Manual

SONO-DIS with SONO-WZ and SONO-M1

More information:
www.imko.de

Moisture Sensor Experts

IMKO

Thank you for purchasing this IMKO product

This manual is an original operating manual of the manufacturer.

The described instructions for use and commissioning are part of the products described and must be kept for future installation or use.

Important!

Please read these instructions carefully to accomplish optimum results with your moisture probe. Please contact your authorized dealer, distributor or service center for troubleshooting, questions or suggestions on your new moisture probe. You may contact IMKO directly, to after exploring your local contact.

We look forward to helping you!

For warranty claims, please contact your local dealer, distributor or service center. The warranty does not include any kind of willful damage to the device or its accessories or an operation outside of the product specification. Please refer to the information in this manual. If you have any questions, please contact IMKO service. Don’t open the device and do not try to repair the device yourself- the guarantee expires when the device is opened or modified.

In the course of product improvements, we reserve the right to make technical and visual changes to the device.

Content

SONO-DIS

SONO-DIS

Robust battery-powered mobile display unit for the SONO-WZ and SONO-M1 moisture probes. Strong, weather-resistant IP67 aluminum housing.

1 General Notices

1.1 Intended Use

This handheld device was designed to serve as a reading device for various IMKO probes. Only the listed probes may be connected to the device. The connection of a probe not intended for connection may lead to damage of the device and/or the connected probe.

1.2 The Chargeable Accumulator

Never change the integrated accumulator yourself.

The stated maximum operating periods refer to ideal conditions. The ambient temperature and the charging cycles can significantly reduce the performance time. In addition, the charging capacity is decreasing for technical reasons within the course of the utilization of the device or due to storage at very high or low temperatures.

1.3 Charging the DIS Handheld device

Only use the respectively provided charger or a comparable power supply unit to charge the SONO-DIS handheld device. Any deviation of the charging voltage can lead to damage of the device.

The device is heating up during the charging process.

Should the SONO-DIS only function for a short period or not at all in spite of several attempts to charge it, the integrated accumulator is defective and must be exchanged. In this case, please contact our local distribution partner or us directly.

1.4 Temperatures and Ambient Conditions

The SONO-DIS handheld device was designed for deployment under rough conditions.

The operation of the device under conditions beyond those depicted may lead to damage of the device.

2 Control Elements

With only 4 control keys, SONO-DIS allows an easy handling and well-structured measurement procedure.

Probe/Charger Connection

Display

„Measurement/Activate“

- Shutting ON/OFF → press 1s
- Perform Measurement → press shortly
- Selection of a Menu Item → press shortly
- Storing a setting → press shortly

„UP“

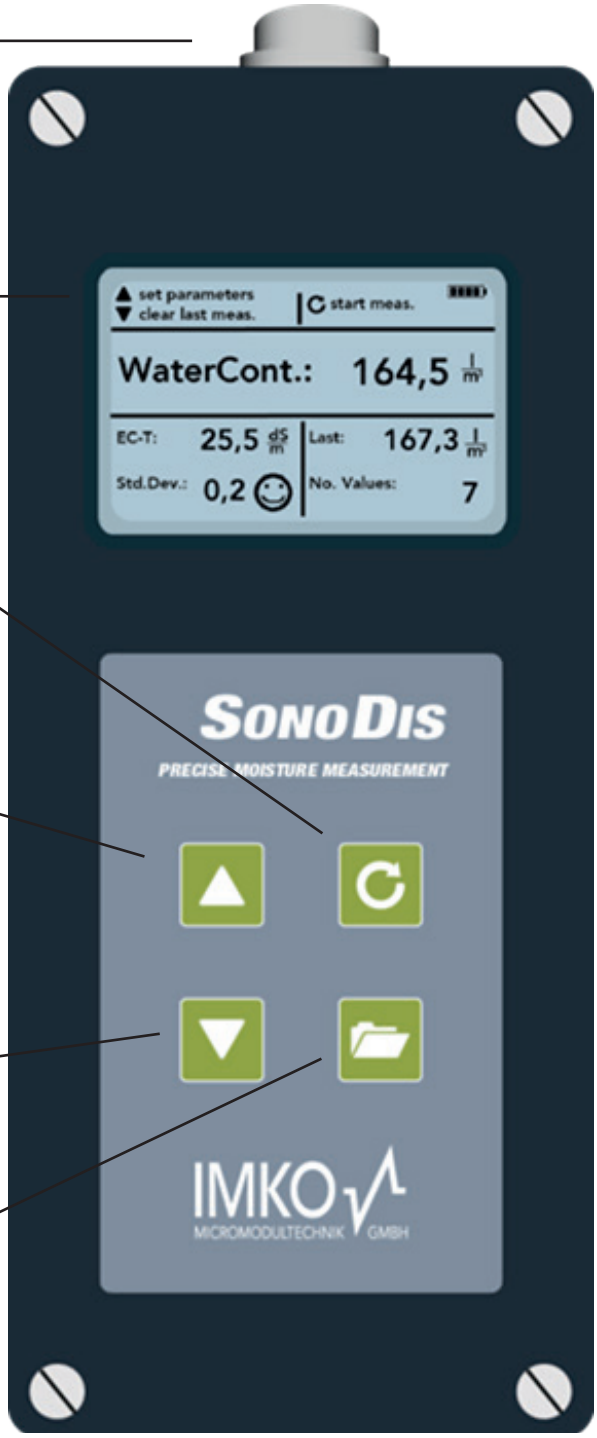
- Back to previous Menu Item or Setting
- Direct link to “CHOOSE-Material Calibration” (Mode: Normal / Average)
- Direct link to “Density setting” (Mode: water calculation)

„DOWN“

- Go to next Menu Item or Setting
- Deleting the Value Memory (Mode – Average Value)

„Settings“

- Conclude Settings
- Leave Menu Item



Attention:

For measuring concrete, the standard calibration curve “Cal. No.4” is pre-selected inside the SONO-DIS. When switching on the SONO-DIS, the display shows the active calibration curve Cal.No.4. This selection needs to be changed when other materials as concrete should be measured.

3 Initial Commissioning

3.1 Safety Instructions

Attention:

Before initial commissioning, please read the General Notices in the first chapter of this operating instructions. Any not intended use may lead to damage of the device.

3.2 Checking the scope of delivery

- SONO-DIS Handheld device
- Plug-in Power Supply Unit (12V/2A)
- Charging Adapter
- Protective Hood
- Manual

3.3 Charging the Accumulator

The integrated accumulator should be charged before putting the device into operation the first time. For this purpose, plug in the provided charging adapter into the 7-pole socket of the SONO-DIS. Subsequently, connect the plug-in power supply unit to the charging adapter. In the event that the device is already switched on, or if the accumulator is completely discharged, the charging process will commence immediately.

If not, switch on the SONO-DIS by pressing the button „Measurement“ for approximately 1 second. An active charging process is indicated in the display by an animated accumulator symbol. The integrated charging electronics charges the accumulator until it is completely charged. In case of complete discharge, this will approximately take 2 hours. As soon as the charging process is completed, all 4 „accumulator bars“ will be permanently presented in the display and the trickle charging will commence.

Attention:

Only charge the accumulator at room temperature (10°C to 30°C). At too low temperatures, it may happen that the accumulator is over-charged. Too high ambient temperatures may lead to damage of the SONO-DIS due to the additional heat-up during the charging process.

3.4 Connecting a Sensor

The SONO-DIS handheld device can be operated with the following IMKO-moisture probes:

Connect the moisture probe to the SONO-DIS by plugging in the 7-pole plug into the socket at the SONO-DIS and fastening the coupling nut.

4 Operation

4.1 General Operation Buttons, Symbols and Messages

Key/Button Designation

Key/Button	Designation
	**Measurement** • Shutting ON/OFF → press 1second • Perform Measurement → press shortly • Selection of a Menu Item → press shortly • Storing a setting → press shortly
	**Settings** • Conclude Settings • Choose Menu • Leave Menu Item
	**UP** • Back to previous Menu Item or Setting • Direct link to “CHOOSE – Material Calibration” (Mode: Normal / Average) • Direct link to “Density setting” (Mode: water calculation)
	**DOWN** • Go to next Menu Item or Setting • Deleting the Value Memory (Mode – Average Value)

Display Symbols

Symbol	Designation
	Residual Accumulator Capacity
	Active Measurement
	Settings are stored
	Intensity of the Background Illumination
	Remaining time until shut-down (illumination / APO)
	Press button „UP“
	Press button „DOWN“
	Warning symbol: Measurement values lower than 3% are not taken into account. The validity of a measurement value is questioned due to large scattering.

Text Meaning

Text	Meaning
Density	Raw density of the fresh concrete to be measured
Water content	Total water content measurement value
ECTRIME	Electrical conductivity, based on the TDR radar signal. ECTRIME offers an evaluation of the used cement inside the measured concrete sample.
Serial No.:	Serial Number of the probe, respectively of the SONO-DIS
HW:	Hardware Version
FW:	Firmware Version

4.2 Switching "ON" the SONO-DIS Portable Measuring Instrument

Switch ON the SONO-DIS by pressing the button „Measurement“ for approximately 1 second.

During the starting-up process, the SONO-DIS will attempt to communicate with the connected probe. This will take approximately 4 seconds. If no probe is connected, or the probe is not able to communicate for any reason, an error message will be generated on the display.

If the probe was successfully detected, the accordingly set background of the operation mode will appear on the display and the SONO-DIS is ready for deployment.

NOTE:

Should no connection to the probe be possible in spite of several attempts, check if the probe is connected properly. Should this not deliver a positive result, please contact our service department.

4.3 Switching "OFF" the SONO-DIS Portable Measuring Instrument

Switch OFF the SONO-DIS by pressing the button „Measurement“ for approximately 1 second.

NOTE:

It is not possible to shut off the SONO-DIS while it is in a „Setting“ procedure. Please, first leave the menu item „Settings“ by pressing the button „Settings“ until the measurement display appears.

4.4 Probe Specific Settings

SONO DIS may be operated in combination with SONO-WZ probe as well as with SONO-M1 probe. Depending on which probe is connected, probe specific menus and settings will be displayed.

The probe specific menus and settings are listed in the respective chapters of the probe in this manual.

5 Technical Data SONO-DIS

Height			36mm
Width			64mm
Length			150mm
Weight			(including accumulator) approx 437g
Power Consumption	Power Down		approx 35µA
	Idle	- Background Illum. OFF	approx 26mA
		- Background Illum. Max	approx 56mA
	Probe turned ON		approx 100mA
	Measurement		approx 350mA
Measurement per Charge	20°C / Background Illum. Max Mode – Continuous Measurement		approx 5000
Connectable Sensors			SONO-WZ
Storage Temperature			-30°C up to 80°C
Operating Temperature			-20°C up to 70°C
Charging Temperature			10°C up to 30°C
Charging Voltage			Nom. 12V, Max. 15V, Min. 12V
Charging Current			approx 1A
Charging Time			At exhaustively discharged accumulator. 2h
Accumulator			Ni-MH (4 x 1.2V) (AA), 2000mAh, >1000 Measurements
Physical BUS			RS485
Bus-Protocol			IMP-BUS-Protocol II
IMP-Bus Port Settings			8 Data Bits, 2 Stop Bits, Odd Parity

SONO-DIS with SONO-WZ

SONO-WZ

Robust mobile moisture probe for measuring water content in fresh concrete.

1 General Settings

SONO-DIS provides diverse possibilities for different settings. By pressing of at least 2 seconds of the button „Settings“ you reach the menu “Settings”. Select the desired function with the buttons „+“ or „-“ and confirm it with the button .

Leave the menu item „Settings“ by pressing the button „Settings“ .

An Overview of the setting options

Settings	Designation
HD2-Mode	Switching the Operating Mode • Normal“ → measurement of the variables Moisture, Temperature, and EC-TRIME “Average Value“ → determination of the average value of up to 6 individual moisture measurement values • „Water Calculation“ → Calculates the content of water of the material in l/m³
Material calibration	• Choosing or change the Material Calibration
Detect Probe	A new search for a connected probe (if an error has occurred during the activation of the device)
Language	Switching the System Language • German • English
Auto-Power-Off	Setting of the automatic shut-down
Display Lighting	Setting of the Background Lighting • Turn-Off-Time • Intensity
LCD-Contrast	Setting of the ideal contrast
Probe Info	Information regarding the probe
SONO-DIS Info	Information regarding the SONO-DIS handheld device

1.1 Detecting Sensor/Probe

In the event that communication problems arise with the probe at the activation of the SONO-DIS portable measuring instrument, or if the probe was not connected, or it is intended to exchange the probe during operation, this menu item should be selected. After selection of this menu item, the SONO-DIS will again attempt to establish a connection to the connected probe. If this attempt is successful, the serial number of the probe will appear in the display.

Should a connection not be possible, „No probe detected“ will be generated on the display.

NOTE:

Should no connection to the probe be possible in spite of several attempts, check if the probe is connected properly. Should this not deliver a positive result, please contact our service department.

1.2 Language

In this menu item, the language of the SONO-DIS portable measuring instrument can be selected. Currently, the user has the choice between the languages English and German. You can select the desired language by actuating the buttons „Up“ ▲ and „Down“ ▼ and activate the same via the button „Measurement“ ↻. After activation of the language, the symbol 💾 will appear in the upper right hand corner of the display.

