TKE

TECHNISCHER KUNDENDIENST & ENTWICKLUNG

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TMM-1 Trace Moisture Meter

Operator's Manual

0 Abstract

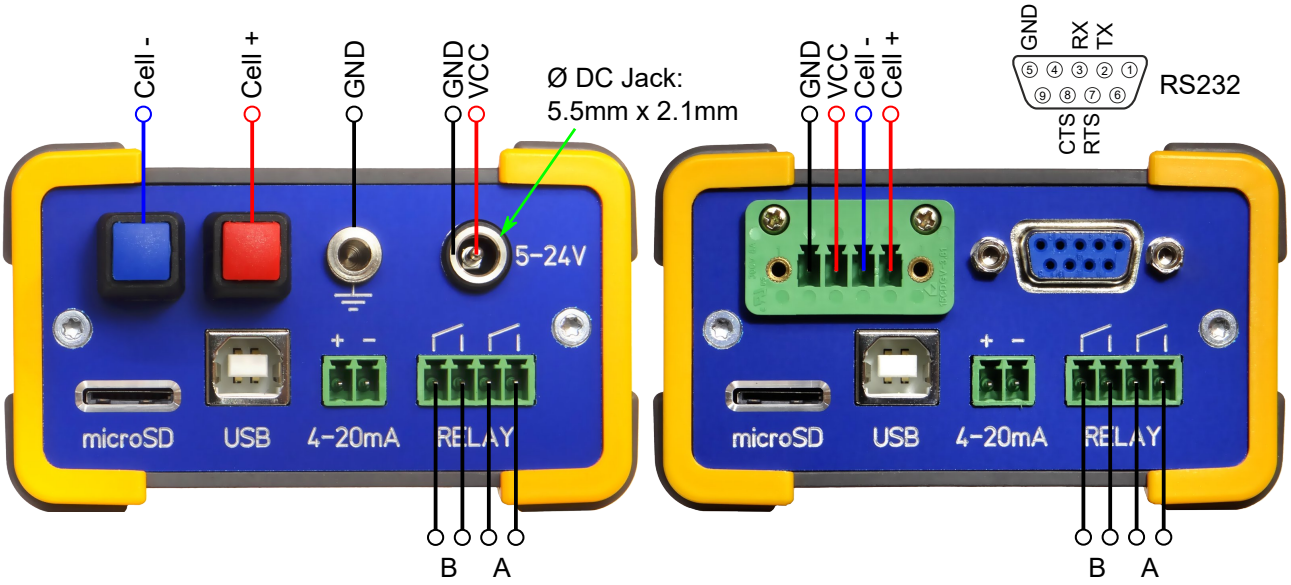
The most basic features of the TMM-1 can be used without computer: Measure the humidity, determine amounts of water and capture measured data. The needed steps are explained in this handbook.

All advanced capabilities and configuration possibilities are unlocked with the Q-Moisture software. Its usage is described in the **Q-Moisture** handbook.

