TKE

T E C H N I S C H E R K U N D E N D I E N S T & E N T W I C K L U N G
N O R B E R T G E R H A R D T

TMM-1 Command Line Operation

Getting Started

0 Abstract

The TMM-1 appears at the PC as a serial interface device. With a simple terminal program the user can manually type commands and request data. The following instructions walk the user through the most important operations possible in this way.

The complete programming interface is described in the *Trace Moisture Meter USB API* document.

With the *Q-Moisture* software you can easily control everything from a graphical surface. For everyday work in the lab or industry you don't need to be aware of the following.

1 Connecting to the PC

Hook the TMM-1 to the PC via a USB cable. In case of Windows 10 the needed drivers will be installed automatically. This takes place silently without notification if the PC is connected to the internet.

Windows creates a new virtual COM port for the device. You can check that in the device manager: Under **Connections (COM & LPT)** there is a **USB Serial Port (COMx)**. Keep the COM number in mind.

Start a terminal program and open the new COM port with it. Communication settings like baud rate, protocol etc. don't need to be altered as these are ignored by the driver anyway. The data rate is always the maximum of Full Speed USB, which is about 1 MByte/s.

In the following examples HTerm is used as terminal program. It can be downloaded here: http://der-hammer.info/pages/terminal.html

2 Open the Terminal

Start hterm.exe. Click on the little **R** button. Then choose in the list of COM ports the one of your device. Click on Connect. If the connection was established successfully, **Connected to COMx** appears in the lower status bar.

Before you can send commands to the TMM-1 and read answers, the following settings in HTerm are necessary:

- **Newline at**: CR must be selected here.

- **Send on Enter**: CR must be selected here as well

- **Show newline characters:** Remove the checkmark.

All other settings can remain at their default values. It is recommended to save the configuration to a file with **File → Save Config**.
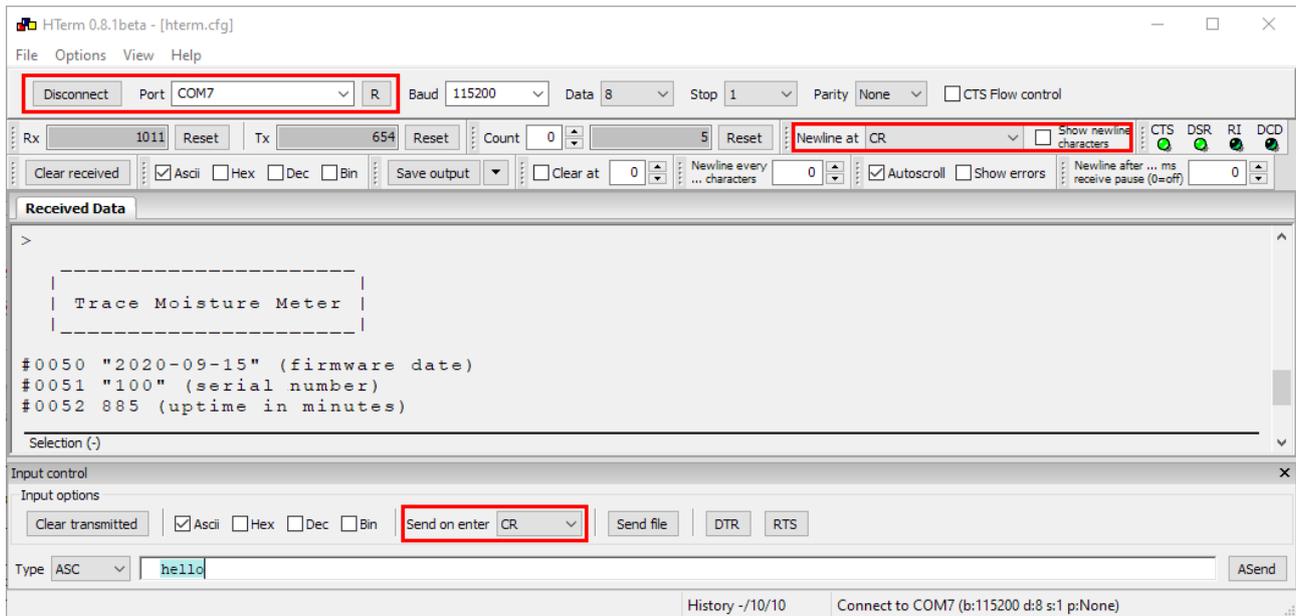
3 Communicating with the TMM-1

Click in the command line in the **Input Control** window and press Enter. A prompt **>** will appear in the **Received Data** window. The TMM-1 is now ready to receive commands. Each command will be executed after pressing Enter.

