OPERATING INSTRUCTIONS

11.41.11 e+ SOIL MCT

Contents

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On these operating instructions

☞ **If the text follows a mark (as shown on the left), this means that an important instruction follows.**

⚠ **If the text follows a mark (as shown on the left), this means that an important warning follows relating to danger to the user or damage to the apparatus.**

Text **Italic indicated text indicates that the text concerned appears in writing on the display(or must be typed).**

Introduction

The e+ SOIL MCT® is an integrated electronic instrument for measuring, recording and monitoring soil moisture levels, conductivity and temperature.

The user instructions describe the start up, use, applications and installation of the e+ SOIL MCT. Attention is also given to a possible calibration procedure before installation.

1. Description

1.1 Package contents

- ❒ e+ SOIL MCT (in various lengths: 11.41.11.01, 11.41.14.01, 11.41.15.01, 11.41.16.01, 11.41.17.01) comprises a data logger with integrated sensors, measuring electrodes, LDM-software (11.11.14) and a battery set e+ logger (11.41.90.01)
- ❒ Available separately:
  - Measuring electrodes e+ SOIL MCT (11.41.11.02)
  - IrDa readout unit (11.31.90), for remotely connecting to a (laptop) computer
  - Readout unit (11.11.10), for connecting to a (laptop) computer
  - Readout cable DRC, for connecting to a (laptop) computer using a communication cable for DRC (11.11.45). Available in the following lengths:
    5 m (11.11.38)
    10 m (11.11.39)
    15 m (11.11.40)
    30 m (11.11.41)
    60 m (11.11.42)
    80 m (11.11.43)
    100 m (11.11.44)
  - Cable e+ sensor e-SENSE® for connecting to the SMS modem e SENSE (field modem) in the following lengths:
    1 m (11.31.78)
    5 m (11.31.70)
    10 m (11.31.71)
    15 m (11.31.72)
    30 m (11.31.73)
    60 m (11.31.74)
    80 m (11.31.75)
    100 m (11.31.76)
    200 m (11.31.77)

1.2 General

The e+ SOIL MCT can be used to measure and record soil volumetric moisture levels, electrical conductivity and temperature.
The e+ SOIL MCT is constructed in a stainless steel housing, which is fitted with two unscrewable conical electrodes and a fixed temperature sensor.
Measurements are repeatedly taken at a fixed, adjustable interval. Measurement values are saved together with the measuring time in the electronic memory.
Changing the settings or reading out the saved measurement values can be effected via the optical IR connector or the IrDa link.

2. Technical data

General:

Length	:	Type dependent (from 220 mm to 1125 mm excl. electrodes)
Working length	:	Type dependent (10, 25, 50, 75 and 100 cm)
Diameter	:	22 mm
Measuring electrodes	:	2 electrodes. Dimensions: 68 x 3 mm. Distance between them: 15 mm
Weight	:	Type dependent (± 300 g to 1163 g)
Temperature working range	:	-20...80 °C
Relative humidity range	:	0...100%
Housing	:	Stainless steel 316L

e+ SOIL MCT data logger:

Storage capacity	:	3 x 20.000 measurements
Measurement interval time	:	10 ...60 sec. 1...60 minutes 1...24 hours
Data logging method	:	Fixed interval time
Clock accuracy	:	1 sec. per day
Alarm level (adjustable)	:	low and/or high alarm in the whole measuring range of all parameters
Battery status indication	:	0...100%

e+ SOIL MCT sensor:

Measuring frequency	:	20 MHz
Measuring volume (saturation)	:	≥ 1000 ml (500 ml 98% accuracy)
Soil moisture measuring range	:	0...100% volumetric
Soil moisture accuracy	:	+/- 2.5% of the measurement value (mineral soil types, 0...50 °C)
Soil moisture resolution	:	0.01%
Conductivity measuring range	:	0...5 mS/cm
Conductivity accuracy	:	+/- 5% of the measurement value (0...50 °C, 0...2 mS/cm)
Conductivity resolution	:	0.01 mS/cm
Temperature measuring range	:	0...80 °C
Temperature accuracy	:	+/- 0.5 °C
Temperature resolution	:	0.01 °C

Power:

Battery	:	3.6V (AA) lithium battery 2.3 Ah
Lifespan of battery	:	1 year (typ. for 1 hour sample speed and 0...50 °C)

Communication:

Via	:	e-SENSE SMS-modem, Optical connector (IR) Readout unit, DRC-cable (5...200m), IrDa readout unit remote (1...2 m)

3. Start up

3.1 Settings

3.1.1 General

The settings of the e+ SOIL MCT are data with which the user can influence the functioning and characterise the measurements performed.
The function settings include the measuring range, measuring interval, alarm limits and the actual clock time. The descriptions include the location, parameter names, measuring units, etc.
Any setting changes are only effected after the data logger is started. All possible measurement data present is then deleted from the memory and a new series is started using the new settings.

☞ **To save measurement data permanently these must be read-out with suitable software e.g Logger Data Manager.**

3.1.2 Functional settings

The e+ SOIL MCT is supplied with the following factory functional settings:
- ❒ measuring range moisture level: 0 to 100%
- ❒ measuring range conductivity: 0 to 5 milliSiemens per centimetre
- ❒ measuring range temperature: -20 to 80 °C
- ❒ alarms are not activated
- ❒ the clock will be running if batteries have been inserted (the clock time should be set to local time)
- ❒ the instrument is stopped and therefore makes no measurements

<u>Measuring range and scaling</u>

The e+ SOIL MCT is supplied with standard settings for mineral (sand) soils.
In practice, the soil type influences the volumetric soil moisture measurement results. Guaranteed high accuracy is therefore only achieved for measurements in soil types for which the sensor is specifically calibrated. The user can himself/herself perform a simple linear (two point) calibration which is described in section 4.2. If great accuracy is required for a soil type, the supplier can perform a soil-specific calibration for you. Contact the supplier for this.