1.3 Auto-Power-Off

In the menu item „Auto-Power-Off“, you can select an automatic shut-down offered in various time periods. Hereby, you can select between the following shut-off times:

- 1 Minute
- 2 Minutes
- 5 Minutes
- 10 Minutes
- 20 Minutes

respectively also deactivate the automatic shut-down function (Display „—min“).

For this purpose, select the desired shut down time by actuating the buttons „Up“ ▲ and „Down“ ▼ and activate the same via the button „Measurement“ ↻. After activation, the symbol will appear in the upper right hand corer of the display.

NOTE:

The SONO-DIS will only automatically shut down, if no further button is actuated. Any actuation of a button will lead to the shut down time to start again.

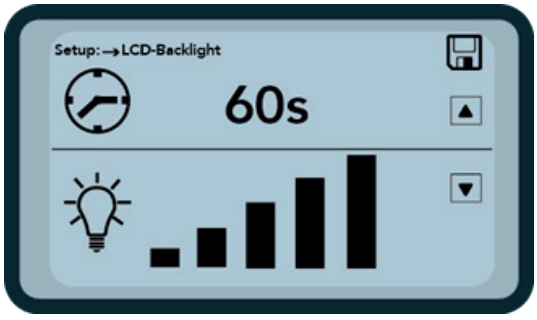
Attention:

For measuring concrete, the standard calibration curve “Cal. No.4” is pre-selected inside the SONO-DIS. When switsching on the SONO-DIS, the display shows the active calibration curve Cal.No.4. This pre-selection should be changed only if other materials as concrete should be measured.

1.4 Display Illumination

If required, the background illumination of the display can be individually adjusted. Consequently, this enables the option to save power and to prolong the operational period.

After the selection of the menu entry, the following screen will be presented on the display:



The selection of the background illumination, respectively the time until the automatic shut-down of the same is selected via the button „Up“ ▲ by actuating the same several times.

Using the button „Down“ ▼, you can adjust the intensity of the illumination, respectively turn the same completely off. Activate and store your settings by actuating the button „Measurement“ ↻.

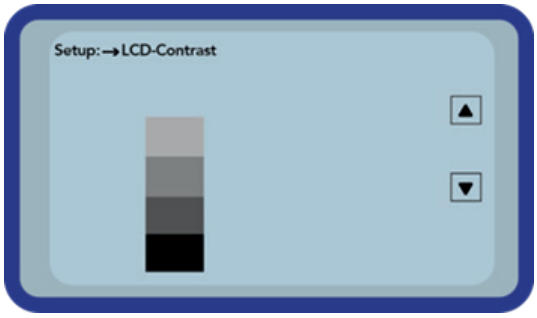
After activation the symbol 💾 will appear in the upper right hand corner of the display.

1.5 Display contrast

At extreme temperatures, it may be necessary to adjust the contrast of the display in order to be able to clearly read the display. For this purpose, select the menu item „Display Contrast“.

Change the contrast by actuating the button „Up“ ▲, respectively „Down“ ▼. Activate and store your settings by actuating the button „Measurement“ ↻.

After activation, the symbol 💾 will appear in the upper right hand corner of the display.



Change the contrast by actuating the button „Up“ ▲, respectively „Down“ ▼.

Set the contrast that you can realize the whole grayscale on the diagram. Activate and store your settings by actuating the button „Measurement“ ↻.

After activation, the symbol 💾 will appear in the upper right hand corner of the display.

1.6 Probe Info

By selecting this menu item, after a short moment, you will be issued various information regarding the connected probe. These are:

- Serial Number
- Probe Type
- Hardware Version (HW)
- Firmware Version (FW)

1.7 Material Calibration Curve

By selecting this menu you have the possibility to adjust the probe SONO-WZ to another calibration curve.

After switching ON the SONO-DIS, the calibration curve which you have selected in this menu point, is displayed for 3 seconds on the lower section of the screen.

Attention:

For measuring concrete, the standard calibration curve “Cal. No.4” is pre-selected. This pre-selection should be changed only if other materials are to be measured. A total of up to 15 different calibration curves can be handled, e.g. for materials like ceramic suspension, sludges and others. Furthermore, it is possible to change the sensitivity of the concrete calibration curve “Cal. No.4”.

For more details please get in contact with IMKO´s service team.

1.8 Info

By selecting this menu item you will be issued various information regarding your SONO-DIS portable measuring instrument. These are:

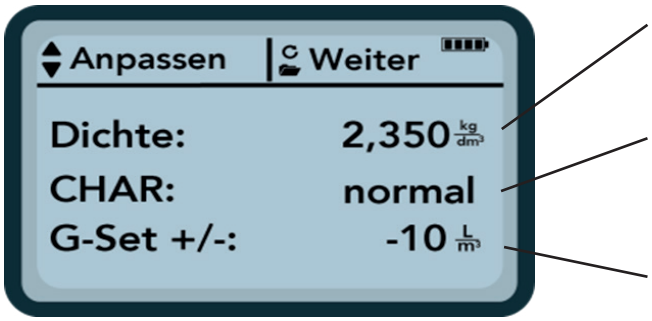
- Serial Number
- Hardware Version (HW)
- Firmware Version (FW)
- Accumulator Capacity
- Accumulator Voltage

1.9 Measuring Mode

This menu enables to switch to expert mode. In expert mode, the water cement ratio (w/c ratio) will be displayed instead of the water content. In addition the start menu will show a fourth setting “Cement” where the amount of cement in the recipe needs to be configured.

2 Concrete Specific Base Parameters

In the start screen of the device three base parameters for the individual measurement task can be set. Before starting measurements, the following three configuration parameters need to be set:



Density: Bulk density

CHAR: Characteristics of the recipe. 4 setting options are available:

G Set +/-: General set

NOTE:

The above settings help with an initial adjustment and may be sufficient under normal conditions, but the measured values should generally be validated against a reference and if necessary, adjusted using the parameter G-Set. A reliable reference measurement is necessary for this.

Please take into account that the standard kiln drying measurements also comprise measurement errors.

Concretes that do not meet the specifications according to DIN EN 206-1 and DIN 1045-2 (concretes that tend to bleed, for example), may lead to significant deviations of the measured values.

2.1 Density

Bulk density, the value from a shatter test, or the density from the mixture calculation can be entered here.

The raw density can be set in steps of +-0.005. Select the correct density value of the concrete sample with the buttons „+“ or „-“ and confirm it with the button . The SONO-DIS switches back to the CHANGE menu.

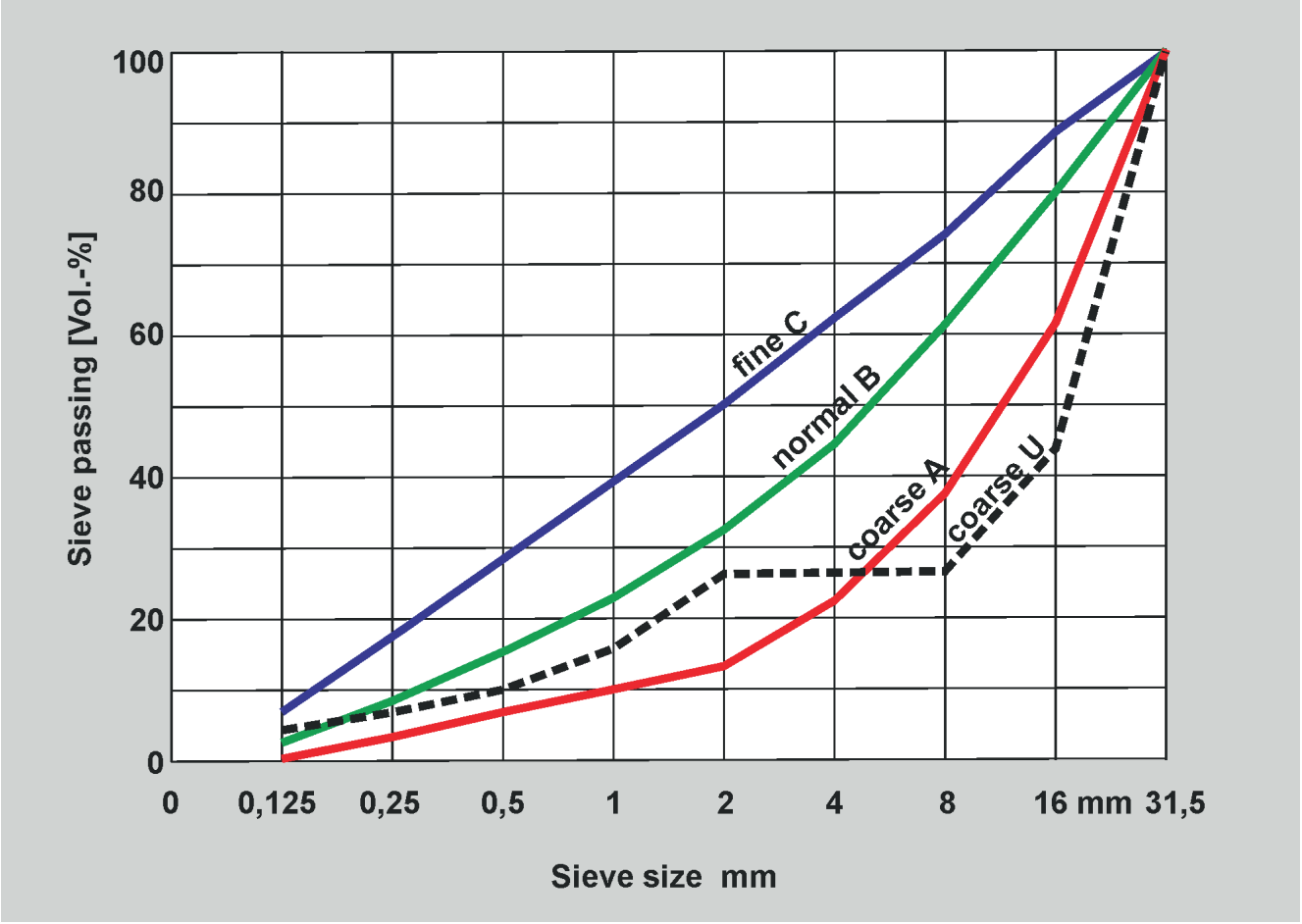
Attention:

The setting of the correct raw density is important. The raw density influences the measurement of the water content inside the SONO-DIS. The difference of raw density between 2.200 and 2.300 corresponds with 8 liter water. If the raw density of the concrete cannot be determined on site, the input of the set density of the mix computation would be however a possible compromise to achieve acceptable results. A deviation of +-0.02 of the density corresponds with +-1.6 liter water.

2.2 The Recipe-Characteristic Parameter CHAR

Sieve curves of the aggregates influence the SONO-WZ measurement. Therefore the system offers 4 different setting possibilities with the parameter **CHAR**:

fine C / normal B / coarse A / special (gap graded U)



fein (Sieblinie C)	**normal** (Sieblinie B)	**coarse** (Sieblinie A)	**special** (gap graded U)
SONO-WZ measures a little too less and has to correct the water content upwards..	no correction	SONO-WZ measures a little too high and has to correct the water content downwards.	SONO-WZ measures too high and has to corect the water content down-wards.
Concretes with lower coarseness factors Concretes with higher sand contents, more fine particles as well as concretes with very high proportion of cement. Standard admixtures like fly ash, standard additives as well as PCEs.	**Well graded sieve curves** Standard admixtures like fly ash, standard additives as well as PCEs.	**Concretes with higher coarseness factors** Well graded B sieve curves with one peculiarity: Concretes with a set value of water which is lower than 160 Liter/m³, plus high-performance concrete plasticizer in higher amounts enabling the general flowability.	**Gap graded recipes** A gap of little or no smaller gravel with size 4/8mm. Standard admixtures like fly ash, standard additives as well as PCEs.

Select the parameter CHAR with entering parameter **CHAR** with **fine, normal, coarse or special (gap graded U)** with the buttons „+“ ▲ or „-“ ▼ and confirm it with the button ↻. The SONO-DIS switches back to the CHANGE menu.

Characteristic of the recipe, with fine (positive-correction), coarse (negative correction), normal (no correction) or special (gap graded with negative correction).

Note:

Primarily the mortar content in the concrete influences the parameter CHAR.

2.3 The general G-Set parameter

SONO-WZ measures the free water for the hydration of the cement. Due to the radar field SONO-WZ is able to also detect a part of the core water!

General-Set allows the fine adjustment for type of concrete and type of aggregates with different core or core water content. G-Set can be adjusted between +- 50 liter/m³. Typical value is -10 liter/m³ which is automatically subtracted during measurement, when the effective water content (the active water) is to be measured. The parameter can be set in the unit liter/m³, in steps of +-1. It is recommended to note appropriate values for individual concrete mixtures.

Select the parameter “G-Set” and enter the value in + or- liters with the buttons „+“ ▲ or „-“ ▼ and confirm it with the button ↻. The SONO-DIS switches back to the CHANGE menu.

3 Standard Measurement mode „Average“

Switch ON the SONO-DIS by pressing the button „Measurement“ for approximately 1 second.

During the starting-up process, the SONO-DIS will attempt to communicate with the connected probe. This will take approximately 4 seconds. If no probe is connected, or the probe is not able to communicate for any reason, an error message will be generated on the display.

If the probe was successfully detected, the display demands the setting of the individual base parameters.