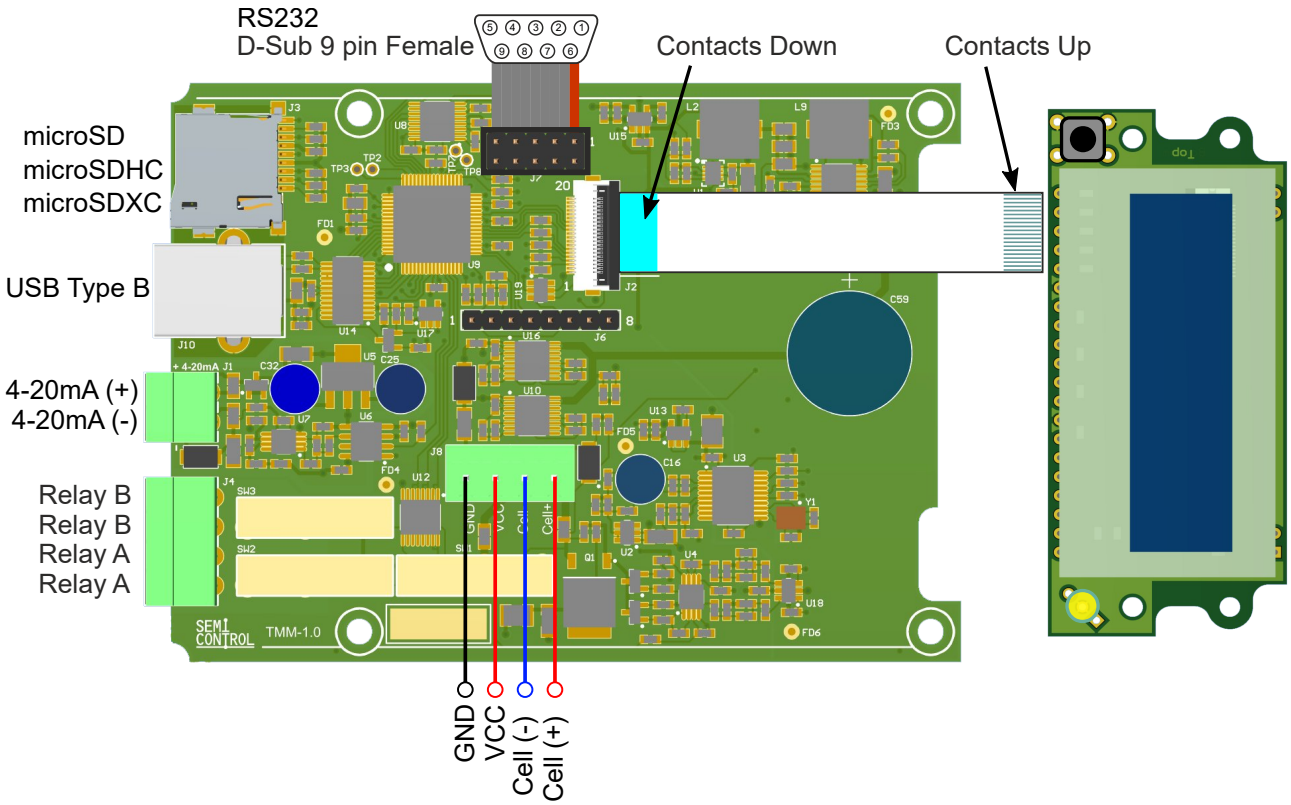
Programmers and system integrators who wish to develop their own operating software or integrate the device in their own software environment, will find the needed interface descriptions in the documents **TMM-1 Command Line Getting Started** and **Trace Moisture Meter USB API**.

1 Connectors

Laboratory Panel (LAB) / Industry Panel (IND)



Printed Circuit Boards without case



1.1 Power Supply

The device can be powered at the same time (redundant) from USB and the DC power jack. It is protected against false polarity and current limited to 750 mA.