The user may decide to adjust the temperature scale unit.
- ❒ Example:
  A measuring range (Range) of 100 degrees Celsius corresponds with a measuring range of 180 degrees Fahrenheit. The standard zero point (Reference) of -20 degree Celsius corresponds with -4 degrees Fahrenheit. To switch from Celsius to Fahrenheit, one should therefore fill in 180 for Range and –4 for Reference.

☞ **The Range and Reference of a parameter must always have the same unit.**

Alarms

The e+ SOIL MCT can give alarms for all 3 parameters.
For a description of the configuration procedure refer to chapter 4.3.

☞ **Alarm functions reach their full potential when using the instrument under e-SENSE direct or e-SENSE Internet.**

Measuring interval

The frequency at which the sensor performs and records measurements is determined by the measurement or recording interval. This time interval may be varied by between 10 seconds and 24 hours, as the user sees fit. With the e-SENSE-system, the minimum measurement interval is 1 minute.

Clock time

The logger is designed with an accurate realtime clock. The clock must, in principle, be set once-only to the right date and time after (re)inserting the battery. We recommend that you check the clock time every 3 months. This guarantees the right chronological position of the measurements.

3.1.3 Descriptive settings

Descriptive settings relate to the names of the measurement location, the names of the parameters and the units of the measurement values. They do not themselves affect the measurements, but define them for the user. They can be filled in by the user as one pleases, but the relevance is clear: it will prove useful to the user to be able to see in hindsight at what place and time the measurements were made and in what units they are expressed.

3.2 Practical

To configure or read out from the instrument, the following is required:

- ❒ Logger Data Manager software
- ❒ An optical link between instrument and (laptop) PC
  The following alternatives are available for this:
  - Readout unit (11.11.10) for office environment
  - IrDa readout unit (11.31.90) for field conditions with good access (distance to 2 metres)
  - Readout/Communication cable DRC (11.11.45 + 11.11.38) for field conditions (distance to 200 metres)
- ❒ a (laptop) PC

3.2.1 Logger Data Manager (LDM)

LDM is a software package for reading out and evaluating measurement data, which can also be used to configure the instrument. LDM is suitable for both e+ sensors and the Essen Groep Diver®.

LDM installation

The installation of LDM on your (laptop) PC is simple, but you must possess sufficient user rights for Windows NT, 2000 or XP. Contact your system manager about this if necessary.
Your (laptop) PC must have a CD-ROM drive. Place the CD in the CD-ROM drive to automatically start the setup programme. If this does not happen, start it manually by clicking on *Start -> Run*, and type in: *<X>:\setup.exe*, where *<X>* represents the drive letter of the CD-ROM drive.
For additional information regarding the installation of LDM see the manual concerned.

After installation, start LDM, click on the *Application Management* tab and make the following changes:
- ❒ *Selected port*: must be set to the port number to which the optical connector will be connected;
- ❒ *User type*: in this case *Basic* is sufficient, choose *Advanced* if a special setting is needed;
- ❒ *English / Deutsch / Nederlands*: set the preferred language as desired.

Now the LDM is ready for the configuration of the instrument.

Linking the instrument to the (laptop) PC

Connect the optical connector to the vacant communication port (RS-232, USB) of the (laptop) PC.
Connect the instrument to the optical connector. To this end, this is placed in the readout unit or screwed into a DRC-connector. When using the IrDA readout unit, it must be aimed at the LEDs on the communication side of the instrument at a distance of 2 metres at most.

Configuring with the help of LDM

For additional information relating to the use of LDM see section 4.1 and the LDM manual.

3.3 Connection

3.3.1 Use of the read-out unit

When the e+ SOIL MCT is used as a demountable unit on a place with good reach, the read-out unit can be used.

3.3.2 Use of the IrDa-interface

When the e+ SOIL MCT is permanently installed and the instrument is placed in a place with good reception, using the IrDa-interface forms a useful alternative to a permanently installed connecting cable. The IrDa interface has an optical unit by which a data logger can be read out at a distance of 1...2 metres and is equipped with a 9-polar sub-D connector for connection to a COM-port of a PC. A laptop PC is used to read out from the instrument in the field.

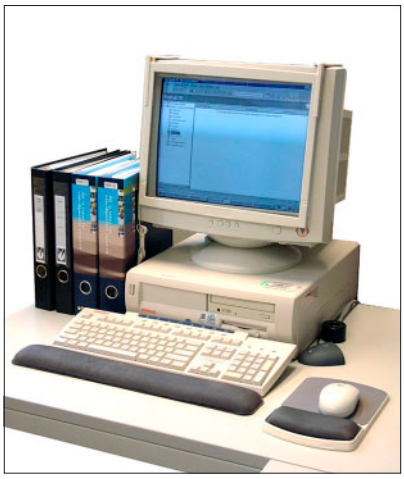
3.3.3 Use of the DRC cable

When the instrument cannot be easily placed in the close proximity of a PC because the e+ SOIL MCT is permanently installed, one can use a DRC readout cable in combination with a DRC communication cable.
DRC readout cables are available in various lengths, are fitted with a special connector for connecting to a DRC communication cable and have an optical IR connector for the instrument. The DRC communication cable has a standard length, is fitted with a connector for connecting to the readout cable and has a 9-polar sub-D connector for connecting to the COM-port of a PC.

3.3.4 Use of the e-SENSE system

In an e-SENSE measurement system, the e+ sensor is usually permanently installed and must be connected to an SMS-modem e-SENSE (field modem) using a cable e+ sensor e-SENSE. In an e-SENSE measurement system, measurement data from the e+ sensors is sent remotely through an SMS-modem to a central (Internet) database. Reading out measurement data in the field is therefore no longer necessary.
For more information regarding e-SENSE measurement systems, e-SENSE Internet or e-SENSE direct and important points regarding installation, see the user instructions for the SMS-modem e-SENSE (field modem), e-SENSE direct and e-SENSE Internet.