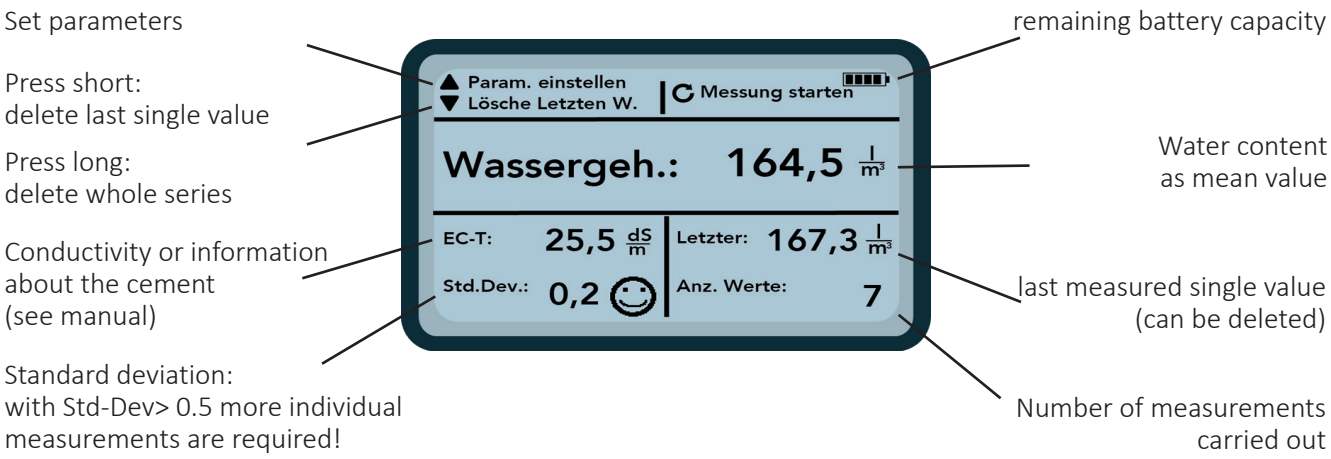
NOTE:

Should no connection to the probe be possible in spite of several attempts, check if the probe is connected properly. Should this not deliver a positive result, please contact our service department.

3.1 Conduct a Measurement of the Water Content

If the base parameters are set, press and the device is in the standard measuring mode “Average”, ready to measure. „Average“ mode determines the total water content of a fresh concrete sample.

The following display will appear:



In order to initiate a measurement cycle, shortly press the button “Measurement” . The measurement will commence and a turning -symbol will appear instead of the accumulator-symbol in the upper right-hand corner. During this period, no other actions can be performed. The measurement requires approximately 2 to 3 seconds. Once the measurement is concluded, the accumulator-symbol will reappear and the measured values will be generated on the display. The measured water content, calculated considering the raw density is displayed. The number of measurements “No. Values” is also displayed.

To achieve a best possible result it is advised to make several single measurements at different places inside the fresh concrete. With smaller grain sizes, up to 5 single measurements can be enough, with concrete tending to bleed, more than 5 single measurements are necessary. The higher the number of single measurement cycles, the higher the average measurement accuracy!

Indication of the measurement quality:

The SONO-DIS is calculating the standard deviation StdDev of the single measurements. With StdDev values of >0.5 the concrete mixture is probably too inhomogeneous, so that it is recommended to make more single measurements. It is recommended to perform at least 5 to 6 single measurements. At a standard deviation StdDev less than 0.5 the series of measurements can be stopped and the final result is reliable.

The smileys in the display indicate the reliablilty of the measurement series:

☺	😐	☹
Good (<0,2)	acceptable (0,2 ..0,49)	not acceptable (>0,5).

The SONO-DIS software does not accept water content values lower than 100 liter/m³. This could happen e.g. if the start button was activated and the probe was not completely inside the fresh concrete. Obviously wrong measurements are indicated with a warning symbol ⚠ at the place of the single measurement value and will not be used for calculation of the average value!

After finishing of the measurement procedure it is possible to delete measurement values with the button DOWN ▽ or to go back to the menu of the individual base parameters using the button UP △.

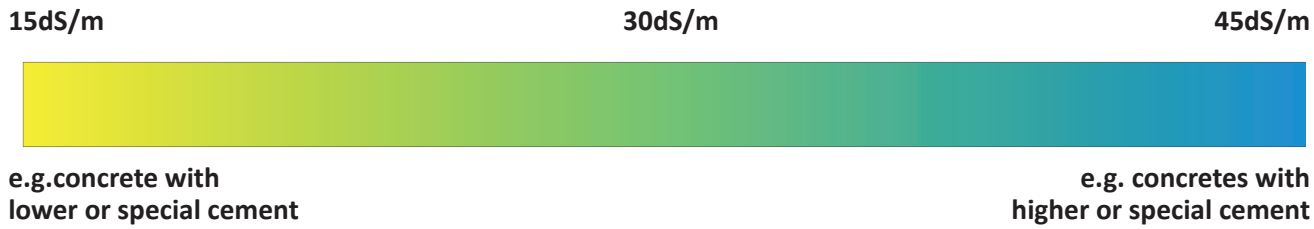
3.2 EC-TRIME - a valuable cement parameter

The main display also shows the radar based Electrical Conductivity parameter EC-TRIME (EC-T). Using and detecting the electrical attenuation of the radar pulse, SONO-WZ determines further information about cement type and cement quantity. The raw value EC-TRIME can be used for a preliminary indication about the amount of cement and the type of cement. Taking the EC-TRIME reading into account, gives another control parameter for recurrently measured standard concretes.

For the measuring of standard recipes the cement can be monitored with EC-TRIME.

The following graphic shows possible EC-TRIME values at different concrete and cement types. As user of SONO-WZ and for later controls and better verifications it is to recommend and helpful, to document EC-TRIME with the respective concrete type. It is to consider that earth moist concretes show lower values for EC-TRIME.

EC_{TRIME} Measurement Range



NOTE:

An evaluation of EC-TRIME only makes sense, when recurrently the same type of concrete is controlled by the SONO-WZ.

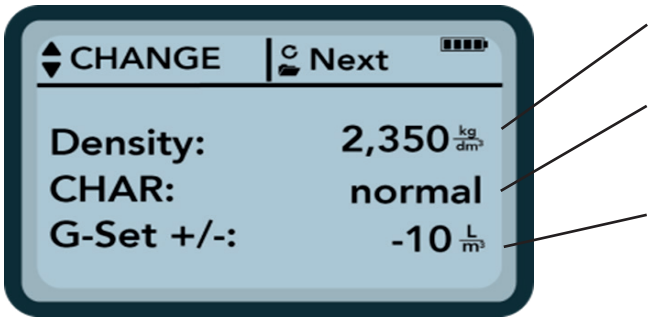
4 In 5 steps to a successful measurement

There should be no metal parts around the probe head of SONO-WZ during the measurement procedure, because metal can influence the electrical field. Best and easiest way is to use a plastic bucket filled with fresh concrete. To avoid air gaps the concrete should be compressed by several stamps of the bucket on the ground. The probes surface must be clean and free of concrete crusts and if necessary the probes surface must be cleaned with a wire brush. During measurement the probe head of the SONO-WZ must be completely immersed inside the fresh concrete.

Step 1: Switch-On the SONO-DIS

By activating the button C for longer than one second, the SONO-DIS starts with the measure mode.

Step 2: Adjust the Raw Density, CHAR-parameter and G-Set (Reference is made to Chapter 7 "Concrete Spescific Base Parameters")



Density: Raw Density

CHAR: Characteristic of the recipe

G Set +/-: If you want to measure the complete water content (the total kiln drying water content) with SONO-WZ, the G-Set is to be entered with a plus value, with 1/3 of the core water!

If the base parameters are set, press C and the device is in the standard measuring mode "Average", ready to measure.

Step 3: Insert the probe SONO-WZ in the fresh concrete and start the measurement

The probe head should be placed inside the concrete with a slight angle, at the edge of the bucket.

For very liquid concretes: Use the covered plastic shovel. Press the probe tip with the black ceramic window in front side, slowly and diagonally to the opposite side of the bottom of the bucket, so that the probe lies diagonally in the bucket with the handle of the probe on the edge of the bucket. This ensures that a representative concrete mixture lies on the probes surface. For stiffer concretes: Compress the concrete by several knockings at the bucket with the foot. Start the measurement by shortly pressing the button "Measurement" C.

Set new parameters

Shortly pressing:
Clear last measurement value.

Longer presing:
clear complete measurement series.

EC Trime:
Radar based conductivity

Standard Deviation:
With StdDev >0,5 more single measurements are necessary!

Residual accumulator capacity

Water content

last measured value (can be deleted)

Number of measurements

The measurement will commence and a turning -symbol will appear instead of the accumulator-symbol in the upper right hand corner. During this period, no other actions can be performed. The measurement requires approximately 2 to 3 seconds. Once the measurement is concluded, the accumulator-symbol will reappear and the measured values will be generated on the display. The measured total water content, calculated using the raw density is displayed. The number of measured values is also displayed.

Bigger gravels in the measurement volume around the probe surface are influencing the single measurement. Therefor it is recommended to make consecutive measurements in different locations inside the fresh concrete. With smaller grain sizes minimal 5 single measurements, with bigger grain sizes more than 5 single measurements are necessary. The higher the number of single measurement cycles, the higher is the measurement accuracy.

About the quality of the measurement:

The SONO-DIS reflects a statement to the accuracy with displaying the standard deviation (StdDev) of the set of measurements. With StdDev values of >0.5 the concrete mixture is probably too inhomogeneous, so that it is recommended to make more single measurements. Only after 5 to 6 single measurements and with a standard deviation StdDev less than 0.5 the single measurement procedures can be stopped and the final result is within a good accuracy.

Smileys in the display show the acceptance of the standard deviation.

☺	😐	☹
Good (<0,2)	acceptable (0,2 ..0,49)	not acceptable (>0,5).

The SONO-DIS is filtering out automatically water content values which are lower than 100 liter. This could happen e.g. if the start button was activated and the probe was not completely inside the fresh concrete. Such wrong measurement values with <100 liter are indicated with a warning symbol ⚠ at the place of the single measurement value and will not be used for calculation of the average value. After finishing of the measurement procedure it is possible with the button Up and DOWN to deleted the measurement values or to set a new raw density value.

<u>Step 4:</u> Start next single measurement cycle

Place the lance probe SONO-WZ again inside the fresh concrete, at another place shifted by 70 to 90 degree. It is necessary to come to a good material mix around the probes surface because smaller or bigger grain sizes are influencing the measurement field. By pressing again the button the next single measurement cycle starts which needs again 2 to 3 seconds.

The new measurement value is displayed above the former value and is stored in the SONO-DIS. An average value of first and second value is done and the average value is displayed on the LCD.

<u>Step 5:</u> Start further single measurement cycles (back to Step4)

Re-process as described under Step 4.

With smaller grain sizes, up to 5 single measurement cycles will be fine, with concrete which tends to bleed, more than 5 single measurements are necessary. If the standard deviation StdDev value is >0.5 after 4 to 5 cycles, the concrete mixture is probably too inhomogenous. So it is recommended to make more single measurements. Therefore mix the concrete with a professional stirrer inside the bucket and place the probe again inside the bucket for performing more measurements.

NOTE:

If the concrete will be not mixed, there is the danger of segregation and measurement deviations.

5 Correct Handling in fresh concrete

SONO-WZ works with state-of-the-art TRIME TDR-method (Time-Domain-Reflectometry) based on radar technology. Plastic and liquid concretes with slump values >30mm can be easily measured with SONO-WZ. An automatic averaging with 4 to 5 single measurements ensures a procedure with representative material mix on the probes surface. Following the structured working method with SONO-WZ, precise and reliable results are displayed within few minutes.

By using and detecting the electrical attenuation of the radar pulse it is possible to determine the cement content and allows therefore higher security for testing of a concrete type which must be controlled continually.

Note:

Concretes which do not conform to standards (e.g. tend to bleed), may lead to considerable fluctuations of the measuring values.

5.1 Measurement field of the SONO-WZ probe

The effective penetration depth of the SONO-WZ probe electrical measuring field is about 50mm around the probe surface.

It is to consider that with all dielectric measurement methods like TDR, microwave or capacitive, the electrical field distribution is not linear but exponentially. This means that the intensity of the electromagnetic field is the highest at the probes surface and decreases with more distance. In consequence this means that bigger gravels which lies tightly at the probes surface can influence the measurement field significantly.

To achieve a best possible result it is advisable to make several single measurements at different places inside the fresh concrete. With smaller grain sizes up to 4 single measurements, with bigger grain sizes more than 4 single measurements are necessary. The higher the number of single measurement cycles, the higher the average measurement accuracy1

Attention

Around the probe head of SONO-WZ there should be no metal parts during the measurement procedure, because metal can influence the electrical field. Best and easiest way is to use a plastic bucket filled with fresh concrete. To avoid air gaps the concrete should be compressed by several stamps of the bucket on the ground.

The probes surface must be clean and free of concrete crusts and if necessary the probes surface must be cleaned with a wire brush.

The probe head of the SONO-WZ must be completely immersed inside the fresh concrete during the measurement.