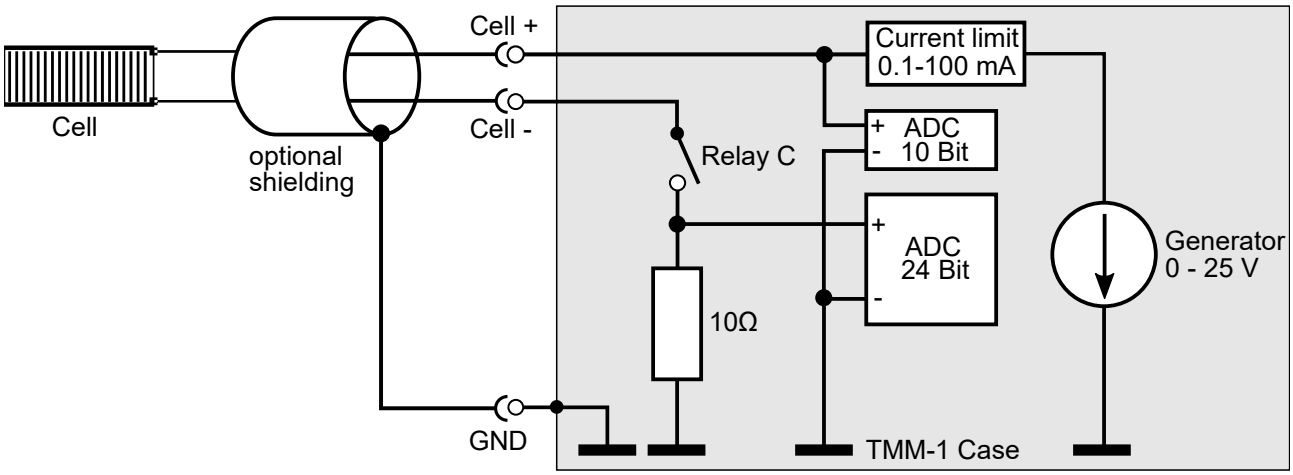
- Voltage: 5 ... 24 V ±10%
- Power consumption: max. 3,3 W
- Power loss support time at 24V: 200 ms (worst case), 750 ms (dry cell, display illumination and relays off)
- Recommended power supply: 24V, min. 6W, DC jack inner diameter 2.1 mm, outer diameter 5.5 mm.

1.2 Cell Terminals

The electrolytic cell is connected here. The polarity is not of importance but the cell may temporarily show an elevated or reduced sensitivity when the polarity is reversed during operation.

There is no limit in cable length. However, coupling of noise should be avoided. If the cell cable needs to be routed together with noisy lines, the use of a shielded cable is recommended. Connect the shielding to GND at the TMM-1 case and leave it open at the cell.

In any case, the minus terminal must never be connected to GND.



1.3 USB Interface

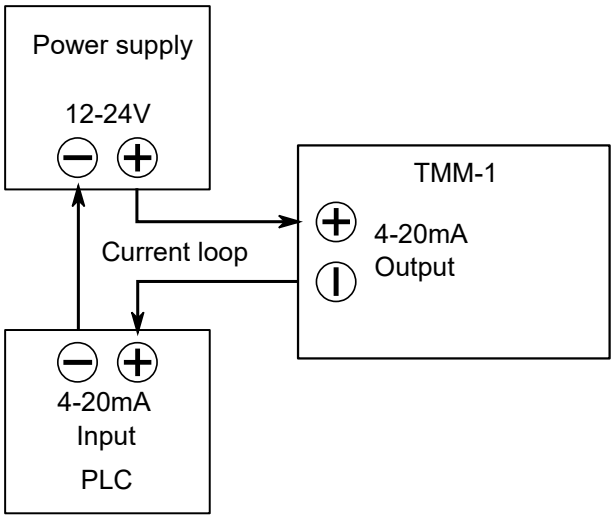
The TMM-1 is equipped with a Full Speed USB interface (USB 2.0 at 12 Mbit/s) as its central data I/O port. It appears at the PC as an FTDI serial interface device, the manual installation of a driver is not needed. All recognized TMM-1's will be listet in the **Q-Moisture** software, then you can connect to one of them to remote control it.

In case the TMM-1 is solely powered via USB, it is recommended to use a USB cable of good quality (thick) and not longer than 3 meters to keep the voltage drop low. If the device is operated behind a USB hub, it must provide its own power supply (powered hub).

It is also possible to operate the device from a USB charger or a USB power bank. These sources must comply with the USB DCP standard (Dedicated Charging Port).

1.4 Analogue Output

The moisture reading and a row of further signals can be put out at the 4-20 mA current loop output. The outlet is fully isolated, therefore it can be placed anywhere within the current loop. In any case an external supply is needed. This can be the supply that is used to power the TMM-1, but a separate supply is possible as well.



With the Q-Moisture Software you can select a signal source and define the signal scaling between 4 and 20 mA.