For more information regarding available connection cable types and lengths and the IrDa-interface, see section 1.1, "Package contents".



3.4 Installation

A suitable place for performing the soil measurements must be found before installation. The measuring location for the e+ SOIL MCT must be selected such that representative measurements are assured.

For permanent installation, the e+ SOIL MCT can be dug in. When using the IrDa-interface, a vertical hole is drilled in which the e+ SOIL MCT is placed, such that the optical connector protrudes above ground level. In both cases, one must ensure that the soil is replaced such that it has the same degree of compaction. To prevent undesirable penetration of moisture, a sealing ring is fitted during installation and before use in combination with the IrDa-interface.

☞ **To perform reliable measurements, the electrode-pens of the e+ SOIL MCT must be fully inserted in the soil.**

☞ **When placing the e+ SOIL MCT in the soil, take care to avoid damaging the electrodes on hard pieces of soil or stones. If necessary, drill a hole first and then refill to the original state.**

The e+ SOIL MCT is housed in a waterproof housing and is so designed that it can be easily buried in soil in any position. The sensor can be read out and configured when completely buried using a DRC-cable.

Horizontal placement

The sensor can be placed in various ways, e.g. horizontally in a spacious hole and re-covered with soil. In this case, the sensor pens can be stuck into the undisturbed hole wall if desired. See figure 1.

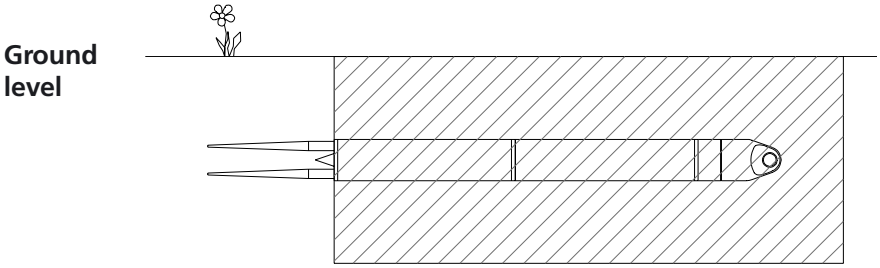


Fig. 1 e+ SOIL MCT in buried horizontal placement

If the e+ SOIL MCT is to be installed for a long time in a certain place, such that the measurement environment of the sensor may not be disturbed, then the sensor should be placed such that the battery holder part is above ground level. This means that one can replace the battery without having to remove the sensor from the measuring position.

Because the sensor is now partially above ground, the measurement depth (under ground level) must be determined. This can be done easily using the following definitions: The notional "centre of the measurement part" of the sensor is in the centre between and halfway along the length of the measuring pens. The working length of the e+ SOIL MCT is the distance calculated from the "centre of the measurement part" to 150 mm from the end of the sensor with the optical links. See figure 2.

☞ **The working length of the most types is as indicated in centimetres in the type specification. The standard type, however, has a working length of approx. 9.5 cm.**

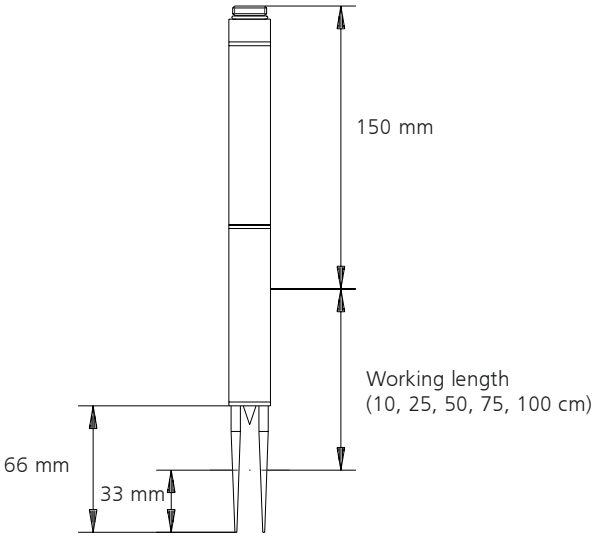


Fig. 2 Working length of e+ SOIL MCT

If soil disturbance is to be kept to a minimum, a special gouge can be used that has had its diameter adjusted according to that of the sensor. A drill hole is made that optimally accommodates the sensor so that preferential water flow through the space between the drill hole and the outer wall of the sensor is avoided as much as possible. In addition, the gouge can be used to make a drill hole of an accurate depth, see figure 3.