Not Correct!	Correct!
The measurement field of the probe is not completely inside the material	The measurement field is completely inside the material

When inserting the probe several times at the same place, there is the danger of segregation effects at this place. By removing the probe out of the fresh concrete, the space will be filled with fine and liquid particles which could lead to higher measurement values.

So it is important not to prick in the probe at the same place for several measurements.

5.2 Measurements of fresh concrete samples in a plastic bucket

It is necessary to perform a measurement of a fresh concrete sample in a plastic bucket because metal parts can influence an electrical field. The bucket should be not too small, minimum should be around 12 liters and the height should be large enough.

To avoid segregation, the fresh concrete inside the bucket should be not shaked. After insertion of the probe, the concrete can be compacted only a little by stamping three times to the bucket, so that the concrete lies closed to the probe´s surface at the dark ceramic plate.

It is recommend to carry out at least 4 to 5 measurements and take care to prick in the probe at different places at the edge of the bucket, shifted by 70 to 90 deg.

NOTE:

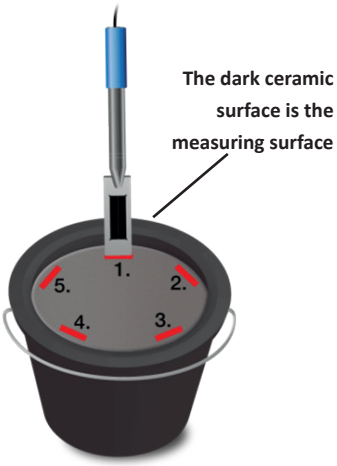
- **The probes surface must be clean and free of concrete crusts and if necessary the probes surface must be cleaned with a wire brush.**
- **The bucket should be filled minimum 30mm higher with fresh concrete than the probe length (180mm).**
- **The probe head should be placed inside the concrete with a slight angle, at the edge of the bucket.**

5.3 Measurement procedure for concrete with slump F2, F3 and F4

NOTE:

When taking a sample of the concrete for filling the bucket, make sure that the concrete is not segregated already during this procedure.

Use a 12 liter plastic bucket commonly used in the construction industry. Do not use a metal bucket (this will affect the electrical measuring field) or a larger bucket (this will result in non-desirable compression).



- Plunge the probe at a slight angle in position 1 on the edge of the bucket.
- Compact the concrete by kicking at the side of the bucket. This ensures that the concrete is optimally compacted on the probe surface.
- Perform a single measurement after compacting.
- Insert the probe about 45° to 90° at position 2 again at the edge of the bucket, kick and carry out another measurement.
- Repeat this process 4 to 5 times, whereby the probe is inserted about 45° to 90° at the edge of the bucket.
- The probe must not be moved during an active measuring process!

NOTE:

When conducting the measurement procedure, be aware of the following rules and empirical values:

1. Never plunge the device at the same spot in the bucket

2. Delete individual measured values if they deviate significantly from the mean value.

3. An increase in the number of individual measurements leads to an increase in accuracy.

4. At the start of the measurement procedure, it is recommended to carry out a test measurement and then delete this first individual value.

5.4 Measurement procedure for concretes with slump F5 and F6

NOTE:

When taking a sample of the concrete for filling the bucket, make sure that the concrete is not segregated already during this procedure.

Use a 12 liter plastic bucket common in the construction industry. Do not use a metal bucket (this will affect the electrical measuring field) and no larger bucket (this will result in non-desirable compression.

1. Only fill the bucket ¾ with concrete.
2. Plunge the probe head with the drawn-out tool shovel (made of plastic) vertically at the edge of the bucket completely into the concrete.

   The shovel ensures that larger pebbles do not move to the side of the probe head during the measurement, which could lead to deviations or increased measurement values.
3. Slowly push the probe head with the black ceramic surface in front to the opposite edge on the bottom of the bucket, with the handle resting on the edge of the bucket (see red arrows). This ensures that the concrete does not separate and that a representative concrete mix is in good contact with the probe surface. Take a measurement.
4. Repeat this process 4 to 5 times, whereby the probe is inserted about 45° to 90° at the edge of the bucket.

NOTE:

When conducting the measurement procedure, note the following rules and empirical values:

1. Never plunge the device at the same spot in the bucket

2. Delete individual measured values if they deviate significantly from the mean value.

3. An increase in the number of individual measurements leads to an increase in accuracy.

4. At the start of the measurement procedure, it is recommended to carry out a test measurement and then delete this first individual value.

5.5 Helpful references and findings from user practice

Mixing in the laboratory:

For mixing with dry aggregates, depending on the rock, a certain waiting time must be taken into account before the measurement takes place, as the saturation time depends on the type of rock. If the measurement is started too early on dry rock, the measured water content will be too high because the core water has not yet been absorbed by the rock!

Subsequent adding of water in the laboratory:

Subsequent mixing of water into a fresh concrete in the bucket (e.g. +50 grams of water to turn a concrete with 175 liters/m^3 into a concrete with 185 liters/m^3) leads to considerable deviations. During the mixing in drops of water can escape from an open bucket, in addition the water evaporates very quickly on the bucket wall. Depending on the mixing time, errors of up to 5 liters/m^3 may occur.

Air pores and glass fibers:

Air pores and glass fibers reduce the concrete density and thus the displayed moisture. This can be compensated with the parameter G-Set.

Concretes with steel fibers:

Measurement deviations can occur due to the steel content. This can be compensated with the parameter G-Set.

If the standard deviation StdDev value is still larger than 0.5 after significant more than 5 measurement cycles, the concrete mixture is probably too inhomogenous. In this case it is recommended to mix the concrete with a professional stirrer inside the bucket and place the probe again inside the bucket to perform more measurements.

6 Theory & Practice of the Water-Cement-Ratio Determination

6.1 The water / liquid proportions measured by SONO-WZ

In principle, SONO-WZ measures the same proportions of water as the kiln drying method.

1. **The effective water** in the concrete mix is the water which is considered for the w/c ratio. This water is the target value to be determined with SONO-WZ.

2. **Part of the core water**, water that is sucked up by the aggregates, whereby 1/3 of the core water is captured by SONO-WZ. Depending on the type of rock, the core water can be 2 up to > 50 liters per m^3.

3. **Additives** that behave like water are also captured by SONO-WZ, which must be taken into account.

The water content determined by kiln drying is composed of effective water, core water and additives:

Kiln drying water = Effective Water + Core water + Additives which behave like water

The SONO-WZ captures the entire effective water and a part of the core water. This must be taken into account when comparing the measured value against the kiln drying result. Since typical concrete recipes contain around 1/3 sand as an aggregate which is completely measured as a component of the cement paste, one can work with the distribution 1/3 to 2/3 as an initial orientation.

6.2 How to adjust the G-Set parameter

6.2.1 Measurement of the effective water with SONO-WZ:

SONO-WZ captures the active water and 1/3 (see above = cement paste) of the core water. This 1/3 of the core water must be compensated in order to correctly record the effective water. This means that the parameter G-Set needs to be set with 1/3 of the core water as a negative value in order to measure the content of effective water.

For example, if a rock takes 15 liters/m^3 of core water (typical), the correct setting of the G-Set parameter is 5 liters/m^3.

6.2.2 Measurement of the kiln drying water with SONO-WZ:

SONO-WZ captures the effective water and 1/3 (see above = cement paste) of the core water. The remaining 2/3 of the core water must be added to measure the kiln drying water. This means that the parameter G-Set needs to be set with 2/3 of the core water as a positive value in order to measure the content of kiln drying water.

For example, if a rock takes 15 liters/m^3 of core water (typical), the correct setting of the G-Set parameter is +10 liters/m^3.

If SONO-WZ shows too high water contents in special concretes, the **G-Set** can be reduced by the corresponding number of liters. The exact positive or negative value to be set as **G-Set** can be determined in two ways:

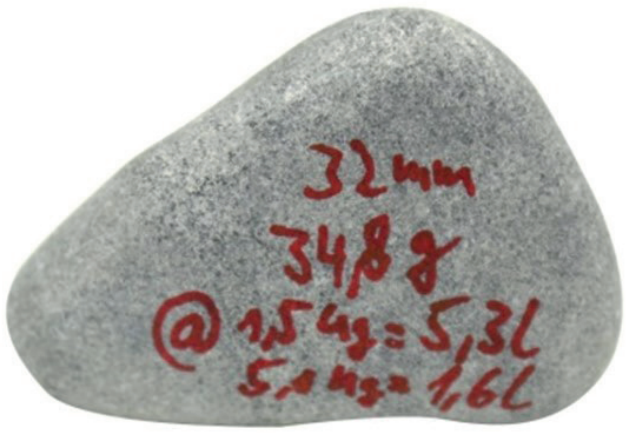
- By comparative measurements with several correct target water contents of the concrete. E.g. with concrete mixtures that were mixed with dry aggregates.
- By comparative measurements with several correct determinations of the water content by kiln drying.

6.3 Using “kiln drying” as a refernce measurement

Correct kiln drying is expert work. A kiln moisture measurement result by weighing of a sample would be falsified if free water would be bonded in cement due to a too long kiln drying time. Therefore kiln drying of fresh concrete must be performed very quickly, in order to prevent that free water in the mixture can be bonded to the cement.

Please be aware of potential sources of errors when kiln-drying:

1. With the same fresh concrete sample, deviations in ranges of +-3 to +-10 liters/m^3 are not unusual when drying with gas ovens or microwave ovens.
   a. By use of gas oven kilns, care must be taken that no amounts of solids are blown away in the air during drying, this would result in a too high moisture value. Fresh concrete samples may be stired during drying, or may not. Depending what method used, different results may be determined. Not-stiring bears the danger that the water will be bonded chemically inside the cement, due to a long drying time. This bonded water will even at high temperatures not evaporate.
   b. By drying with microwave ovens the drying time should be noted depending on the electrical power of the microwave oven as both parameters influence the evaporation. As the overall amount of concrete used with this method is comparatively small, it is important to use exact the same weights in consecutive measurements.
2. When taking concrete samples for kiln drying, considerable deviations may occur. There is the danger of segregation effects if the concrete was left in the bucket for a while. When taking samples of very liquid concretes at the bucket surface, the dried sample could have a considerably too high water content.
3. When weighing very hot dried samples, the weighing result may be influenced considerably due to lift forces of vertical hot air streams. When weighing a 4kg weight, dependent on weighing cell, the difference may be up to 30 grams forced by the hot air stream. 30 grams at 4kg weight corresponds to a moisture error of 0.75%. In worst case, these 0.75% moisture correspond to an error of +17 liter water per cubic meter.
4. Taking representative samples is very important: For example a 32mm gravel represents a water content of 5.3 Liter/m^3 when a small sample quantity of 1,5kg for microwave oven drying is used. With a higher sample quantity of 5kg for gas oven drying, this gravel still represents a water content of 1.5 Liter/m^3. In any way, and especially dependent on the used drying method, one gravel more or less can lead to significant errors.



To minimize the influence of potential errors for comparative measurements, we recommend to be aware of the above mentioned sources of error and to make use of the form “Construction Site Test” in the Annex.

A higher accuracy can be achieved, when a reference concrete is mixed by using absolute dry sand and dry gravel with and a precise addition of mixing water. Nevertheless care must be taken, as a long mixing time of small samples may also lead to an escape of water. For example, one minute mixing time of a small sample can lead to an error (loss) of up to-5 liter water/m^3.

6.4 Measurement of earth-moist concrete

Stiff concretes with slump values <30mm cannot be measured with the SONO-WZ by hand. They have air gaps and it is not possible to compress such concretes precise by hand.

In Preparation:

For this application a measurement procedure with a subsequent and defined addition of water into the earth moist concrete inside a 10 liter bucket is suggested. The subsequent addition of water is used to get from a stiff concrete to concrete with a fluid consistency. After measuring the water content of the concrete with fluid consistency, the water content of the earth-moist concrete can be recalculated by mathematics. More information on request!

6.5 Usefull hints and experiences from lab and field

6.5.1 Lab experience example 1: Problems with subsequent mixing

A lab test to check the SONO-WZ shows deviations diverging water cement ratios. The procedure is as follows:

1. About 8 Liter fresh concrete are measured in a bucket with SONO-WZ with a measurement result of for example 178 Liter/m^3 water.
2. Later +50 gramm water is added to the fresh concrete inside the bucket, which should lead to an increase of the water content from 178 Liter/m^3 to 184.25 Liter/m^3. After mixing during one minute of the concrete in a small mixer, the concrete is tested for slump and raw density. The tested concrete then is refilled in the bucket for measuring the water content again with SONO-WZ.
3. The measurement result with SONO-WZ shows the expected 184.25 Liter/m^3, for example 181 Liter/m^3.

What causes the deviation?

During mixing of the concrete in a small and open mixer, water escapes because the water adheres to open surfaces and evaporates quickly. With further test of slump and raw density, there are additional extensive surfaces where water and fine particles adhere.

Double testing with SONO-WZ before and after a second intensive mixing will lead to decreasing water contents. A one minute mixing may lead to a loss of about 3 Liter/m^3 water.

→ Subsequent mixing of concrete will reduce the water content and lead to significant measurement deviations!

6.5.2 Lab experience example 2: Problems with completely dried aggregates

When using dry aggregates in the lab, it is necessary to wait a certain delay before controlling the water content with SONO-WZ. A dry rock needs time for saturating. The time for saturation of the rock is dependent on the type of rock. Perhaps 5 to 10 minutes delay time can be necessary dependent on the type and physical characteristic of the rock.

