

GREISINGER

— electronic —

Operation Manual

Material moisture meter for non-destructive measurements

Application: camper, caravan and boat

as of version 1.0

GMK 210



Made in Germany

WEEE-Reg.-Nr. DE 93889386

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1 Intended Use

The device is designed for measurements of moisture (%u) and water content (%w) of materials with flat surface and a thickness of at least 10mm.

In addition, it is possible to find moist spots very quickly and comfortably by means of the “detector mode”, the display value here is relative [digit].

The measurement takes place at an insulated measuring spot at the rear side of the device.

The GMK 110 is particularly suited for moisture measurements in the following materials:

- wood
- GRP

The GMK 110 is especially designed to meet the needs of moisture ratings of boats, camper vans and caravans.

For use at construction site we recommend the GMK 100 (wood, floor screed and plaster characteristics, CM-humidity)

The safety requirements (see below) have to be observed.

The device must be used only according to its intended purpose and under suitable conditions.

Use the device carefully and according to its technical data (do not throw it, strike it, ...)
Protect the device from dirt.

2 General Note

Read this document carefully and get used to the operation of the device before you use it. Keep this document within easy reach near the device for consulting in case of doubt.

2.1 Safety signs and symbols

Warnings are labeled in this document with the followings signs:



Caution! This symbol warns of imminent danger, death, serious injuries and significant damage to property at non-observance.




Attention! This symbol warns of possible dangers or dangerous situations which can provoke damage to the device or environment at non-observance.



Note! This symbol point out processes which can indirectly influence operation or provoke unforeseen reactions at non-observance.


2.2 Safety guidelines


This device has been designed and tested in accordance with the safety regulations for electronic devices. However, its trouble-free operation and reliability cannot be guaranteed unless the standard safety measures and special safety advises given in this manual will be adhered to when using the device.

1. Trouble-free operation and reliability of the device can only be guaranteed if the device is not subjected to any other climatic conditions than those stated under "Specification".
If the device is transported from a cold to a warm environment condensation may cause in a failure of the function. In such a case make sure the device temperature has adjusted to the ambient temperature before trying a new start-up.
2.  **WARNING** If there is a risk whatsoever involved in running it, the device has to be switched off immediately and to be marked accordingly to avoid re-starting.
Operator safety may be a risk if:
 - there is visible damage to the device
 - the device is not working as specified
 - the device has been stored under unsuitable conditions for a longer time.In case of doubt, please return device to manufacturer for repair or maintenance.
3. When connecting the device to other devices the connection has to be designed most thoroughly as internal connections in third-party devices (e.g. connection GND with protective earth) may lead to undesired voltage potentials that can lead to malfunctions or destroying of the device and the connected devices.



This device must not be run with a defective or damages power supply unit.
Danger to life due to electrical shock!

4.  **WARNING** Do not use these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury or material damage.
Failure to comply with these instructions could result in death or serious injury and material damage.

5.  **WARNING** This device must not be used at potentially explosive areas! The usage of this device at potentially explosive areas increases danger of deflagration, explosion or fire due to sparking.

3 Product Description

3.1 Scope of supply

The scope of supply includes:

- GMK 210
- 9V - battery
- Operating manual
- Short manual

3.2 Operation and maintenance advice

If 'bAt' is shown in the lower display the battery has been used up and needs to be replaced. However, the device will operate correctly for a certain time.



The battery has to be taken out, when storing device above 50°C.
We recommend taking out battery if device is not used for a longer period of time.