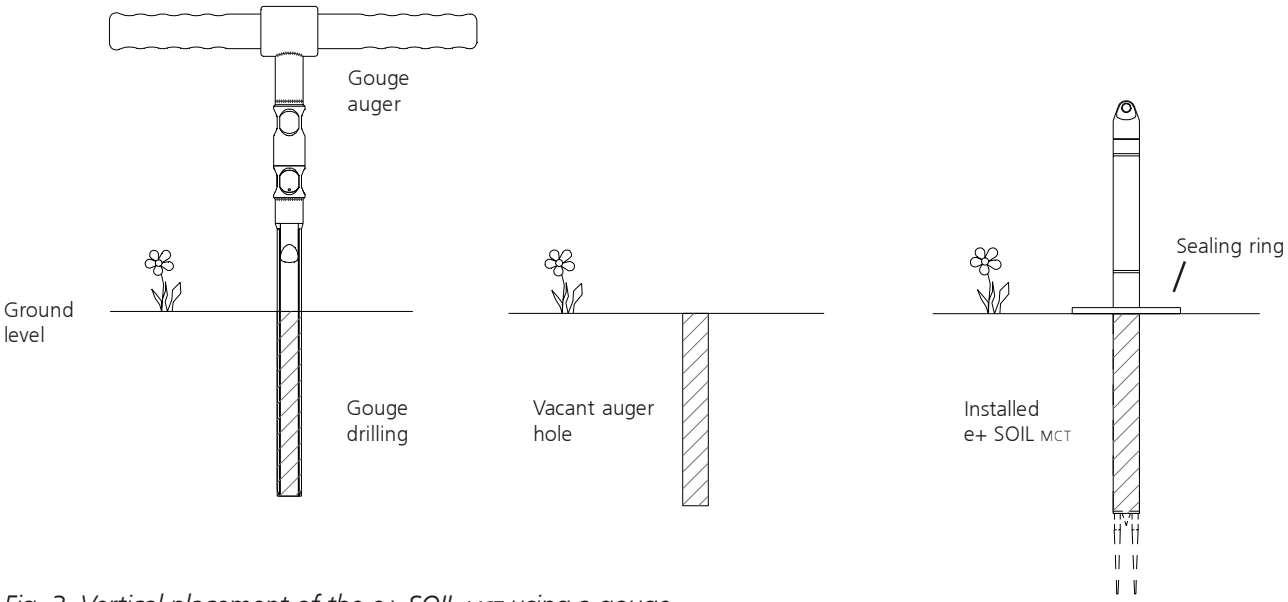
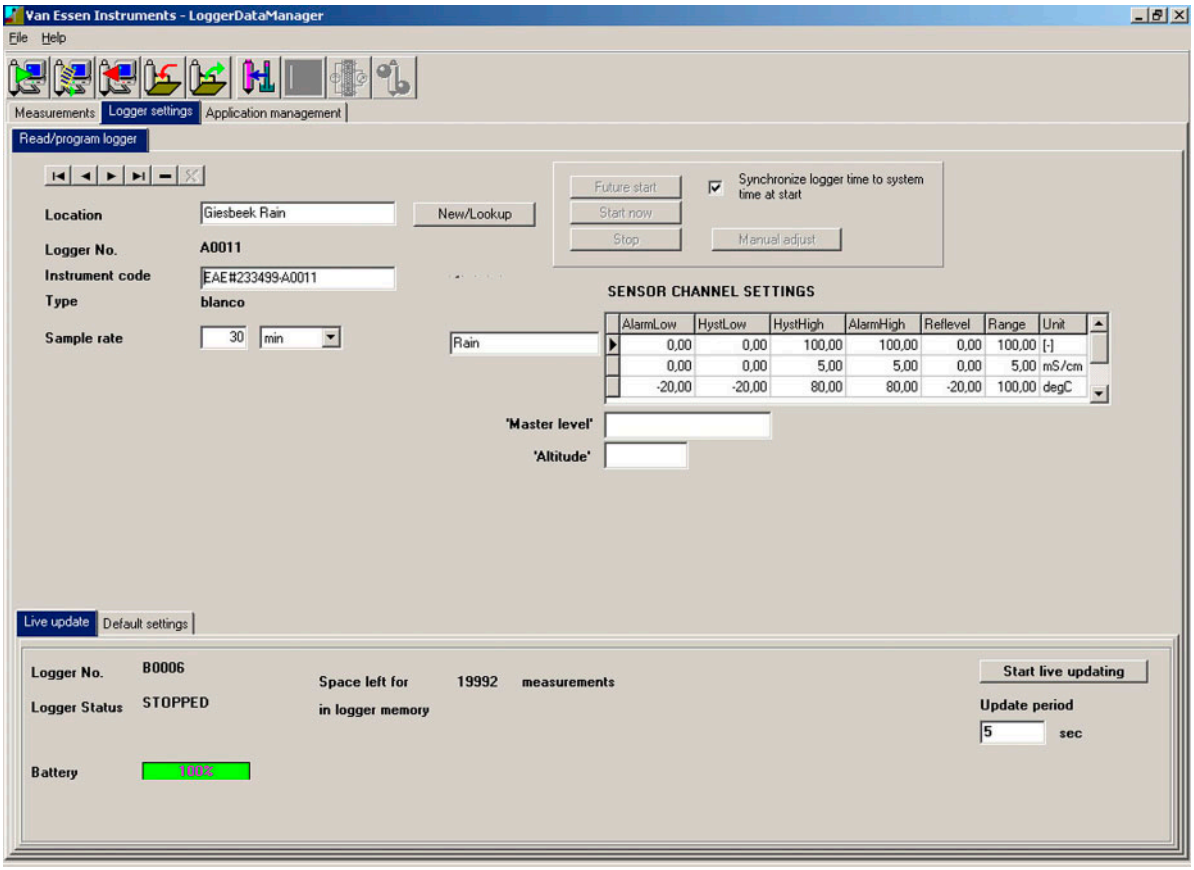


Fig. 3 Vertical placement of the e+ SOIL MCT using a gouge

For vertical placement, to prevent rain seeping in along the housing, the flexible synthetic sealing ring can be used by placing it around the sensor at ground surface.

4. Use

4.1 Logger Data Manager (LDM)



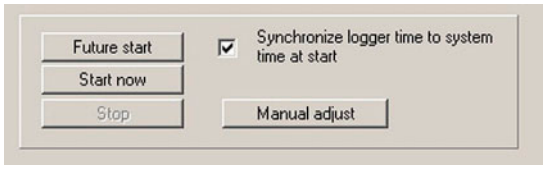
Control over the instrument is performed in LDM in the window under the *Settings* tab. [Figure LDM] Here, the four most important actions are performed, namely:

- ❒ <u>Reading out the measurement values:</u>
  The measurement data present in the memory of the instrument, is read out by pressing the button depicted on the right. The readout measurement data is saved in LDM.
  All readout and saved series measurement data are given in a list under the tab *e+ measurements -> Series*.
  If a measurement series is selected using the lists, the measurement results can be viewed and analysed in the window *e+ measurements -> Tables and graphs.* Additionally, one can also export the data in the main window using the menu *File -> Export data*.