Type the command `hello`. The device returns a title block and some numbers.

Now type the command `verbose 1`. This switches on the explanatory texts behind messages from the device. If you now try again to send `hello`, the numbers explain themselves.

The command `help` returns a list of all available commands.

4 The Most Important Settings

4.1 Voltage

The generator voltage is set with `setu [Volt]`. You can request the actual setting with `setu ?` Examples:

`setu 12.5`	Sets the voltage to 12.5V. The allowed range is 0 ... 25 V.
`setu ?`	Request of the set value. The TMM-1 returns a message with the generator set voltage.

The true voltage at the electrolytic cell will be a little lower than the generator voltage depending on the current draw, because the internal 10 Ohm resistor drops some voltage. Whenever the current or power limit is reached, the cell voltage will also be reduced.

4.2 Current

The current limiter is programmed with the command `seti [mA]`. The actual setting can be retrieved with `seti ?` Examples:

`seti 3.45`	Sets the current limit to 3.45 mA. The allowed range is 0.1 ... 100 mA.
`seti ?`	Request of the actual value. The TMM-1 returns a message with the set current limit.

4.3 Sampling Interval

You can set the sampling interval time with `sett [ms]`. The actual setting can be requested with `sett ?`. The sampling interval applies to the reporting of data through USB and RS232 as well as to writing on the microSD card. The 4-20 mA analog output works independent from this setting and always runs at 1 kHz sample rate. Examples:

3

sett 100	A new message with measurement data is issued each 100 ms. Only integer numbers in the range of 10 - 1000000 (corresponding to 100 Hz up to 1000 secs) are allowed.
sett ?	Returns the actual interval time setting.

4.4 Data Reporting

The command report 1 activates the reporting of measurement data over USB. Once per interval time the following message is repeated:

```
#2001 [Timecode] [Voltage] [Value] [Integral][CR]
```

- #2001 is the unique identifier of this message.

- Timecode is the sampling time in ms counted from 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 modified with the convunit command and is preset to 76.1035 ppmV @ 100 ml/min per mA.

- Integral is the integrated current (charge) multiplied with the integral factor. The factor is preset to 0.09383 µg water per mAs. It can be modified with the intunit command.

- Each message is terminated by Carriage Return.

Example:

```
#2001     15000 24.974  8.671310E+00  1.869670E-02
#2001     16000 24.974  8.671182E+00  3.052246E-02
#2001     17000 24.974  8.670918E+00  4.234787E-02
#2001     18000 24.974  8.671756E+00  5.417441E-02
```

A new sample is taken each 1000ms, the voltage is stable at 27.974 V, the moisture value moves around 8.67 ppmV, the integral amount of water is constantly ramping up.

The command report 2 starts the reporting via RS232. The same data will be issued there as on USB. With report 3 the messages appear on RS232 and USB simultaneously. The command report 0 ends the reporting.

A one-time request of the same values is possible with the command getval 7. When using long sampling intervals, you can get a value between two regular samples this way.

4.5 Conversion Factor

The moisture value is calculated from the measured cell current in mA by multiplication with the conversion factor. It is preset to 76.1035 ppmV @ 100 ml/min per mA. This factor

is valid at a gas flow rate of 100 ml nitrogen per minute under normal pressure and room temperature and results in a value given in parts per million of the volume. If you require a different factor for other conditions or other result units you can enter it with the command `convunit [Factor] "[Unit]"`. Examples:

```
convunit 1 "mA"
```

Sets the factor to unity, so the resulting display is directly the current in mA. The text "mA" is shown on the display.

```
convunit 76.1035 "ppmV @ 100ml/min"
```

Sets the display to the factory default value.

```
convunit 0.018656 "mmol / h"
```

Sets the display to millimol per hour.

```
convunit 20.14848 "mg / min"
```

Sets the display to milligram per minute.