As an example the measured water content of SONO-WZ can start with 185 liter/m^3 after mixing of the concrete with absorbent aggregates and can reduce to 180 liter/m^3 after 10 minutes waiting time.

→ When using dry aggregates in the lab, it is necessary to wait a certain delay before controlling the water content of the fresh concrete with SONO-WZ.

6.5.3 Field experience example: Sampling in the transport concrete plant

Mixing time in transport concrete plants often is very short to increase the throughput. Full homogenization finally takes place during the transport in the transport truck.

In this example a concrete sample was drawn directly from the twin-shaft mixer into a bucket. The sample with a normally distributed sieve line and a water nominal value of 170 liters/m^3 was measured using the SONO-WZ with 170 liters/m^3. Following that, another sample quantity of 5 kg was dried in a kiln dryer. The calculated kiln drying value resulted to 149 liters/m^3.

What causes the deviation?

Fast and short time mixing in the twin-shaft mixer resulted in a mixed but inhomogienious distribution of large gravels in the sampling. These large gravels have led to a considerable error in the sampling, the kiln drying sample contained more than average large gravels. This pulled the measured value downwards to 149 liters/m^3 because gravels have no water content.

The following table illustrates the influence of a little number of large gravels on the water cement ratio:

	luence on the water content of the gravels during sampling	**Example recipe with relatively high fine content and little 16/32mm gravel content**	**Recipe B with a gap grading recipe, little 4/8mm and high 16/32mm gravel content**
Concrete sample of 1,5 kg 	2 large gravels more or less cause a deviation of 9 Liter/m^3 more or less	1,5 kg sample contains approx. 5 pieces 16/32mm gravels 	1,5 kg sample contains approx. 15 pieces 16/32mm gravels 
Concrete sample of 5,0 kg . 	2 large gravels more or less cause a deviation of 3 Liter/m^3 more or less	5 kg sample contains approx. 16 pieces 16/32mm gravels 	5 kg sample contains approx. 100 pieces 16/32mm gravels 

A single 16/32mm gravel weighs between 10 to 50g. If one assumes an average of 20 g per gravel, the procedure of sampling needs to be done very accurate with high precision.

A very small number of gravels being in the sample or not, do change the theoretical result by a significant volume of water.

The smaller the sample weight is, the more accurate the procedure needs to be conducted.

7 Recipe Handling and Archiving

With the proper adjustment of the parameters Density, CHAR (fine, coarse, normal, special), as well as the G-Set, a good matching of the water cement ratio with the reference methods can be achieved.

With repeated use of different concrete recipes and for obtaining the best possible result in accuracy, it is recommended to note the required settings of Density, CHAR, and G-Set together with the type or variety of concrete.

A table like in the following example can be used to archive CHAR, Largest Gravel Size and G-Set:

Type or Variety of Concrete	Nominal Raw Density	Parameter CHAR	Parameter G-Set
F600TL	2.422	coarse	-10
AAV2	2.441	normal	-5
163802	2.330	normal	-7
3716CL	2.367	fine	-12

8 Form “Construction Site Test”

Date:	**Construction Site:**	**Concrete type: (C20/25…):**
Nominal raw density according recipe:	**Nominal water content according recipe:**	
Cement type and quantity in kg: e.g. CEMI, CEMII, CEMIII, CEM IV, etc. 32,5 350kg	**Admixtures like fly ash in kg:**	**Chemical additives in liter:**
Amount of aggregates in kg or %: **Sand Gravel 1 Gravel 2 Gravel 3**		**Core moisture (water in liter/m³):**

Kiln drying water content and further information:

Kiln drying method (microwave, gas oven):	**Kiln water content by oven drying in l/m3 inclusive core moisture:**	**Kiln quantity in kg:**	**Kiln drying time:**

Set values of SONO-DIS:

Raw densitiy in kg/dm³:	**CHAR-Parameter (fine, coarse, normal or special):**	**G-Set, fine adjustment for type of concrete and rock type with core water:**

Determined values of the SONO-DIS:

Raw densitiy in kg/dm³:	**CHAR-Parameter (fine, coarse, normal or special):**
EC-TRIME in dS/m:	**Number of values:**
Radar time tp (with longer pressing of the button ▲, the radar time in Picoseconds is displayed.	

Please fill out completely!

9 Technical Data SONO-WZ

9.1 Technical data SONO-WZ probe

Power supply:	7V..24V-DC
Power consumption:	100mA @ 12V/DC during 2..3sec. of measuring
Water content measuring range:	Up to 0..100% moisture content
Repeated accuracy:	±2 liter /m^3
Absolute accuracy:	±3% from the total quantity of water
Conductivity range:	0..50dS/m
Range for water/cement ratio	from 0.4 to >1
Measuring volume:	0,5 Liter
Operating temperature:	0°C...50°C
Calibration:	Universal calibration for fresh concrete
Probe body:	Stainless steel and ceramic, sealed to IP68
Size:	155 x 60mm
Interface:	1,5m cable with 7-pin female connector

SONO-DIS with SONO-M1

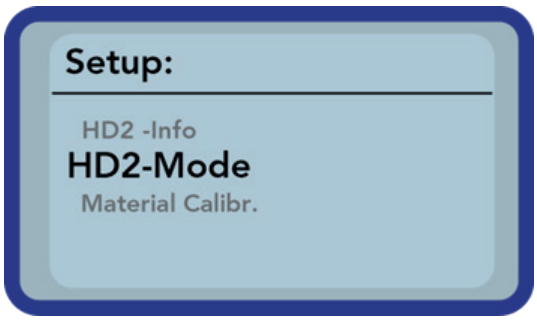
SONO-M1

Mobile moisture probe for sand, gravel, crushed stone and expanded clay.

1 General Settings

1.1 Settings

There are various options to modify and align the settings of the SONO-DIS handheld device. You will reach the following menu configuration by pressing the button „Settings“ :



By actuating the buttons „Up“ and „Down“ , the entry intended for processing can be marked and subsequently be selected with the button “Measurement” . You can exit the current menu item and also the menu “Settings”, with the button “Settings” .

An Overview of the Setting Options

Settings	Designation
HD2-Mode	Switching the Operating Mode • Normal“ → measurement of the variables Moisture, Temperature, and EC-TRIME “Average Value“ → determination of the average value of up to 6 individual moisture measurement values • „Water Calculation“ → Calculates the content of water of the material in l/m³
Material calibration	• Choosing or change the Material Calibration
Detect Probe	A new search for a connected probe (if an error has occurred during the activation of the device)
Language	Switching the System Language • German • English
Auto-Power-Off	Setting of the automatic shut-down
Display Lighting	Setting of the Background Lighting • Turn-Off-Time • Intensity
LCD-Contrast	Setting of the ideal contrast
Probe Info	Information regarding the probe
HD2-Info	Information regarding the SONO-DIS handheld device

1.2 SONO-DIS-Mode

In this menu item, the operating mode of the SONO-DIS handheld device can be changed.

With the selection „Normal“, an individual measurement of the three probe parameters Moisture, Temperature and the EC-TRIME is selected.

The parameter Moisture is, depending on the selected calibration, showing the moisture in volumetric or gravimetric percentage or showing the running period of the TDR pulse. When showing the running period of the TDR pulse, the unit is „ns“.

When selecting “Average Value”, depending on the selected calibration, only the moisture in %vol or %grav, respectively the running period in “ns”, is determined. The measured value is stored in a list of up to 6 measurement values. The arithmetic average is determined from the shown values.

NOTE:

Only a maximum of 6 values can be stored in the list. Older values are removed from the list and are not used for the calculation of the average value.

The selection “Water Calculation” will switch on the mode determining the content of water in l/m³ of the measured material. To get the moisture of a bigger volume, it is recommended to probe at various places of the material. The single values will calculated up in one average value.

By actuating the buttons „Up“  and „Down“  , the entry intended for processing can be marked and subsequently be selected with the button “Measurement”  . After the selection, the symbol  will appear in the upper right hand display corner which indicates that the selection is activated and has been stored.

The SONO-DIS handheld device offers three operating modes:

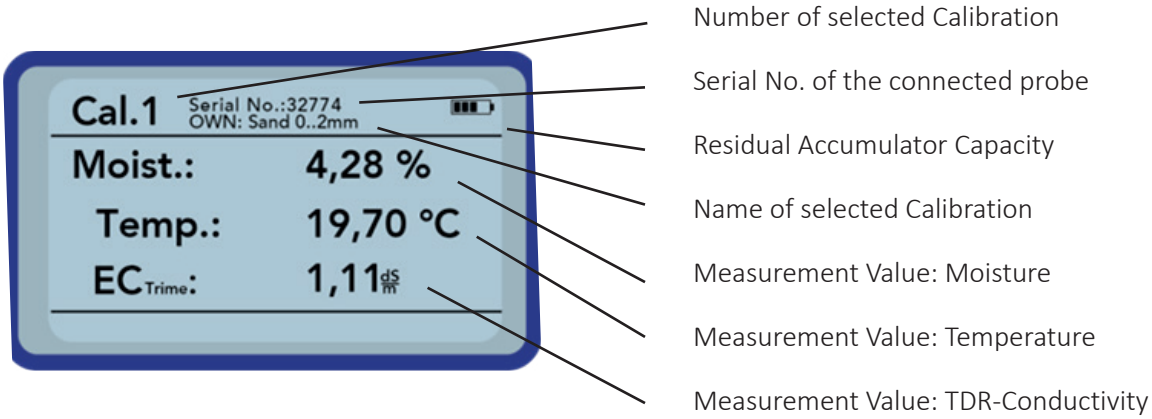
1. Normal → Individual Value Display – presents the measurement variables Moisture, Temperature and the EC-TRIME
2. Average Value → presents the average value of the moisture of up to 6 individual measurements
3. Water calculation → determines and presents the content of water in l/m³

NOTE:

During a measurement, no further actions are possible. It is necessary to wait until the measurement is concluded.

1.3 Operating Mode „Normal“

After switching on the SONO-DIS handheld device, the following display will appear in the operating mode „Normal“ after the start screen:



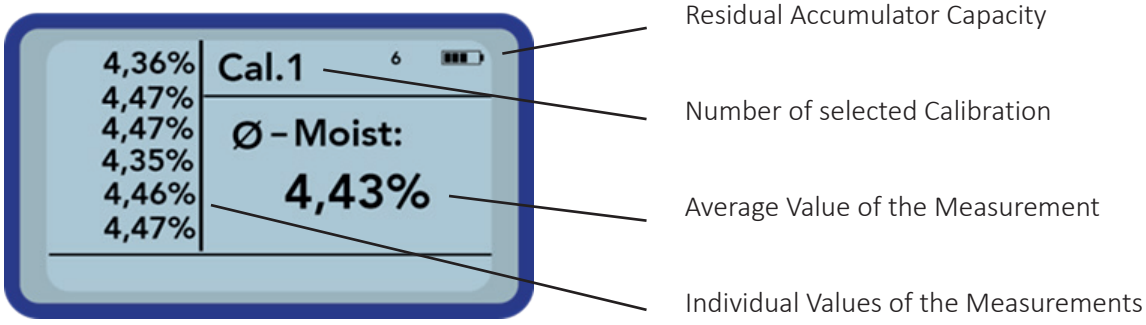
In order to initiate a measurement, shortly press the button “Measurement” . The measurement will commence and a turning -symbol will appear instead of the accumulator-symbol in the upper right hand corner. During this period, no other actions can be performed. The measurement requires approximately 4 to 5 seconds.

Once the measurement is concluded, the accumulator-symbol will reappear and the measured values will be generated on the display. The displayed results will remain until a new measurement is started.

1.4 Operating Mode „Average Value“

In this operating mode, only the moisture is measured and an average value of up to 6 individual values is calculated. Depending on the set calibration, either the volumetric or the gravimetric moisture is presented.

After switching on the SONO-DIS handheld device, the following display will appear in the operating mode „Average value“ after the start screen:



In order to initiate a measurement, shortly press the button “Measurement” . The measurement will commence and a turning -symbol will appear instead of the accumulator-symbol in the upper right-hand corner. During this period, no other actions can be performed. The measurement requires approximately 4 to 5 seconds.

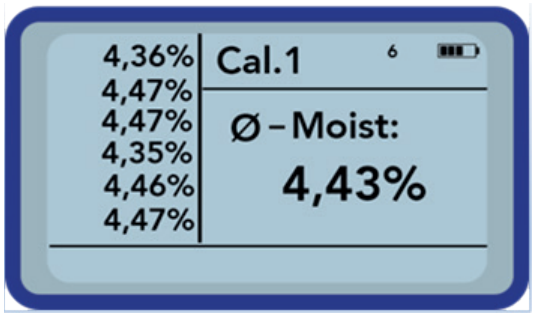
Once the measurement is concluded, the accumulator-symbol will reappear. On the left-hand side of the display, the individual values of the measurements will be presented. The currently measured value is presented at the top and old values will be shifted one position onwards. The arithmetic average value is displayed on the right-hand side. The average value is calculated out of the existing individual values up to a number of 6 values.

NOTE:

Only a maximum of 6 values can be stored in the list. Older values are removed from the list and are no longer taken for the determination of the average value

In order to delete the measurement series, actuate the button „Down“ ▼.

TIPP!