- ❒ Readout of the settings: [figure: settings readout button]
  The configuration of the e+sensor can be read out and saved in LDM by pressing this button. This registers the e+sensor within LDM.
  The user can from this point configure the e+sensor "off-line" within LDM. The modified configuration is consequently only known within LDM.

❒ Configuring the instrument (or writing the settings):
The instrument is set (configured) using the programming button.
Pressing this button transfers the settings, as they were determined in LDM, to the instrument.

❒ Starting and stopping the instrument:
The following functions are available:



- *Start now*: The instrument is started immediately by pressing this button.
- *Start in the future*: The instrument is started by pressing this button at the time and date indicated in the *Standard settings* window.
- *Synchronise logger time with system time at start*:
  If this box is checked, the RTC clock of the instrument is synchronised with the system clock of the PC at the start.
- *Stop*: The instrument is immediately stopped by pressing this button.

The measurement process can be checked by pressing the *Direct readout* tab at the bottom of the Settings window and then by pressing the *Start direct readout* button in this screen. The actual status is then continuously read out and displayed.

☞ **When starting the instrument, all existing measurement values are deleted from the instrument's memory and a new measurement session is started.**

☞ **If the instrument is started and setting changes are made, these only take effect after the instrument is stopped and restarted.**

4.2 Performing measurements

4.2.1 Soil moisture

For soil moisture measurements, the quantity of soil moisture is expressed in both volume percentages and mass percentages. The use of volume percentages is most commonly accepted. The e+ SOIL MCT measures the quantity of soil moisture, expressed in volume percentage. The sensor determines the electrical permittivity using a so-called Frequency Domain (FD)-measuring principle. The volumetric soil moisture fraction is calculated from this using the Topp-model (1980).

Volumetric soil moisture is defined as follows:

$$\theta_v = 100 * V_w / (V_w + V_b + V_g) \ [\%]$$

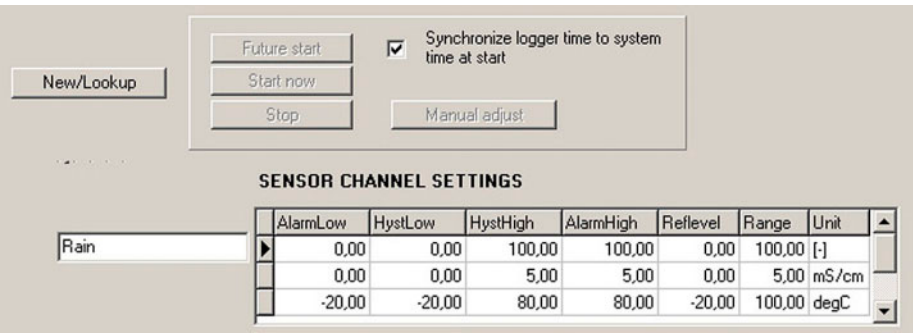
Key:
θ_v : The volumetric soil moisture percentage
V_w : The volume of the water component
V_b : The volume of the soil component
V_g : The volume of the gas component

4.2.2 Soil conductivity

The e+ SOIL MCT measures the total soil conductivity, also called the bulk conductivity, not to be confused with the interstitial water conductivity.
Soil conductivity is principally caused by two components. The first component is that of the water component, where the conductivity is the result of the ions that it contains. The second component is that of the soil component, where the conductivity is the result of bonded elements. Soil conductivity is expressed in milliSiemens per centimetre (mS/cm).
The soil conductivity measurement values of the e+ SOIL MCT are temperature compensated and represent the conductivity at a reference temperature of 20 °C. For this, it is assumed that the total conductivity changes proportionally by approx. 2 percent per degree Celsius.

4.2.3 Calibrations

The e+ SOIL MCT can be calibrated by the user by adjusting the values of "*Reference*" and "*Range*".
In the LDM-software, the fields are displayed under "*Logger Settings*" in the columns "*Ref.*" (Reference) and "*Range*". In the row sequence, soil moisture is in the first position, followed by conductivity and temperature in the second and third rows respectively. See the figure below:



For a two-point calibration for moisture measurement, the following procedure can be applied.

- ❒ Take two samples of the desired soil type, with significantly different but known soil moisture levels. These two known values have the symbols "moisture%1" and "moisture%2".
- ❒ Take a measurement of the soil moisture level in both samples using the e+ SOIL MCT.
  This yields two measurement values, symbolised by "measurement%1" and "measurement%2".
- ❒ If the values moisture%1 and measurement%1 are sufficiently close to each other - and the same goes for the values moisture%2 and moisture%2 - then further calibration is not required.
- ❒ However, if the corresponding values are too different, the e+ SOIL MCT must be corrected. This is done by changing the values of the *Reference* and *Range* according to the formula below:

$$Range_{new} = Range_{old} \times (moisture\%1 - moisture\%2) / (measurement\%1 - measurement\%2)$$

and

$$Reference_{new} = moisture\%2 - (measurement\%2 - Reference_{old}) \times (moisture\%1 - moisture\%2) / (measurement\%1 - measurement\%2)$$

In these formulas, $Range_{old}$ and $Reference_{old}$ are the values of the *Reference* and *Range* at the moment that the measurements are performed with the e+ SOIL MCT. $Range_{new}$ and $Reference_{new}$ are the new values for Reference and Range that must be entered in the e+ SOIL MCT using LDM.

The procedure above is described for soil moisture, but this can also be similarly performed for conductivity and temperature.