4.6 Integral Factor

The integral factor converts the measured electrical charge from mAs into the display value. You can modify it with the command `intunit [Factor] "[Unit]"`. Examples:

```
intunit 1 "mAs"
```

Directly shows the charge in mAs on the display.

```
intunit 0.09383 "~g Water"
```

Sets the display to the factory default. The tilde character ~ is printed as micro µ on the display.

4.7 Analog Output

With the command `current [Signalnumber] [4mA-value] [20mA-value]` you can configure the analog output. The Signal number selects one of the following signals:

0   Fixed current value
1   Cell voltage in V
2   Cell current in mA
3   Power dissipation of the cell in W
4   Internal resistance of the cell in Ohm
5   Moisture value according to the conversion factor
6   Integral value according to the integral factor

The parameters 4mA-value and 20mA-value define the boundaries of the signal range that will be represented by the current between 4 and 20 mA. Examples:

`current 0 5`   Sets the analog output to a fixed value of 5 mA.

`current 2 1 100`	The output range from 4 up to 20 mA corresponds to a cell current of 1 up to 100 mA.
`current 5 0 1000`	The output range from 4 up to 20 mA corresponds to a moisture value of 0 up to 1000 ppmV.

4.8 Relays

There are two independent relays A and B. Both are single-pole single-throw (SPST) contacts. Their behavior is configured with the commands `relaya` and `relayb` using the following syntax:

`relaya [Signalnumber] [Threshold]`

The signal number selects one of the following signals:

0	Relay is always off
1	Relay is always on
2	Relay has the same state as the other relay
3	Relay has the opposite state as the other relay
4	Relay is on when the cell voltage is above the threshold
5	Relay is on when the cell voltage is below the threshold
6	Relay is on when the cell current is above the threshold
7	Relay is on when the cell current is below the threshold
8	Relay is on when the cell power dissipation is above the threshold
9	Relay is on when the cell power dissipation is below the threshold
10	Relay is on when the cell resistance is above the threshold
11	Relay is on when the cell resistance is below the threshold
12	Relay is on when the moisture value is above the threshold
13	Relay is on when the moisture value is below the threshold
14	Relay is on when the integral value is above the threshold
15	Relay is on when the integral value is below the threshold

Examples:

`relaya 0`	Relay A is constantly switched off.
`relaya 7 10`	Relay A switches off when the cell current goes above 10 mA.
`relayb 12 50`	Relay B switches on as soon as the moisture value exceeds 50 ppmV.
`relaya 3`	Relay A switches on when relay B goes off.

The command `relayc 0` isolates the negative cell terminal. In this way the offset calibration can be checked, the value must read 0 then.

4.9 Save Settings

To save the momentary operational state send the command `save` . On the next powerup the TMM-1 will remember the saved state and continue to work as before. This is also true for the reporting of data. When `save` is carried out during an active reporting (command `report`), then the reporting will continue after a power interruption.

4.10 Data Logger

You can start a new log file with the command `logging 1 "[filename]"` .

Logging in CSV format: If the filename ends with .csv a text file in the CSV format (comma separated values) will be created. This type of file can easily be imported in a spreadsheet program for analysis. The recorded data includes a timestamp in ms, the cell voltage, the cell current and the integral value (charge count). The values are already converted with the conversion factors.

Logging in TMM-1 binary format: If the filename does not end with .csv a binary file will be created. This type of file can only be opened with the Q-Moisture software. Q-Moisture is capable of exporting the data to other formats including CSV. The binary file takes less space on the memory card and in addition to the measurement values it also registers relay switching events and user interactions, e.g. changes of the generator voltage.

```
logging 1 "Experiment 2020-1-25 blabla.csv"

logging 1 "mylogfile.tmm"

logging 1 "test123"
```

The first example results in a CSV file, the others in a binary file.

To end the logging send the command `logging 0` .

With `logging ?` you will be informed about the logger activity and the filename and it's accumulated size.

4.11 microSD Card Administration

These commands help you tidy up the memory card:

`getlog ?`	Lists all files and directories in the root directory of the microSD card.
`delete "[filename]"`	Deletes the specified file.
`format`	Formats the microSD card with FAT32. All files will be erased!

Document date: 09.02.2021