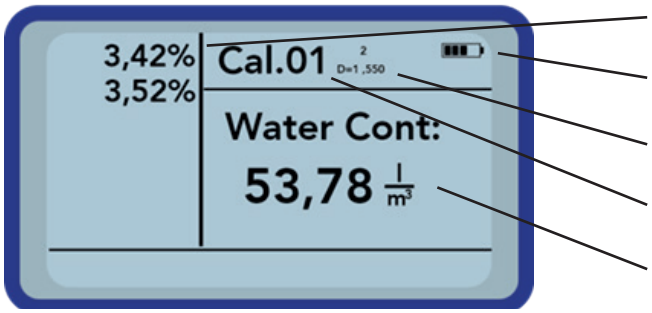


Within the operating mode „Average Value”, the SONO-DIS will deliver a representative measurement result for the volume of the material..

1.5 Operating Mode „Water Calculation“

In this operating mode, only the variable Moisture is measured. There will be up to six single values stored and concluded to an average value. Out of this the water content per m³ is calculated. To get the correct water content it is necessary to set up the density of the measured material.

The measurement is initiated by actuating the button „Measurement“ ↻. Repeating this will add another measurement value. The average water content will be calculated and displayed.



Individual Values of the Measurements

Residual Accumulator Capacity

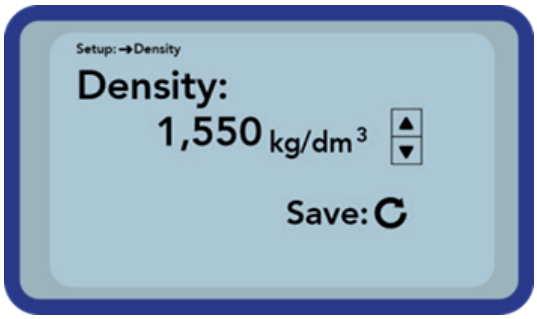
Density in kg/dm³

Number of selected Calibration

Average of Water content in l/m³

In order to delete the measurement series, actuate the button „Down“ ▼.

To set up the density of your material, actuate the button „Up“ ▲. Then you will get the following screen in the display:

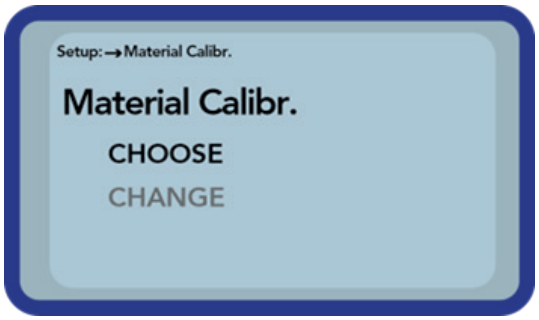


Adjust the density of your material by actuating the buttons „Up“ ▲ and „Down“ ▼. Confirm your setting by pressing the button “Measurement” ↻. You will get back to the measurement screen. Leave the setting without changing the density by pressing the button „Settings“ 🗁.

1.6 Material Calibration

Depending on the task of the deployment, various calibrations are deposited in the probe. These can be volumetric calibrations for grounds of various densities, gravimetric calibrations for the measurement of sand moisture contents, or also running period calibrations.

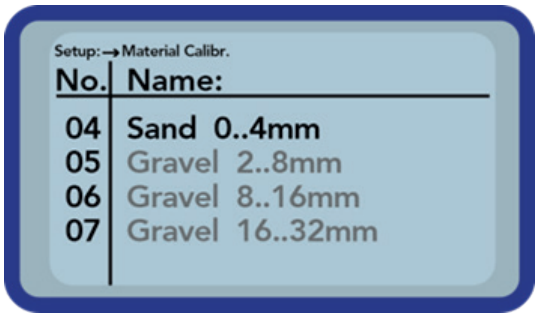
You can select the calibration required for your application within the menu item „Material Calibration“. This enables to cover a multitude of deployment options with merely one probe. Also it is possible to setup your own calibration, to enable the measurement of special materials.



After the selection of the menu item „Material Calibration“, you have to choose between “CHOOSE”, to save one out of fifteen calibration as default calibration, or “CHANGE”, to setup an individual new calibration in one of the fifteen calibration storages.

1.7 Menu Item: “CHOOSE”:

The 15 calibration options are displayed by name. This requires a short moment of time. A display in a similar form as follows will be presented:



The list can be scrolled and the desired calibration be selected by actuating the buttons „Up“ and „Down“ .

The “!“ in front of a calibration indicates the currently active one. You can set the selected calibration to become the active one by actuating the button „Measurement“ .

After a short moment, the symbol will appear in the upper right hand display corner to indicate that the selection has been activated. In addition, the „!“ will be placed in front of the now active calibration.

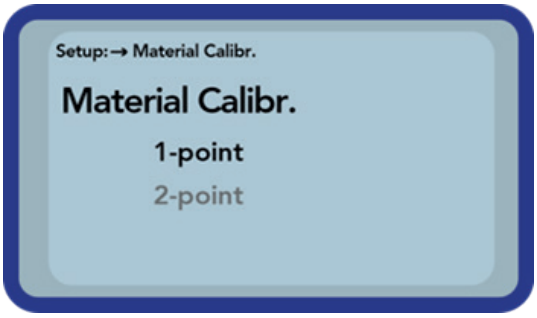
TIPP!

NOTE:

Get to this menu item directly out of the measurement screen, by actuating the button „Up“

Menu item: “CHANGE”:

In this menu an own material calibration can be set, or an existing one can be changed according the individual requirement. Two options are available:



1 point calibration:

- Shifts an existing calibration curve to a choosen moisture point.
- The gradient isn’t changed.
- Only one measurement is necessary.

2 point calibration

- Creates a linear calibration between two measured moisture points
- Two material samples with different moisture values are necessary

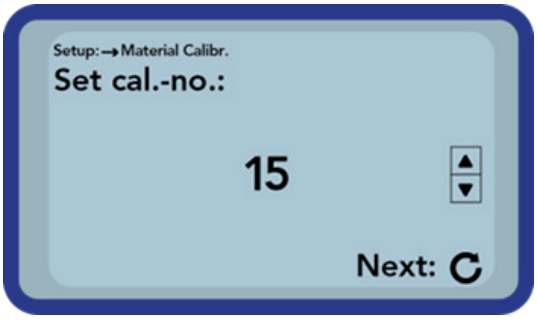
1.7.1 1 Point Calibration

In this material calibration option an offset of the appointed calibration is done. As no change of the calibration curve gradient is proceeded, it is necessary to choose a calibration curve that fits to the material.

NOTE:

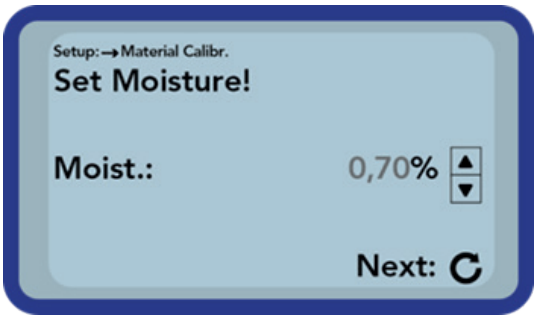
To perform a 1-point material calibration you need a sample of the material to be measured. The moisture of this material has to be exactly determined with another method before starting the calibration.

Procedure



First you have to set the calibration curve to be changed (01 – 15) by pressing the buttons „Up“ ▲ and „Down“ ▼.

Apply your setting by actuating the button „Measure ment" ↻.



Next set the moisture of the material by pressing the buttons „Up“ ▲ and „Down“ ▼. Apply your setting by actuating the button „Measurement“ ↻.

To start the measurement of the material press the button „Measurement“ . To improve the accuracy, four measurements will be taken.

The individual values are averaged. The duration of a measurement takes around 20 seconds. After each measurement the signal runtime will be displayed for a short period.

NOTE:

Ensure that the probe rods are totaly covered with the material during the time of the measurement and that the probe is not moved.

Attention:

If you choose “SAVE” at the end of calibration, the stored calibration in the probe electronics will be overwritten! The original calibrations can be restored by connecting the probe with a RS485 adapter (for example SM-USB) to a PC and to use the software PICO-Config.

Finally, you can store the calibration into the choosen calibration storage inside the probe. Choose „SAVE“ and confirm by pressing the button „Measurement“ .

If you choose “DISCARD” everything is left untouched.

To name of the changed calibration, is the original with the prefix „OWN:“.

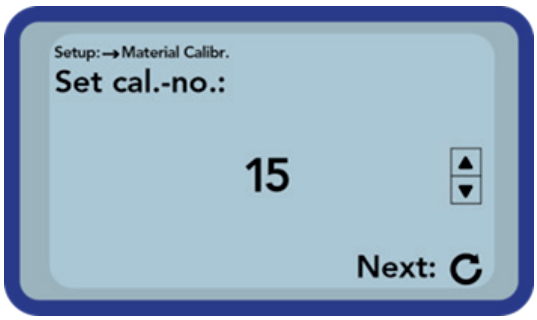
1.7.2 2 Point Calibration

During the 2-point material calibration, two material samples with different moisture values are measured. From these measurements, a linear equation (f(x) = mx + b) is calculated. This linear equation delivers very good measurement results especially in lower moisture values.

NOTE:

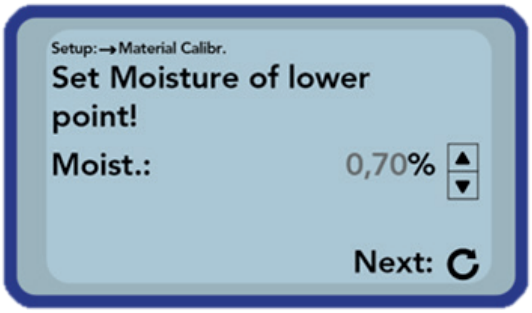
To perform a 2-point material calibration you need two material samples with different moisture values. You have to determine the moisture of these materials using another method before starting the calibration. The given sequence, first to measure the lower moisture point and second to measure the higher moisture point must be strictly followed.

Procedure



First you have to set the calibration curve to be changed (01 - 15) by pressing the buttons „Up“ ▲ and „Down“ ▼.

Apply your setting by actuating the button „Measurement“ ↻.



Next set the moisture of the lower moisture point by pressing the buttons „Up“ ▲ and „Down“ ▼.

Apply your setting by actuating the button „Measurement“ ↻.

To start the measurement of the material press the button „Measurement“ ↻. To improve the accuracy, four measurments will be taken. The individual values are averaged. The duration of a measurement takes around 20 seconds. After each measurement the signal runtime will be displayed for a short period.

NOTE:

Ensure that the probe rods are totaly covered with the material during the time of the measurement and that the probe is not moved.

Next set the moisture of the higher moisture point by pressing the buttons „Up“ ▲ and „Down“ ▼.

Apply your setting by actuating the button „Measurement ↻.

To start the measurement of the material press the button „Measurement“ . To improve the accuracy, four measurments will be taken. The individual values are averaged. The duration of a measurement takes around 20 seconds. After each measurement the signal runtime will be displayed for a short period.

NOTE:

Ensure that the probe rods are totaly covered with the material during the time of the measurement and that the probe is not moved.

Attention:

If you choose “SAVE” at the end of calibration, the stored calibration in the probe electronics will be overwritten! The original calibrations can be restored by connecting the probe with a RS485 adapter (for example SM-USB) to a PC and to use the software PICO-Config.

Finally, you can store the calibration into the choosen calibration storage inside the probe. Choose „SAVE“ and confirm by pressing the button „Measurement“ .

If you choose “DISCARD” everything is left untouched.

To name of the changed calibration, is the original with the prefix „OWN:“.

TIPP:

Save your calibrations which are stored inside the probe to your PC. A RS485 adapter (such as SM-USB) and the software PICO-Config is required. With this method, individual calibrations can also be transferred to other probes.

1.8 Detecting Sensor/Probe

In the event that that communication problems arise with the probe at the activation of the SONO-DIS handheld device, or if no probe was connected, or it is intended to exchange the probe during operation, this menu item should be selected.

After selection of this menu item, the SONO-DIS will again attempt to establish a connection to the connected probe. If this attempt is successful, the serial number of the probe will appear in the display. Should a connection not be possible, „No probe detected“ will be generated on the display.

NOTE:

Should no connection to the probe be possible in spite of several attempts, check if the probe is connected properly. Should this not deliver a positive result, please contact our service department.

1.9 Language

In this menu item, the language of the SONO-DIS handheld device can be selected. English and German can be set. You can select the desired language by actuating the buttons „Up“ and „Down“ and activate the same via the button „Measurement“

After activation of the language, the symbol will appear in the upper right hand corner of the display.

1.10 Auto-Power-Off

In the menu item „Auto-Power-Off“, you can select an automatic shut-down offered in various time periods.

The following shut-off times can be selected:

- 1 Minute
- 2 Minutes
- 5 Minutes
- 10 Minutes
- 20 Minutes

The automatic shut-down function can be deactivated by choosing „-min“.

For this purpose, select the desired shut down time by actuating the buttons „Up“ and „Down“ and activate the same via the button „Measurement“ .

After activation, the symbol will appear in the upper right hand corner of the display.