4.3 Setting alarms

The e+ sensors have an alarm function. Each parameter has two alarm statuses: one for the high value and one for the low value. When the measurement value of a parameter exceeds an alarm limit, the associated alarm status is made active.
The alarm status must be (re)set to non-active using an external device, generally the e-SENSE field modem. The alarm status can only be activated again after the hysteresis limit value has been reached. To illustrate see the figure below.

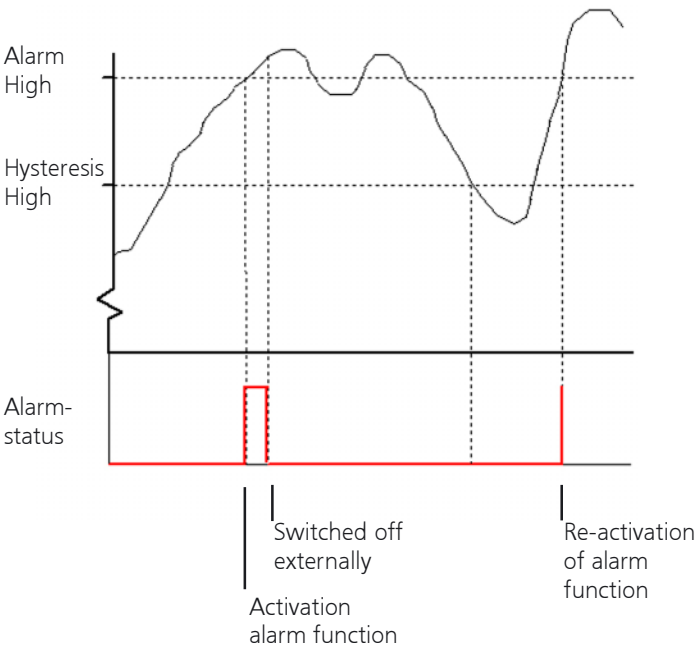


Fig. 4 Course of the alarm

The limit values can be set in LDM. However, LDM itself does not support any alarm functionality. The settings concerned have the following meaning:

- ❒ *Alarm High*: specifies the high limit value at which the alarm status is activated.
- ❒ *Hyst.(= Hysteresis) High*: specifies the high limit value at which the alarm function is reactivated
- ❒ *Alarm Low*: specifies the low limit value at which the alarm status is activated
- ❒ *Hyst. Low*: specifies the low limit value at which the alarm function is reactivated

To generate a "low" alarm, *Alarm Low* and *Hyst. Low* must be provided with a value that is higher than the lower limit of the measuring range. Additionally, *Hyst. Low* must be greater than or equal to *Alarm Low*.

To generate a "high"-alarm, "*Alarm High*" and "*Hyst. High*" must be provided with a value that is lower than the upper limit of the measuring range. Additionally, "*Hyst. High*" must be lower than or equal to "*Alarm High*".

The "low"-alarm function is made inactive by making "*Alarm Low*" and "*Hyst. Low*" the same as the lower limit of the range.

The "high"-alarm function is made inactive by making "*Alarm High*" and "*Hyst. High*" the same as the upper limit of the range.

☞ **The SMS-modem e-SENSE (field modem) and e-SENSE direct support alarm functionality. If an SMS modem detects an active alarm status for a sensor, e-SENSE direct can pass on an alarm message sent by the SMS-modem to a mobile telephone number.**

The values of alarm and hysteresis must be within the interval constituted by on the one side the Reference and on the other side by the sum of Reference and Range.

In formula: Ref. <= Alarm <= (Ref. + Range) and Ref <= Hysteresis <= (Ref. + Range)

☞ **The user must always (also when no telemetry is used) fill in the values for alarm high, hysteresis high, alarm low and hysteresis low.**

5. Applications

The e+ SOIL MCT® is an integrated electronic instrument for measuring, recording and monitoring soil moisture levels, conductivity and temperature.

Applications, amongst others in:
- ❒ Agri- and horticulture and plant science e.g. to monitor and control irrigation parameters.
- ❒ Area's where the actual value or the actual change of water content is of importance.
- ❒ Foodstuffs before and during longterm storage.
- ❒ Dike guarding
- ❒ Salinization processes

At this moment, the following e+ sensors are available:

- ❒ e+ RAIN (Rain: intensity and total)
- ❒ e+ SOIL MCT (Soil moisture: volumetric, conductivity and temperature)
- ❒ e+ WATER L (Water height: level, temperature)

At this moment, the following Divers® by Van Essen Instruments are available for the following fields of application:
- ❒ Diver (water depth and temperature)
- ❒ CTD-Diver (water depth, temperature and conductivity)
- ❒ Baro-Diver (air pressure and temperature)
- ❒ OTD-Diver (water level, temperature and oxygen level)

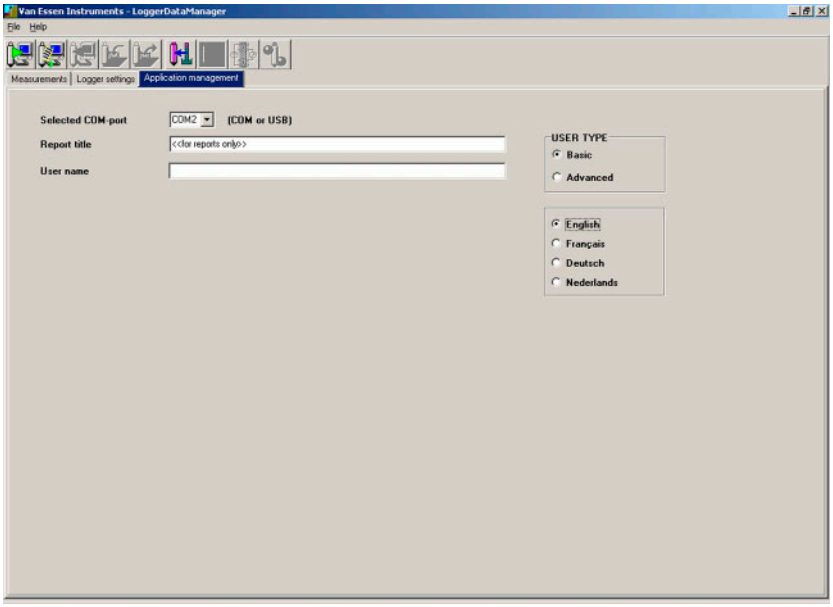
New types of e+ loggers are being developed for various other fields of application. Ask for information about the possibilities that may become available soon for your specific application.