Properties of the analogue interface:

- Minimal voltage drop: 6 V, maximal allowed voltage drop: 26 V
- Quiescent current with TMM-1 powered off: 3,0 mA
- DAC resolution: 13 Bit, sample rate: 1 kHz
- Factory setting: 4 ... 20 mA ≙ 0 ... 100 ppmV @ 100ml / min

1.5 Relay Outputs

There are two independent relays A and B. Both are single-pole single-throw (SPST) contacts. With the Q-Moisture Software you can choose a signal source and a switching threshold.

Power rating of the relay contacts:

- max. 250 V AC or 30 V DC.
- max. 3 A (5 A at reduced lifetime)

1.6 RS232 Interface

The RS232 pin header can be wired to a 9 pin D-Sub connector using a ribbon cable. The TMM-1 with industrial case has this connector already built in. The connection to the PC goes over a 1:1 serial cable. The interface has a fixed configuration of:

Baud rate: 115200 bit/s, Protocol: 8 Data bits, 1 Stop bit, no parity (8N1).

The following line of text will appear on the RS232 output regularly in the set sampling interval time, if it has been activated through the Q-Moisture software:

```
[Timecode] [Voltage] [Value] [Integral][CR][LF]
```

- **Timecode** is the sampling time, counted in ms since the beginning of the reporting. The timecode will roll over at 2^{32} ms (1193 hours).
- **Voltage** is the cell voltage in V.
- **Value** is the cell current multiplied with the conversion factor for the moisture measurement. The conversion factor can be changed with Q-Moisture software and is preset to 76.1035 ppmV@100ml/min per mA.
- **Integral** is the counted electrical charge multiplied with the integral factor. The factor is preset to 0.09383 µg water per mAs. It can be changed with the Q-Moisture software.
- Each line is terminated with Carriage Return and Line Feed.

Example:

```
100000 24.975  2.0016692E+01 0.000000E+00[CR][LF]
```

This sample has been taken 100 secs after the beginning of the reporting, the cell voltage was 24.975 V, the moisture measurement was 20.016 ppmV @ 100 ml/min. The integral value is stuck at zero because the integration has not been started yet.

Further functionalities of the RS232 port (e.g. readout of additional sensors, communication with a PLC, controlling valves etc.) can be implemented as customer specific development.

1.7 Display Connector

If the TMM-1 is delivered without case (PCBs only) the optional display is connected here. The connection is made with a 20 pole FFC foil cable with 0.5 mm pitch. The maximal cable length is 15 - 20 cm.

A display is not necessary for the operation of the TMM-1. All functions can be carried out through the USB port.

1.8 microSD Card

Insert a microSD memory card here for the recording of measurements. SD, SDHC and SDXC cards are supported. They must be formatted with FAT16 or FAT32.

microSD, microSDHC: These cards are factory formatted with FAT16 or FAT32, so they can be used off the shelf. This type of cards is recommended for the TMM-1.

microSDXC: Cards with a capacity of **more** than 32 GB are sold under the SDXC label, they are preformatted in the exFAT format. These cards can be used as well, but they have to be formatted to FAT32 first. This is easily done with the Q-Moisture software. Windows

does not offer formatting this type of cards into FAT32, so you need to use a specialized formatting tool like the *AOMEI Partition Assistant* or other.

Should the card already be formatted in a non-FAT format (e.g. NTFS) from a previous application, it is not possible to re-format it to FAT32 with the TMM-1. In this case it must be formatted in a computer.

2 Local Operation

The most basic features can be utilized directly at the device, a connection to a computer is not needed.

On the front side of the device there is a pushbutton with which you can switch between four display pages, and a signal LED.