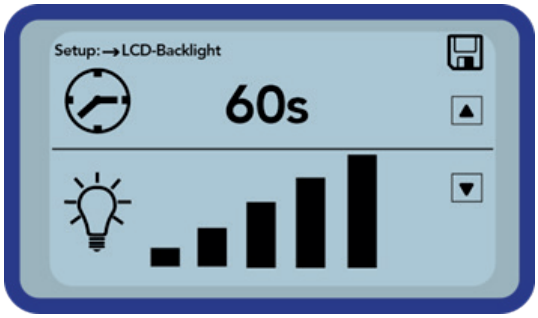
NOTE:

The SONO-DIS will only automatically shut down if no further button is actuated. Any actuation of a button will start the shut down time again.

1.11 Display Illumination

If required, the background illumination of the display can be individually adjusted. Consequently, this enables the option to save power and to prolong the operational period.

After the selection of the menu entry, the following screen will be presented on the display:



The selection of the background illumination, respectively the time until the automatic shut-down of it is selected via the button „Up“ by actuating it several times.

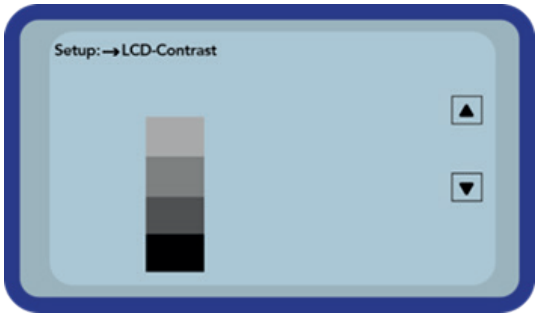
Using the button „Down“ , is used to adjust the intensity of the illumination, respectively turn the same completely off.

Activate and store your settings by actuating the button „Measurement“ .

After activation, the symbol will appear in the upper right-hand corner of the display

1.12 Display Contrast

At extreme temperatures, it may be necessary to adjust the contrast of the display in order to be able to clearly read the display. For this purpose, select the menu item „Display Contrast“.



Change the contrast by actuating the button „Up“ , respectively „Down“ .

Set the contrast that you can realize the whole grayscale on the diagram. Activate and store your settings by actuating the button „Measurement“ .

After activation, the symbol will appear in the upper right hand corner of the display.

1.13 Probe Info

By selecting this menu item, the display presents information regarding the connected probe.

These are:

- Serial Number
- Probe Type
- Hardware Version (HW)
- Firmware Version (FW)

1.14 SONO-DIS-Info

By selecting this menu “item”, the display presents information regarding the SONO-DIS handheld device.

These are:

- Serial Number
- Hardware Version (HW)
- Firmware Version (FW)
- Accumulator Capacity
- Accumulator Voltage

2 Measurment Volume | Probe Dimensions

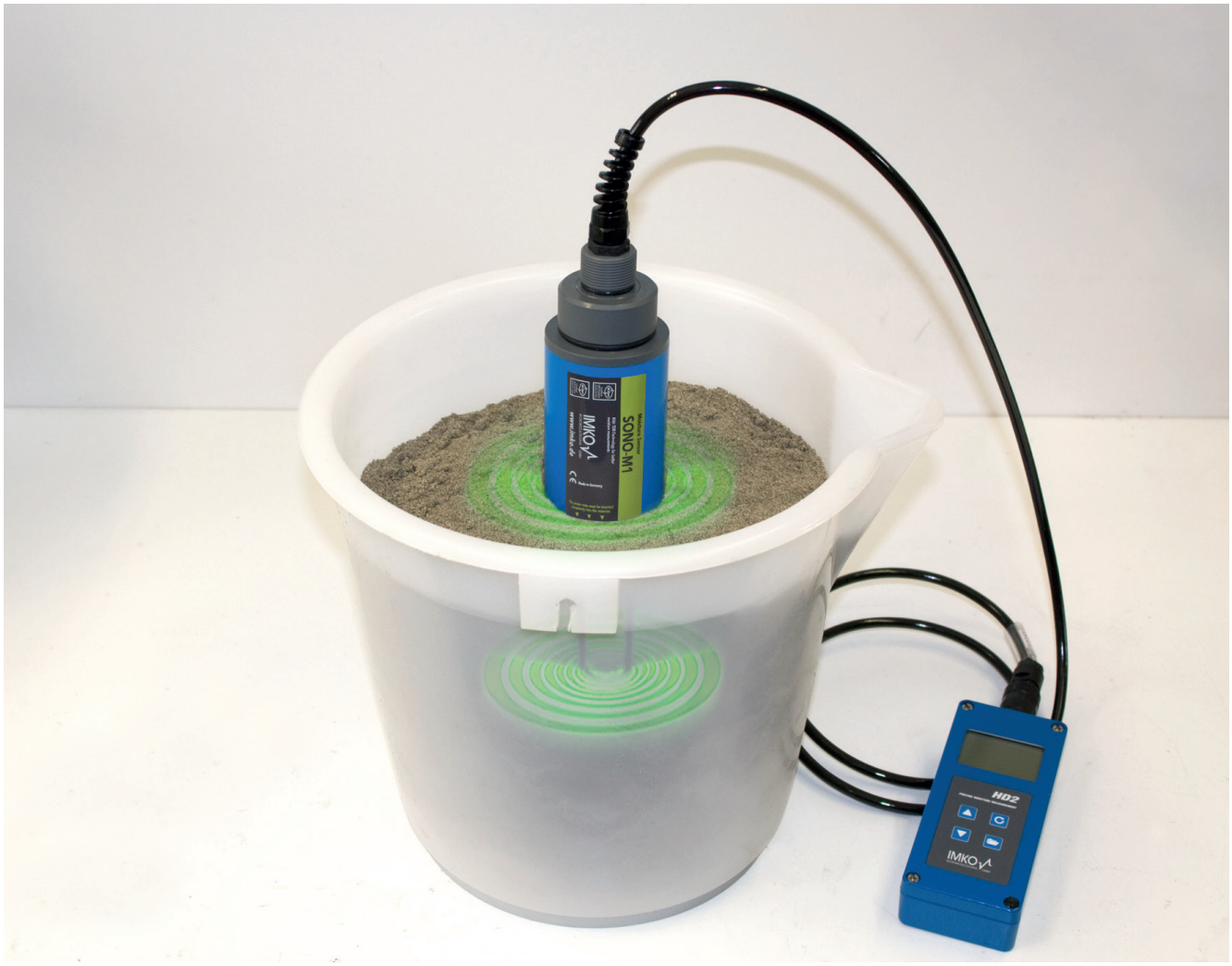
2.1 Introduction

In theory the penetration depth of the electrical and magnetic flux lines reach indefinitely far into the measured material. However, the effective penetration depth of a SONO-M1 probe relevant for the measurement is approximately cm in the vicinity of the probe rods. The illustration demonstrates the effective measurement volume (green waveform). The measurement field is large enough to generate adequate and reliable information about arepresentative volume of the measured bulk good.

2.2 Measurement Volume of the SONO-M1 Probe

The penetration depth of the electrical and magnetic flux lines in theory reach indefinitely far into the measured material. However, the effective penetration depth of the SONO-M1 probes relevant for the measurement is approximately 2 cm in the vicinity of the probe rods.

The illustration demonstrates the effectively registered measurement volume (green waveform).



3 How to use the SONO-DIS kit

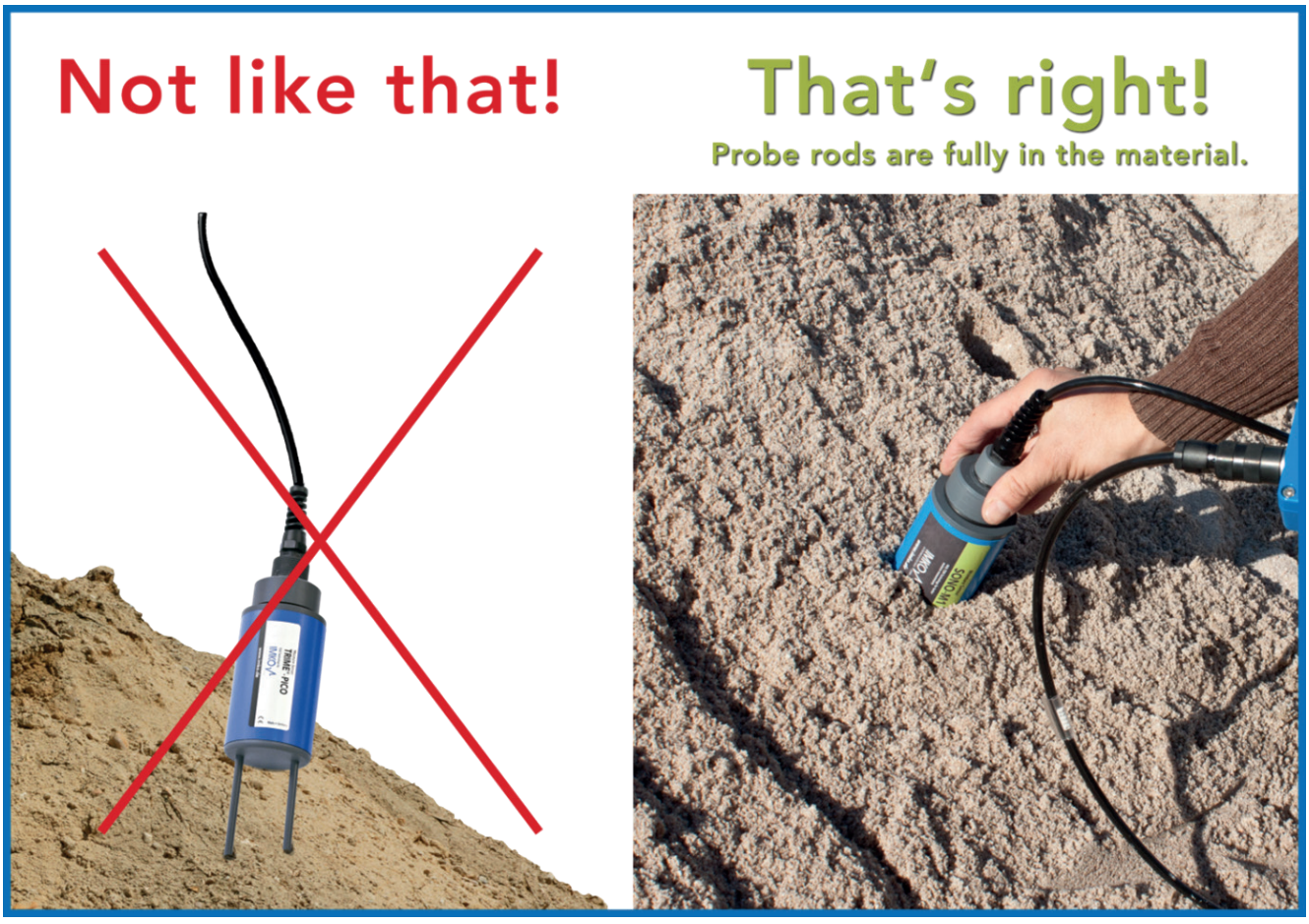
3.1 Measurements directly in the sand and gravel pile

For measurements in sand and gravel pile, make sure that the probe rods are inserted in the material down to the gray probe bottom, so that the rods are in any case fully covered by the material.

To obtain a representative moisture value of the material, select the operating mode "Average Value" and take measurements at different locations.

NOTE:

After rain, the material is usually more wet in surface areas compared to the core volume. Of course this is vice versa after periods of drought. Then, the material dried up on the surface, but contains more water in the core volume. Therefore it is recommended to measure at different locations of the pile

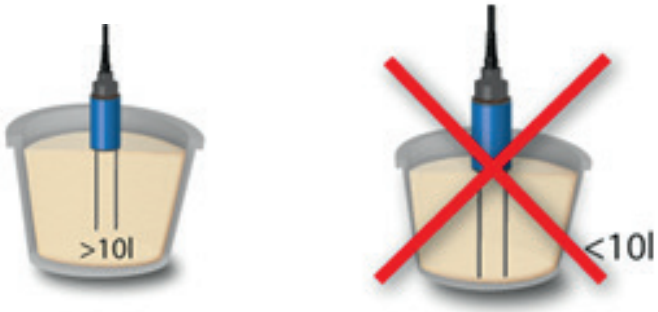


3.2 Measurement of laboratory samples in the bucket

Following requirements are mandatory, to ensure the optimal accuracy of the system:

- The probe rods must be covered completely by the material

- The bucket must have a volume of 10 liters or more. Never use a metal bucket, the metal is disturbing the measurement field of the probeDer Behälter sollte annähernd **zylindrisch** sein



- The bucket should be as far as possible cylindrical, to prevent compaction of the material

- The filling depth of the bucket must exceed the rod length by minimum 5cm

- The SONO-DIS Kit is high precission measurement device. Carefully follow the above requirements to achieve repeatable, reliable and precise results from your measurements.

The SONO-DIS Kit is high precission measurement device. Carefully follow the above requirements to achieve repeatable, reliable and precise results from your measurements.

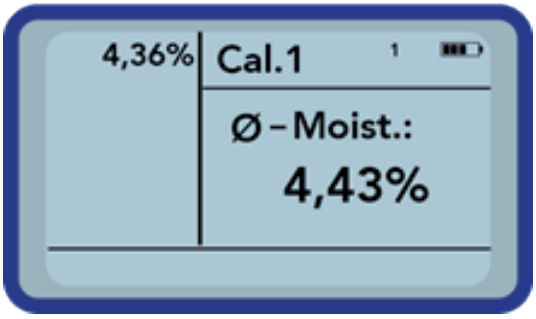
1. Dump the sand sample into the bucket.