6. Problems and solutions

This section provides useful tips and information for problems that may occur when using or turning on the instrument. One can determine what is wrong and possibly correct the fault oneself using the tips that are given below.

❒ After starting the instrument, no measurement values appear after start up.

- If the instrument is used as standalone:
  Check whether the right type of connection cable is being used and whether the cable is damaged, whether the infrared eyes of the instrument are dirty or whether the readout unit has been connected correctly. Then check whether the correct COM-port has been set in LDM e+ under the tab *Application management -> Programme settings*.



- If the instrument is connected to an SMS-modem e-SENSE (field modem) and if use is made of e-SENSE direct or the e-SENSE Internet:
  If the fault occurs with all the data loggers used, there is probably a problem with e-SENSE direct or the e-SENSE Internet. In this case, refer to the user instructions of e-SENSE direct or e-SENSE Internet.
  If the fault only occurs with the data loggers that are connected to a certain SMS-modem, there is probably a problem with the SMS-modem concerned. In this case, refer to the user instructions of the SMS-modem.
  If the fault only occurs with one instrument, check whether the right type of connection cable is being used and whether the cable is damaged.

- If the problem is not solved with the above measures, remove the instrument and check the operation using a readout unit and a (laptop) PC with LDM e+ installed on it. If in LDM e+ one cannot communicate with the instrument, replace the battery as described in section 7, "Maintenance".

☞ **Contact the supplier if all the named measures do not solve the fault.**

❒ Communication with the instrument is correct, but no measurement values appear.

- If the instrument is used as standalone:
  In LDM e+ check the settings for the *Sample speed* and *Future start* and also check the system time of the (laptop) computer under *Settings*, *Configuration screen*, *Date and Time*.
  Synchronise the RTC when starting the instrument. Depending on the set *Sample speed* and the possibly set *Future start,* measurement values should now be available from a certain time.

- If e-SENSE direct or e-SENSE Internet is used:
  Check whether the settings *Sample speed, Send interval*, *Send start* and *Channel is activated*. The setting for *Sample speed* must be smaller than that for *Send interval*, while *Channel is activated* must be active.
  Depending on the value for *Send interval* and *Send start,* measurement values should now be available from a certain time. If this is not the case, check:
  ⇨ The signal strength level of the SMS-modem e-SENSE (field modem) if applicable. For checking the field strength level of the SMS-modem, refer to the user instructions of the SMS modem.
  ⇨ The signal strength of the PC GSM-modem if applicable. The field strength level is given in the status bar of e-SENSE direct.

❒ The instrument produces incorrect measurement values.

- Check the *Reference* and *Range* settings of the data logger and enter the settings again if necessary.
  The *Reference* and *Range* settings are a part of the sensor calibration.

❒ The alarm of the sensor does not function or functions incorrectly.

- The alarm functionality is only supported by e-SENSE direct or e-SENSE internet.

- If no alarm messages are received: check the settings *Alarm Low*, *Hyst. Low*, *Hyst. High* and *Alarm High*. Configure the alarm values if one or more settings are set to zero.

- If an alarm message comes in once and then not again: the value of *Hyst. High* chosen must be smaller than *Alarm High.* The value *Hyst. Low* must be bigger than *Alarm Low*. If this does not solve the problem, select both hysteresis values so that they are closer to the alarm values.

- If numerous alarm messages are repeatedly received: choose hysteresis values that increase the difference between them and the alarm values. If this does not solve the problem, check the development of the measurement values and set a larger *Sample speed* if the measurement values vary widely.

7. Maintenance

Reliable and accurate measurement results can only be obtained with regular maintenance. We recommend inspecting the instrument and performing the following maintenance at set times:

- ❒ If use is made of the IrDa-interface, always place the cap on the optical connector when the e+SOIL-mct is not being used for readout, as invading sunlight increases battery use somewhat. Each time you use it, check the optical connector and the cap for dirt. Clean if necessary.

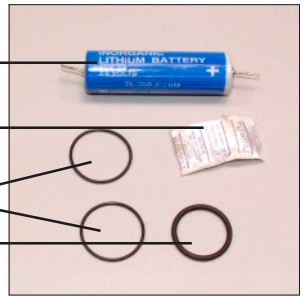
- ❒ Replace the battery of the instrument with a new one of the same type in good time. Section 2, "Technical data", gives the expected lifespan of the battery. To replace the battery, a battery set can be purchased separately (see section 1.1, "Package contents"). For replacing the battery correctly, refer to the user instructions of the e+ logger battery set (11.41.90.01).

- ❒ When the e+ SOIL MCT is installed permanently, the instrument and the electrodes are possibly liable to contamination and corrosion. When replacing the battery, thoroughly clean the instrument with water and check the electrodes for damage or corrosion. Replace the electrodes if necessary.

Do not pull the e+ SOIL MCT out of the soil by the connection cable, but dig it out carefully.