2.1 Signal LED

The red / green signal LED indicates the following operational states:

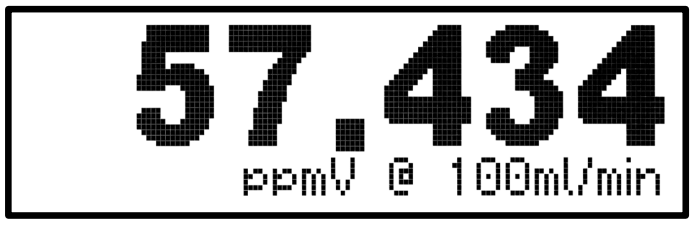
dark	There is no voltage on the cell, relay C is open. The relay C can be toggled with the Q-Moisture software or by a long press on the pushbutton.
green	The cell voltage is switched on (relay C is closed). The cell receives the nominal voltage. This is the normal operational state.
red	The cell voltage does not reach the nominal voltage because the current is limited. Possible reasons are: • The cell is wet and has a low inner resistance. • The cell or wiring may be short circuited. • The current limit is set too low. It can be changed with the Q-Moisture software, the factory setting is 30 mA. • The power limit is reached. The maximal output power is 1 Watt, it can be further reduced in Q-Moisture.

2.2 Pushbutton

A short press on the pushbutton steps through the display pages.

A long press (longer than 2 secs) triggers a function, depending on which display page is currently shown, as described in the following.

2.2.1 Display Page 1: Current Gauge



The current gauge is based on the measured electrical current through the cell multiplied with the conversion factor. The line under the value shows the according unit. Factor and unit text can be changed in Q-Moisture. The factory setting is ppmV @ 100ml / min.

A long press on the pushbutton toggles the relay C and thus turns the cell voltage on and off.

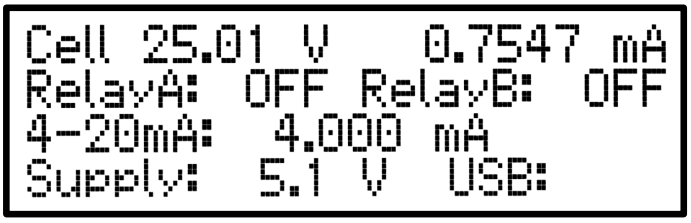
2.2.2 Display Page 2: Integral Gauge

The integral gauge is based on the counted electrical charge that has flown through the cell. The TMM-1 determines the charge in mAs by continuous integration of the current. The charge value is multiplied with a conversion factor and displayed together with the according unit. Factor and unit text can be changed with the Q-Moisture software. The factory setting is µg water.

A long press on the pushbutton resets the charge counter to zero and starts the integration.

Another long press stops the integration. The last value remains on the display.

2.2.3 Display Page 3: Operational States

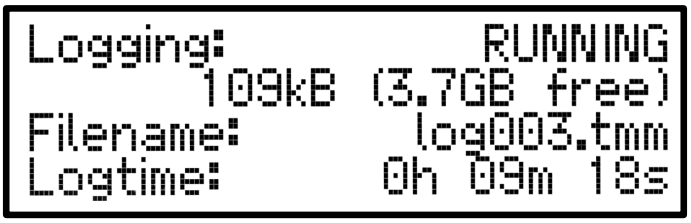


This display page provides an overview of the most important values:

- Line 1 shows the actual cell voltage in V and the cell current in mA. The voltage may read a bit lower than the given nominal voltage because of voltage drop at the internal 10 Ohm shunt resistor that is used for current measurement.
- Line 2 shows the switching states of the relays A and B.
- Line 3 shows the current at the 4-20mA current loop outlet.
- Line 4 shows the supply voltage of the device. In case the device is operated from USB and the DC jack at the same time (redundant), the higher of both voltages will appear here. Furthermore the USB data connection state is displayed.

A long press on the pushbutton toggles the display backlight.

2.2.4 Display Page 4: Data Logger



This page handles the data recording onto microSD card.

