 30 seconds, and when the
switch is operated on one of the ConSensus devices, this
device will accept and store the device address, and use it
from then on. To use this program feature:
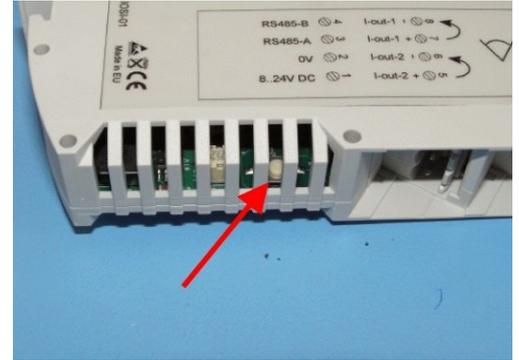
- open File / Settings / Device list.
- A screen will open that shows a list of all
  31 possible ConSensus devices connected
  to the bus. Select an empty box and enter
  the type of device. In this example, we
  will make device number 10 a CMA.

- Click the 'binoculars' button in box 10 to
  locate this device.

- If necessary, change the device address,
  but usually the address will be the same
  as the box number.
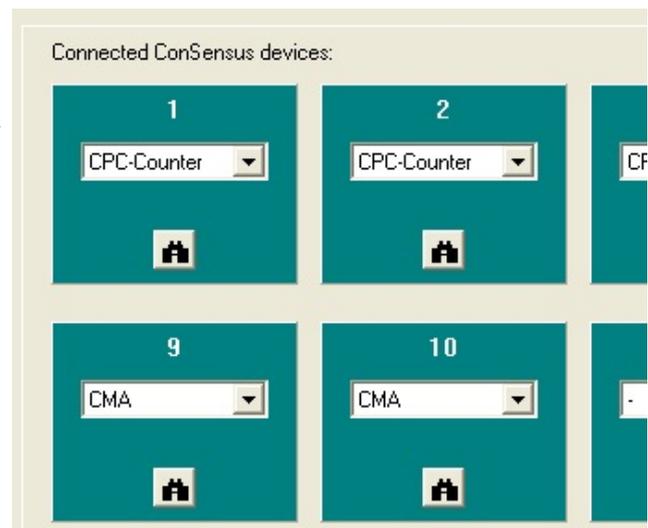
- click OK: this will start a special sequence in which the device is requested to accept the
  number.

- At the device, press a non-conductive (plastic) pin
  through the little hole above the Power led to operate
  the miniature switch. After about one second the
  device will start to communicate and the "Change
  device address" window on screen closes.
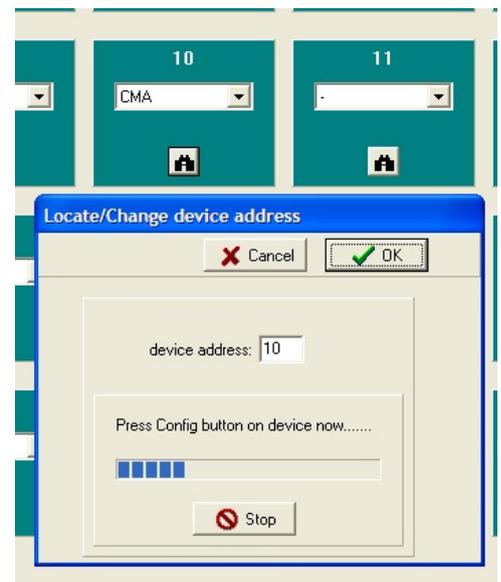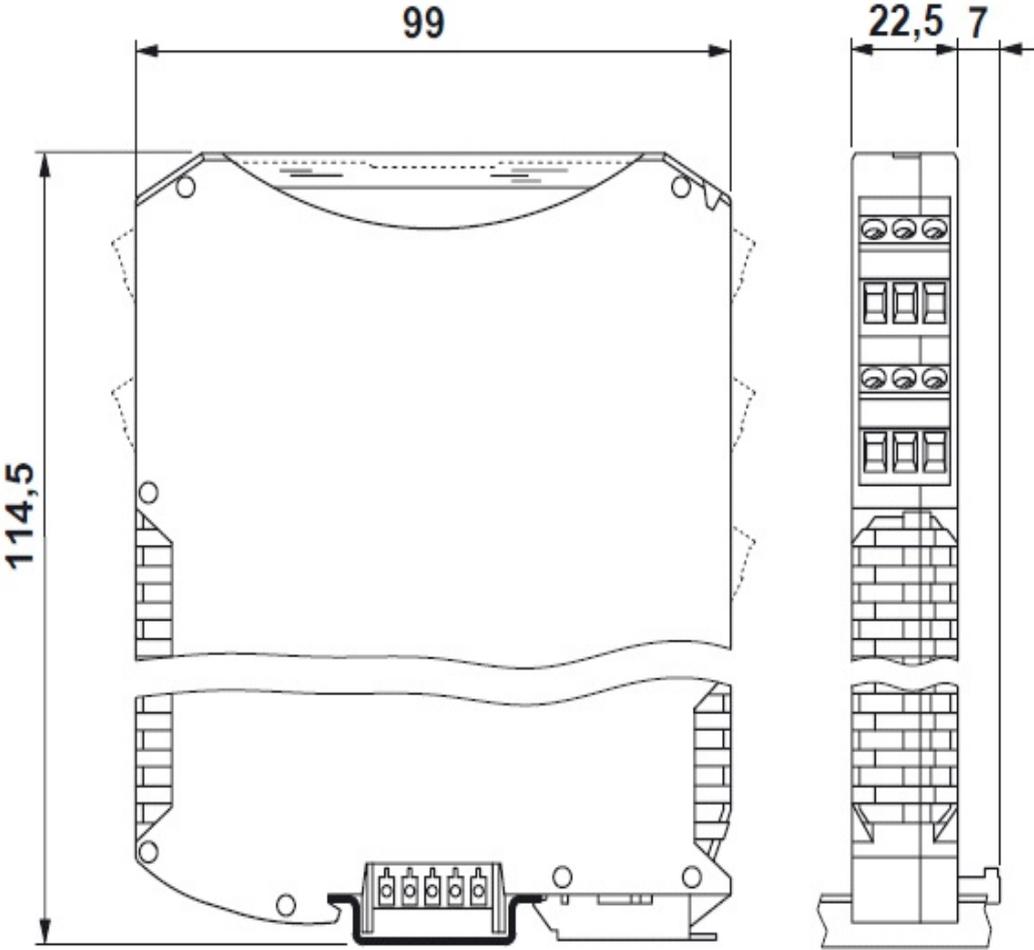