2. Compact the sand sample by lifting the bucket 5cm and letting it fall down vertically onto a solid base and repeat this procedure 5 times (if you still observea compaction after 5-times, repeat this procedure until there is no more compaction to see!)

3. Sand: Insert the probe rods into the sand completely, until the gray probe body reaches the surface of the sand and press until you feel counter pressure of the sand (neither jiggle nor rotate the probe while inserting)

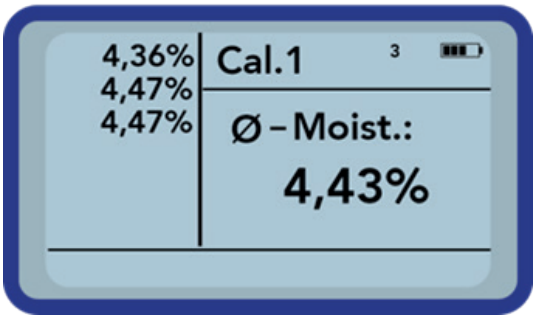
Gravel/ Grit: For gravel and grit also compact the material before inserting the probe, additionally jiggle the bucket while inserting the rods, as the sensor else is difficult to insert. Additionally this procedure helps to ensure, that the material is in good contact with the probe rods)

4. Follow the measurement instructions in Chapter 4.3.1.2 Operating Mode „Average Value”



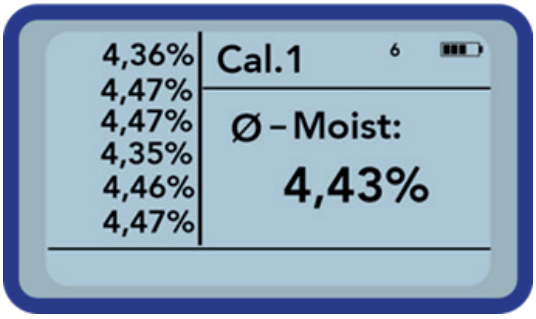
5. After the measurement pull the probe out of the material and loosen up the material again by shaking the bucket.

6. Follow the instructions point 2 to point 4 two more times to obtain in total three averaged measurement values.



7. Fill the material into another bucket, as then the bottom layers are on top and vice versa. This procedure is in particular important for material near the saturation point, as free water may build up at the bottom layers.

Follow the instructions point 2 to point 4 three times to obtain in total another three averaged measurement

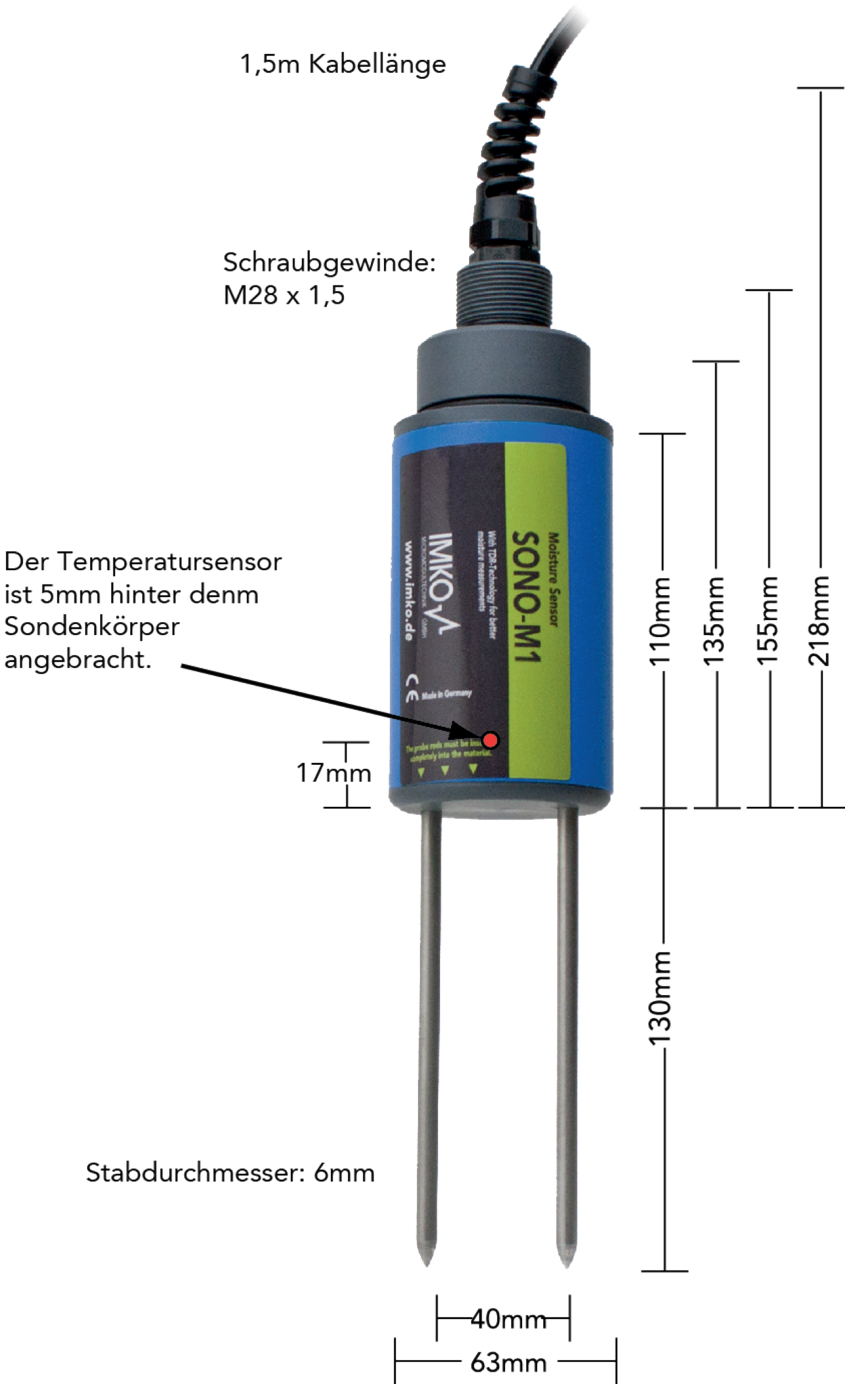


8. In total six averaged measurements are available now. The representative value for the probe is the average value out of these six measurements.

4 Technical Data SONO-M1 Probe

4.1 Probe dimension SONO-M1

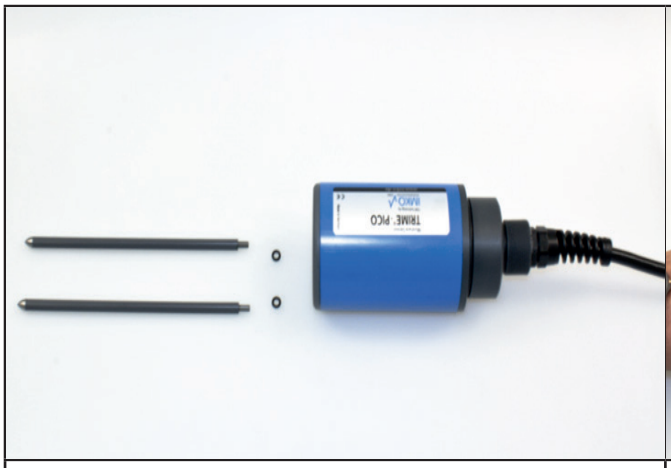
- For measurement of the moisture content in sand, and gravel
- State-of-the-art sensor with integrated TDR-electronics
- Measurement Value Range 0..40 vol.%
- Integrated Temperature Sensor
- Deployable up to more than 5dS/m Total Conductivity (Bulk-Soil-Conductivity).
- Measurement Volume ≅ 1000ml
- Robust (IP68), proven, and suited for long-term usage



Technical Data

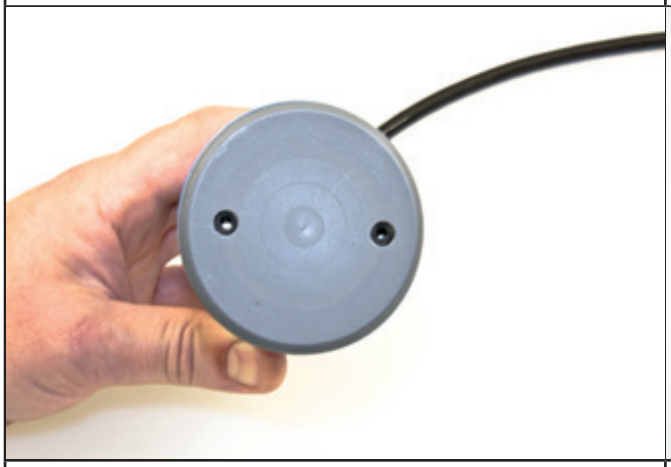
Power supply:	7V..24V-DC
Power consumption:	100mA @ 12V/DC during 2..3sec. of measuring
Moisture measuring range:	0..100% volumetric water content
Accuracy (in % volumetric water content):	±0.2%
conductivity range:	0..5dS/m
Repeating accuracy:	±0.3%
Temperature caused drift of lectronics (full range):	±0.3%
Material temperature measuring range:	-15°C...50°C
Material temperature measuring accuracy:	±0,5°C (permanent installed inside the probe)
Measurement volume:	1,0L ≅ 130x100mm diameter
Operating Temperature:	-15°C...50°C
Calibration:	Calibration for sand and gravel is installed
	customizable material specific calibration storage of up to 15 user defined calibration curvescalibration of dielectric permittivity is possible
Probe body:	waterproof sealed PVC (IP68)
Size:	155 x Ø63mm
Rod lenght::	standard: 130mm
Rod diameter:	6mm
Interface	1,5m cable with 7-pin female connector

5 Exchange of the Probe Rods



1) Prepare the gaskets, the probe body and the probe rods

2) Press the gaskets into the bore holes



3) Press the gaskets until they reach the interior thread

4) Screw the rods into the probe body

6 Safety Notes

In this documentation, text points are highlighted, which require special attention.

DANGER:

The Warning Triangle with the exclamation mark warns you against personal injury or property damage.

Intended Use

Sensors and measuring systems of IMKO GmbH may only be used for the purpose described, taking into account the technical data. Misuse and use of the equipment other than for its intended purpose are not eligible. The function and operational safety of a sensor or measuring system can only be guaranteed if the general safety precautions, national regulations and the special safety instructions in this operating manual are observed during use.

The moisture sensors and measuring systems of IMKO GmbH are used to measure moisture according to the measuring purpose and measuring range defined and defined in the technical data. Only adherence to the instructions described in the manual is regarded as intended use. The manual describes the connection, use and maintenance of IMKO sensors and IMKO measuring systems. Read the manual before connecting and operating a sensor or measuring system. The manual is part of the product and must be kept close to the sensor or measuring system

Impairment of safety

The sensor or the measuring system has been designed and tested in accordance with EN 61010 safety regulations for electronic measuring instruments and has left the factory in a safe and safe condition. If the sensor or the measuring system can no longer be operated safely, it must be put out of operation and secured by means of marking before further commissioning. In case of doubt, the sensor or the measuring system must be sent to the manufacturer or his contractual partner for repair or maintenance.

Modifications

For safety reasons, it is not permitted to carry out any modifications or modifications to the sensor or the measuring system without the consent of the manufacturer. The opening of the sensor or hand-held meter, adjustment and repair work, as well as all maintenance work other than the work described in the manual may only be carried out by a specialist authorized by IMKO. The sensor or the measuring system must be disconnected from the power supply before installation or maintenance work. Do not open or repair the hand-held unit and the power supply!

Hazard Warnings

Danger due to improper operation. The sensor or the measuring system may only be operated by instructed personnel. The operating personnel must have read and understood the operating instructions.

Danger by electricity

The hand-held meter must not be immersed in water or other liquids. The sensor is insensitive to moisture contained in the typically measured products. Only connect the hand-held meter to a properly installed outlet with the supplied voltage supply cable, the voltage of which corresponds to the technical data.

Make sure that the power outlet is well accessible, so that you can unplug the power supply quickly if necessary. Use only the adapter that is suitable for your outlet.

Only operate the meter with the supplied original accessories. If you need additional accessories or replacement, please contact the manufacturer.

- Do not use the meter in following case:
- if the measuring instrument, sensor, plug-in power supply or accessories are damaged,
- the sensor or the measuring system does not operate as intended,
- the power cord or plug is damaged,
- the sensor or the measuring system has fallen down.

Unplug the power supply from the wall outlet in following case:

- if you do not use the sensor or the measuring system for an extended period of time,
- before cleaning, unpacking or changing the sensor or the measuring system,
- if you are working inside the sensor or measuring instrument, e.g. connect devices,
- if a fault occurs during operation,
- during thunderstorms.

Caution - Property damage

Ensure that there is a sufficient distance to strong heat sources such as heating plates, heating pipes. Disconnect the sensor or handheld device from other devices before relocating or transporting it. Disconnect the connectors on the device.

Do not use aggressive chemical cleaning agents, scouring agents, hard sponges or the like

7 Notizen

Contact

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