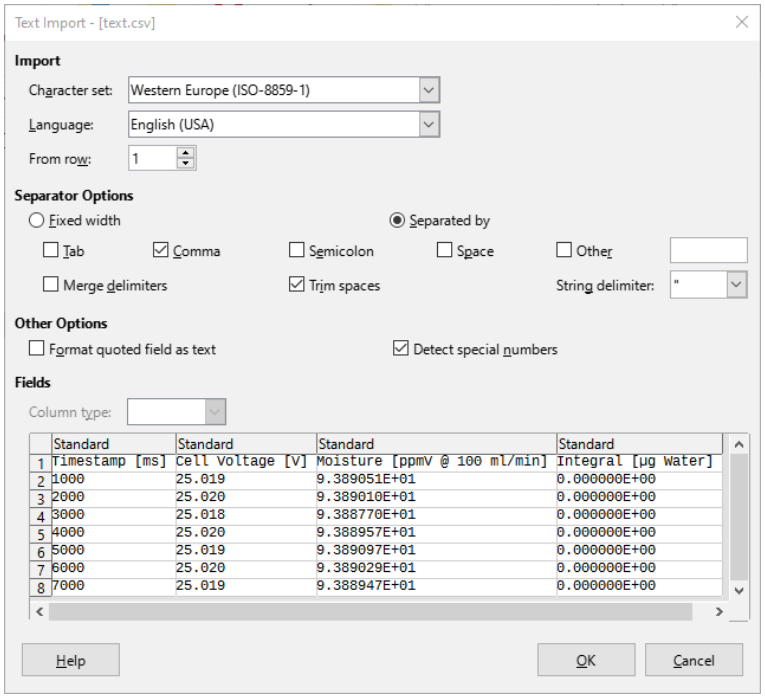
- Line 1 indicates the activity of the data logger.
- Line 2 informs about the momentary size of the log file and the free space on the memory card.
- Line 3 shows the name of the current log file.
- Line 4 shows the elapsed time since the start of the logging.

A long press on the pushbutton starts a recording. A new logfile with an increasing number suffix will be created. The file name can be changed with the Q-Moisture software.

If the filename ends with .csv, a CSV formatted file will be created which you can easily import to a spreadsheet program (e.g. LibreOffice Calc) for analysis. All other filenames will result in a space saving binary file, which can only be opened with the Q-Moisture software.

Another long press on the pushbutton ends the recording.

Notice: Always end the recording before taking out the microSD card, otherwise data corruption may occur.



When importing the CSV log file make sure to set the language to English, so that numbers will be recognized correctly.

3 Technical Specifications

Dimensions	52 mm x 90 mm x 113 mm
Weight (with case)	300 g
Power supply voltage	5 ... 24 V ± 10%
Max. power demand	3.3 Watt
Hold up time at 24V	200 ms (worst case), 750 ms (open load)
Generator voltage	0 ... 25 V
Accuracy of the generator voltage	0.1% ± 10 mV
Current limiter	0.1 ... 100 mA
Accuracy of the current limiter	±0.2 mA
Maximal output power	1 Watt
Measuring accuracy of the cell voltage	10 Bit ± 1 LSB
Sampling interval	1000 s ... 100 Hz
Resolution of the cell current ADC	24 Bit, 1 kHz
Accuracy of the cell current	±(0.1% + 100 nA)
Current measuring resistor	10 Ohm, 0.1%
Resolution 4-20mA output	13 Bit
Rise time 4-20mA output	100 ms (10-90%)
Voltage drop range 4-20mA output	min. 6 V, max. 26V
Quiescent current 4-20mA output	3.0 mA while device is powered off
Relay contacts	250 V AC or 30 V DC, max. 3 A
Measurement accuracy of supply voltage	10 Bit ± 1 LSB
Display resolution	6 digit floating point
USB interface	FTDI serial port, Full Speed USB, 12 MBit/s
RS232 interface	±10 V, 115.2 kBit/s, 8N1
microSD card	SPI Mode, 24 MHz
Display	32 x 132 Pixel LCD, white backlight
MCU	32 Bit MIPS, 48 MHz, 32 kB RAM

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