Appendix; Battery set e+ logger

☞ **Always replace the 3 O-rings!**

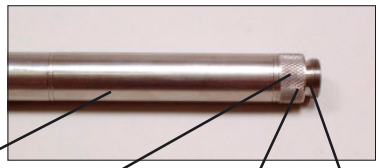


11.41.90.01 Battery set

Description	Art.no.	Qty.
e+ Battery	H5.00.18.0	1
O-ring (d 15,6x1,78)	H2.22.61.2	1
O-ring (d 18 x 1)	H2.22.62.0	2
Socket-head screw wrench	99.75.02.05	1
Acid free vaseline	H2.74.18.0	1
Desiccant pack	H2.76.41.0	1

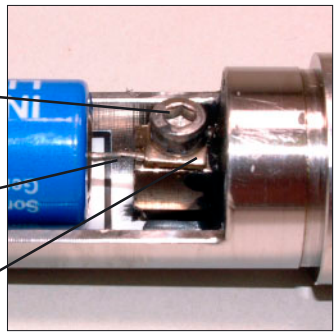
Required material:

❒ Clean dry towel



1. Disconnect the sensor connector from the **e+** logger.
2. Make the outside of the **e+** logger dry and clean.
3. Remove the O-ring and the nut.
4. Slip the support ring, battery cover and both thin O-rings of the **e+** logger.
5. Remove the desiccant pack.
6. Remove the battery by unscrewing the clamping screws
7. Clean the inside and the O-ring seat
   There are 3 O-rings:
   1 O-ring 1 —> sealing battery cover sensor-side
   2 O-ring 2 —> sealing battery cover Irda-side
   3 O-ring 3 —> sealing/locking protective cap

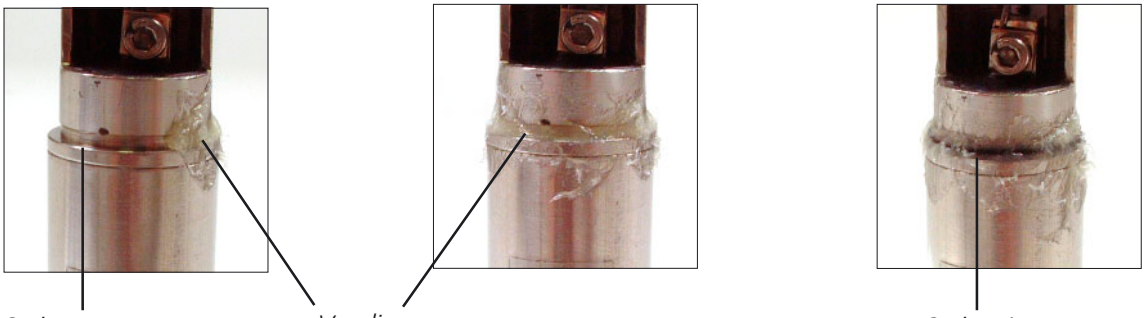
8. Place the new battery (H5.00.18.0) and secure it with the clamping screws and clamping plates.
   For the correct position of + and - see the sticker in the **e+** logger.



☞ **Attention for the + and -!**

9. Check the functioning and configuration of the **e+** logger according to the instructions of the **e+** logger.

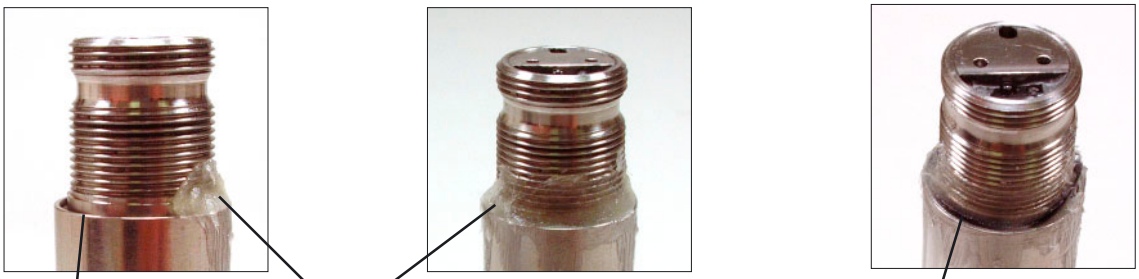
10. Grease the O-ring seat for O-ring 1 ample with vaseline.
11. Carefully slip the O-ring (H2.22.62.0) in the vaseline on the O-ring seat and grease also the outside of the O-ring with vaseline. The O-ring must be covered completely with vaseline.



O-ring seat for O-ring 1 *Vaseline* *O-ring 1*

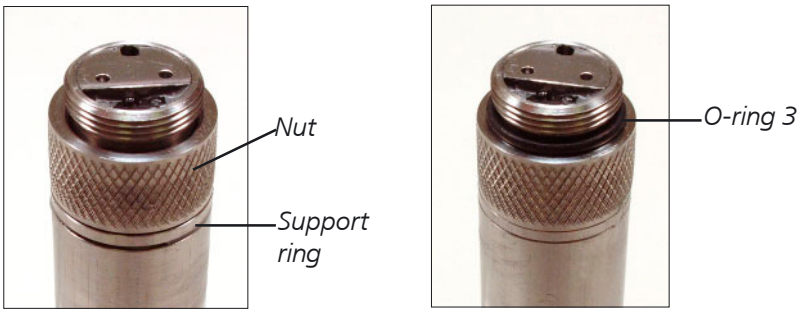
12. Place the desiccant pack (H2.76.41.0).
13. Slide the battery cover on the **e+** logger. Note: the O-ring must slid correctly in the recess of the battery cover.

14. Grease the O-ring seat for O-ring 2 ample with vaseline.
15. Carefully slip the O-ring (H2.22.62.0) in the vaseline on the O-ring seat and grease also the outside of the O-ring with vaseline. The O-ring must be completely covered with vaseline.



O-ring seat for O-ring 2 *Vaseline* *O-ring 2*

16. Place the support ring and screw the nut on the **e+** logger, place O-ring 3.



17. Clean the outside of the **e+** logger, remove the superfluous vaseline.
18. Re-connect the sensor connector to the **e+** logger or replace the protective cap.