Technical specifications:

Parameter	Min	Typ	Max	Unit
Sample rate (note 1)		8		smpl/s
Analog input current:	0	20	22	mA
Analog input resolution:		1		μA
Input impedance (note 2)	50		75	ohm
Pt-100/1000 measurement accuracy (uncalibrated)		1		°C
Pt-100/1000 exitation current (note 3)	180	210/420	500	μA
Pt-100 measurement range	-40		350	°C
Pt-1000 measurement range	-40		250	°C
Pt-100/1000 resolution		0.02		°C
Thermocouple measurement accuracy (uncal)		4		°C
Internal temperature accuracy (uncal, note 4)		3		°C
Thermocouple measurement range (note 5)	-50		600	°C
Thermocouple resolution		0.1		°C
Power supply:	12		24	VDC
Power consumption:	1		6	VA
Communication wire length			100	m
Number of devices on a single bus line			31	
Wire diameter (solid)	0.5		4	mm^2
Environment temperature	0		55	°C
Humidity	10		85	%
Protection		IP40		

Note 1:   The AD convertor performs one analog-to-digital conversion (also called sample or conversion) per 125 milliseconds. Each analog input channel requires 1 sample, while temperature measurement requires 2 samples. If all sensors are activated (3 analog and 2 temperature channels) the conversion rate will be 5*125 = 625 ms, or 1,6 samples/second. This sample rate is chosen for maximum suppression of 50Hz and 60Hz noise from the mains voltage.

Note 2:   measurement resistance is 50ohm, but the total input resistance is higher due to the thermal fuse and the resistance of connectors and PCB traces.

Note 3:   2- and 4-wire sensors will receive 420uA excitation current, while 3-wire sensors will receive only 210uA: the other 210uA is used to compensate wire resistance.

Note 4:   The Internal temperature sensor is used for Cold-Junction-Compensation of the thermocouple sensors.

Note 5:   range may depend on thermocouple type.

Trouble shooting guide:

Problem:	Suggestions:
Power LED not lit:	• Check supply voltage (DC 12..24Volt) • Check polarity: pin 1 should be +
Comm LED does not blink:	• Device not addressed by master: first add it to the device list. • Device has not been programmed with device address: see chapter "setting the device address". • Check polarity of the RS485 wires.
Error LED is lit:	• No configuration data has been received after power up. Check the communication and check that the master transmits the configuration first.
Pt-100/1000 temperature is incorrect:	• check that the correct sensor type is configured in the software. • For 2 and 3 wire sensors: check that the wire links are in place.
Thermocouple temperature is incorrect:	• check that the correct sensor type is configured in the software. • check the polarity of the sensor.

Mechanical dimensions:

99

22,5 7

114,5

Electrostatic warning:

The CMA-02 is equipped with internal anti-static protections. Nevertheless, the device should not be subjected to high electrostatic potentials. A grounding strap or similar protective device is strongly recommended when handling or connecting the device. Avoid touching the connections or any other metallic element.

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