

## TP32MTT.03 - TP32MTT.03.1



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### TP32MTT.03 - TP32MTT.03.1

#### PROBES FOR SOIL THERMAL PROFILE MEASUREMENT

The temperature probe TP32MTT.03 is equipped with seven Pt100 1/3 DIN sensors for the measurement of temperature at depth: +5 cm, 0, -5 cm, -10 cm, -20 cm, -50 cm, -1 m with respect to the soil level, according to the indications of the World Meteorological Organization (WMO).

The probe TP32MTT.03.1 is equipped with six Pt100 1/3 DIN sensors for the measurement of temperature at depth: +5 cm, 0, -5 cm, -10 cm, -20 cm, -50 cm with respect to the soil level.

The fibreglass tube ensures a perfect impermeability and a high thermal insulation along the vertical axis.

The RS485 digital output with MODBUS RTU protocol allows the use of even very long connection cables. It can be connected to the datalogger HD32MT.1 and HD32MT.3, or to any other datalogger with RS485 MODBUS RTU input.

The M12 connector present on the hand grip of the probe allows an easy connection of the cable. Cable length (optional) 2, 5 or 10 m, with open wires at the end.

Power supply 6...30 Vdc.

#### TECHNICAL SPECIFICATIONS

<b>Sensors</b>	Pt100 1/3 DIN
<b>Resolution</b>	0.01 °C
<b>Accuracy</b>	± 0.1 °C @ 0 °C
<b>Working temperature</b>	Stem: -40...+125 °C Hand grip: -40...+85 °C
<b>Temperature drift</b>	0.003 %/°C @ 20 °C
<b>Power supply</b>	6...30 Vdc
<b>Consumption</b>	5 mA @ 12 Vdc
<b>Output</b>	RS485 with MODBUS-RTU protocol
<b>Connection</b>	8-pole M12 male connector
<b>Cable</b>	Optional, with 8 poles with length of 2, 5 or 10 m (to be defined at the order) with open wires at the end.
<b>Protection Degree</b>	IP 68

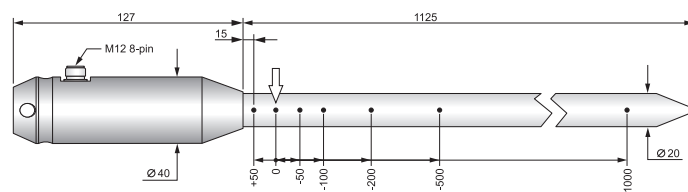


Fig. 1: dimensions of the probe TP32MTT.03 (mm)

#### INSTALLATION

By means of an accessory, perform a hole into the soil deep enough to accommodate the stem of the probe. Never use the probe to make the hole in the soil, to avoid mechanical damage to the probe itself.

Once the hole has been performed in the soil, insert the stem of the probe so that the indicator of the zero level is in correspondence with the surface of the soil. The probe must be stable in a vertical position.

After the introduction of the probe into the hole, fill in the empty spaces between the soil and the stem of the probe with some soil made powder. To obtain accurate measurements, the soil should be in contact with the stem.

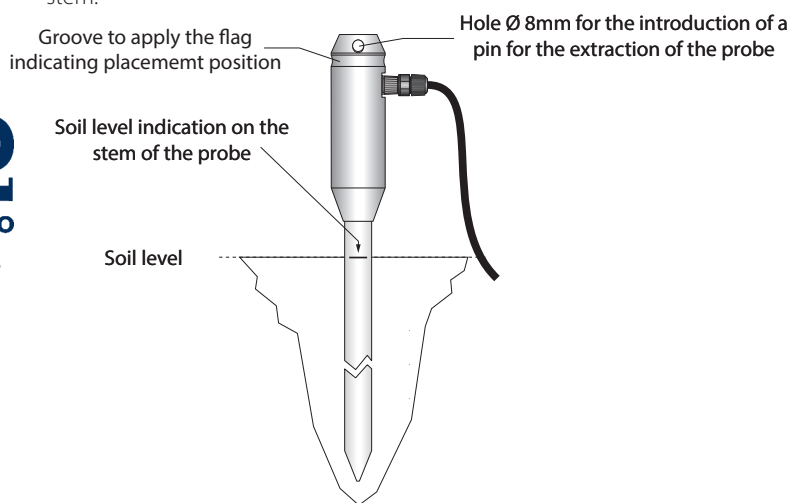


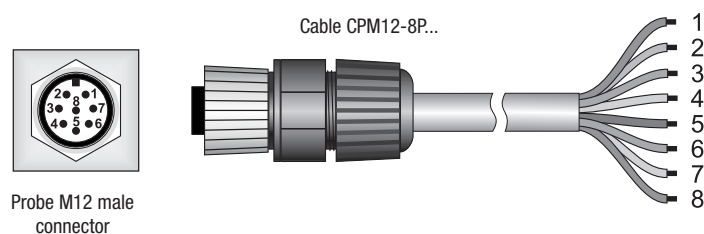
Fig. 2: installation

Indicate the presence of the probe during the maintenance operations of the soil (e.g. lawn mowing, ploughing, mechanized harvesting, etc.).

To remove the probe from the soil, insert a pin into the Ø 8mm hole at the top of the handle and pull it upwards. Remove the probe vertically, avoiding its inclination during extraction to avoid damaging the stem.

Connect the M12 connector as shown in Fig 3 and 4.

On request, 5 or 10 m standard cables with 8-pole M12 female connector are available (other lengths available on request).



Connector numbering	Function	Colour
1	Negative power supply	Black
2	Positive power supply	Red
3	Not connected	
4	RS485 A/-	Brown
5	RS485 B/+	White
6	Not connected	
7	Not connected	
8	Not connected	

Fig. 3: connections

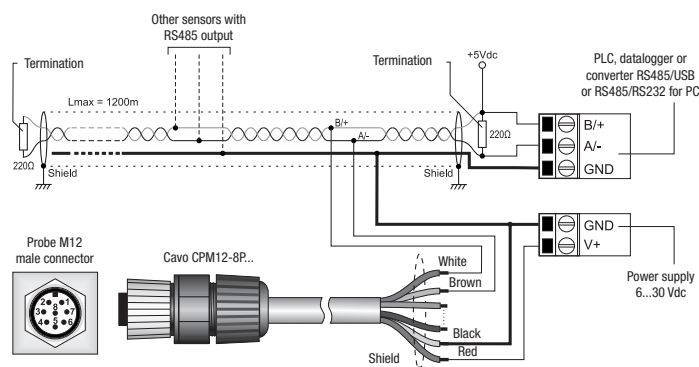


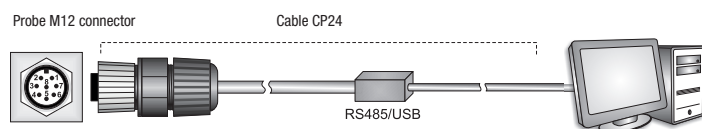
Fig. 4: RS485 connection

### SETTING OF RS485 COMMUNICATION PARAMETERS WITH A STANDARD COMMUNICATION PROGRAM

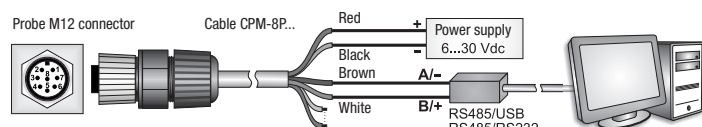
Before connecting the probe to the RS485 network you must assign an address and set the communication parameters, if different from the factory preset.

The parameter setting is performed by connecting the probe to the PC according to one of the following two ways:

- A. By using the optional cable CP24, with built-in RS485/USB converter. In this connection mode, the probe is powered by the USB port of the PC. To use the cable it is necessary to install the USB drivers in the PC.



- B. By using the supplied 8-pole M12 female connector or the optional cable CPM12-8P ... and a RS485/USB or RS485/RS232 generic converter. In this connection mode the probe should be powered separately. If RS485/USB converter is used it is necessary to install the relative USB drivers in the PC.



Notes on the installation of unsigned USB drivers: before installing unsigned USB drivers into Windows operating systems 7 and 8, it is necessary to restart the PC disabling the driver signature request. If the operating system is 64-bit, even after installation, it is necessary to disable the request of the driver signature every time the PC is restarted. Disabling is not necessary if the CP24 cable is used.



### PROCEDURE FOR SETTING THE PARAMETERS:

1. Start while the sensor is not powered (if the CP24 cable is used, disconnect one end of the cable).
2. Start a serial communication program, HyperTerminal for example. Set the Baud Rate to 57600 and set the communication parameters as follows (the instrument is connected to a COM type port): Data Bits=8, Parity=None, Stop Bits=2. In the program, set the number of the COM port to which you connect the probe.
3. Switch the sensor on (when using the CP24 cable, connect both ends).
4. Wait until the probe transmits the @ character, then send (within 10 seconds from probe power on) the command @ and press Enter. Note: if the probe does not receive the @ command within 10 seconds from power on, the RS485 MODBUS mode is automatically activated. In such a case, it is necessary to switch off and power on the probe again.
5. Send the command CAL USER ON. Note: the CAL USER ON command is disabled after an inactivity of 5 minutes.
6. Send the following serial commands to set the RS485 MODBUS parameters:

Command	Reply	Description
CMA <sub>nnn</sub>	&	Set address RS485 to nnn Ranging from 1 to 247. Preset on 1
CMB <sub>n</sub>	&	Set RS485 Baud Rate: n=0 ⇒ 9600, n=1 ⇒ 19200 Preset on 1 ⇒ 19200
CMP <sub>n</sub>	&	Set RS485 transmission mode (data bits, parity, stop bits): n=0 ⇒ 8N1, n=1 ⇒ 8N2, n=2 ⇒ 8E1 n=3 ⇒ 8E2, n=4 ⇒ 8O1, n=5 ⇒ 8O2 Preset on 2 ⇒ 8E1
CMW <sub>n</sub>	&	Set receiving mode after RS485 transmission: n=0 ⇒ Violate protocol and go in Rx mode right after Tx n=1 ⇒ Respect protocol and wait 3.5 characters after Tx Preset on 1 ⇒ Respect the protocol

7. It is possible to check the settings of the parameters by sending the following commands:

Command	Reply	Description
RMA	Address	Read RS485 address
RMB	Baud Rate (0,1)	Read RS485 Baud Rate: 0 ⇒ 9600, 1 ⇒ 19200
RMP	Tx Mode (0,1,2,3,4,5)	Read RS485 transmission mode: 0 ⇒ 8N1, 1 ⇒ 8N2, 2 ⇒ 8E1, 3 ⇒ 8E2, 4 ⇒ 8O1, 5 ⇒ 8O2
RMW	Rx Mode (0,1)	Read reception mode after RS485 transmission: 0 ⇒ Violate the protocol and go in Rx mode right after Tx 1 ⇒ Respect the protocol and wait 3.5 characters after Tx

Note: the command CAL USER ON is not required for reading the settings.

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## OPERATING MODE

The probe enters RS485 MODBUS-RTU mode after 10 seconds from power on. During the first 10 seconds from power on, the probe does not respond to any request from the MODBUS master unit. After 10 seconds, it is possible to send MODBUS requests to the probe.

## READING THE MEASUREMENTS

In MODBUS mode, it is possible to read, through the function code 04h (Read Input Registers), the measured values and the status of the probe. The following table lists the available MODBUS Input Registers:

### MODBUS INPUT REGISTERS

Register Number	Register Address	Datum	Format
1	0	Temperature in °C at -1 m from the soil [x100] Note: the value has no meaning for the probe TP32MTT.03.1	16-bit integer
2	1	Temperature in °C at -50 cm from the soil [x100]	16-bit integer
3	2	Temperature in °C at -20 cm from the soil [x100]	16-bit integer
4	3	Temperature in °C at -10 cm from the soil [x100]	16-bit integer
5	4	Temperature in °C at -5 cm from the soil [x100]	16-bit integer
6	5	Temperature in °C at the soil level [x100]	16-bit integer
7	6	Temperature in °C at +5 cm from the soil [x100]	16-bit Integer
8	7	Temperature in °F at -1 m from the soil [x100] Note: the value has no meaning for the probe TP32MTT.03.1	16-bit Integer
9	8	Temperature in °F at -50 cm from the soil [x100]	16-bit Integer
10	9	Temperature in °F at -20 cm from the soil [x100]	16-bit Integer
11	10	Temperature in °F at -10 cm from the soil [x100]	16-bit Integer
12	11	Temperature in °F at -5 cm from the soil [x100]	16-bit Integer
13	12	Temperature in °F at the soil level [x100]	16-bit Integer
14	13	Temperature in °F at +5 cm from the soil [x100]	16-bit Integer

Note: in case of measurement error -9999 is returned.

## READING THE ERROR CONDITIONS

The function code 03h (Read Holding Registers) allows to read the r16-bit register number 3 (address 2) containing information on any error status of the probe.

The bits of the register indicate the error condition according to the following correspondence:

Bit	Description
0...8	Functional error with the circuit board or error in the calibration data.
9	Sensor measurement error at -1 m
10	Sensor measurement error at -50 cm
11	Sensor measurement error at -20 cm
12	Sensor measurement error at -10 cm
13	Sensor measurement error at -5 cm
14	Sensor measurement error at 0 cm
15	Sensor measurement error at +5 cm

The register is cleared after reading. If the error condition persists, then the error code is restored.

## ORDERING CODES

**TP32MTT.03:** Temperature probe equipped with seven Pt100 1/3 DIN sensors for the measurement of temperature at depth: +5 cm, 0, -5 cm, -10 cm, -20 cm, -50 cm, -1 m with respect to the ground level, according to the indications of the WMO. RS485 digital output with MODBUS-RTU protocol. 8-pole M12 male connector. Power supply 6...30 Vdc. The CPM12-8P... cable must be ordered separately.

**TP32MTT.03.1:** Temperature probe equipped with six Pt100 1/3 DIN sensors for the measurement of temperature at depth: +5 cm, 0, -5 cm, -10 cm, -20 cm, -50 cm with respect to the ground level, according to the indications of the WMO. RS485 digital output with MODBUS-RTU protocol. 8-pole M12 male connector. Power supply 6...30 Vdc. The CPM12-8P... cable must be ordered separately.

**CP24:** PC connecting cable for the configuration of the MODBUS parameters. With built-in RS485/USB converter. 8-pole M12 connector on probe side and USB A-type connector on the PC side.

**CPM12-8P.2:** 8-pole cable. Length 2 m. 8-pole M12 connector at one side, open wires on the other side.

**CPM12-8P.5:** 8-pole cable. Length 5 m. 8-pole M12 connector at one side, open wires on the other side.

**CPM12-8P.10:** 8-pole cable. Length 10 m. 8-poles M12 connector at one side, open wires on the other side.

**TP32MTT.03A:** Accessory to perform the hole in the soil to insert the probe.

**TP32MTT.03B:** Accessory for signaling the presence of the probe.

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