4 Handling

4.1 Display elements



1: Main display	Display of the current moisture or water content
2: Material display	The name of the selected material characteristic curve is displayed
3: Moisture rating	Moisture rating via bar graph
4: HLD	The measuring value is 'frozen' (hold-key)

4.2 Control elements

Key 1:	on/off key, Press long: switch device off Press shortly: activation of backlight see chapter 11, "Li"
Key 2:	sort up Material selection: upwards, see chapter 5.5
Key 3:	hold: press shortly: The measuring current value is 'frozen' (hold-function), 'HLD' is displayed press for 2sec.: Zeroing function (see chapter 5.6)
Key 2 and 3 together:	sort down Material selection: downwards, see chapter 5.5



Depth switch: (on the right side)	Sliding switch up: ca. 10 mm measuring depth (d 10) Sliding switch down: ca. 25 mm measuring depth (d 25) After changing the measuring depth "d 10" (for 10mm) or "d 25" (for 25 mm) is briefly displayed.
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4.3 Measuring spot: rear side



Rear side of device:

The entire dark grey surface has to lie on the measured material without any air gap.

The areas "10 mm" (grey) and "25 mm" (white) mark the area under that it is predominantly measured.

4.4 Start of operation

Switch the device on with the key .

After segment test  the device displays some information to its configuration:

- 5. # if there is a slope adjustment for the 10 mm measurement (see chapter 12)
- 5.25 if there is a slope adjustment for the 25 mm measurement (see chapter 12)
- P.oF if the automatic-off-function is activated (see chapter 11)

The device is ready for measuring afterwards.

5 Measurement Basics

5.1 Measuring field & depth

The device measures by means of an electric field (capacitive measuring method), which propagates from the rear side downwards. The measuring depth can be changed between approx. 10 mm and 25 mm with the sliding switch.



Side view: measuring field and penetration depth for switch setting "10 mm"



Side view: measuring field and penetration depth for switch setting "25 mm"

The specifications for the penetration depth 10 mm and 25 mm are just approximate values. The actual depth will be the higher the wetter the measured material is. Therefore areas deeper than 25 mm will be measured in very wet materials and for switch setting 25 mm.

On the rear side the area is marked under that it is predominantly measured.

ATTENTION: For precise measurements the device has to lie on the measured material not only at the marked measuring spot but at its whole rear side. If there is an air gap between device and material the measured value will be too dry!



Some examples for measurements that are not precise. (Measured value too dry in all cases):



False: wrinkled surface (extreme example!)



False: unsteady surface



False: material too thin

5.2 Humidity rating ('WET' - 'MEDIUM' - 'DRY')

In addition to the measuring value there is a moisture rating via bar graph and acoustic signal (if activated (see chapter 11)): Therefore the determination 'wet or dry' is easy and comfortable for most applications and has no longer be deduced from literature and tables.

ATTENTION: However, this rating can only be a first approximate value, because factors like the application field of the measured material have to be taken into account for the final rating. This device cannot completely replace the knowledge of an experienced craftsman or technical expert.



5.3 Holding the device

ATTENTION: The water content of the hand has an impact on the measuring value, if the device is held inappropriately.



The best results will be obtained if you lay the device down or hold it the way as shown in picture 3.



Picture 1: Held in a wrong way!



Picture 2: laid down – right!



Picture 3: Held in the right way!

5.4 Moisture *u* and water content *w*



Either moisture *u* or water content *w* is needed according to the application.

Carpenter, joiner, etc. normally use moisture *u* (relating to oven-dry mass)

Water content *w* is normally used for combustibles (i.e. wood briquette).

You can choose whether the device should use moisture or water content (see chapter 11).

Moisture *u* (relating to oven-dry mass) - recommended setting

$$\text{moisture } u[\%] = (mass_{wet} - mass_{dry}) / mass_{dry} * 100$$

or:

$$\text{moisture } u[\%] = (mass_{water} / mass_{dry}) * 100$$

The unit is %u (also common: % atro, weight percent).

mass_{wet}: mass of the sample (= total mass = *mass_{water}* + *mass_{dry}*)

mass_{water}: mass of the water contained in the sample

mass_{dry}: mass of the oven-dried sample after (water has been evaporated)

Example: 1kg wet wood that contains 500g water has a moisture *u* of 100%.

Water content *w* (= moisture relating to wet total mass)

$$\text{water content } [\%] = (mass_{wet} - mass_{dry}) / mass_{wet} * 100$$

or:

$$\text{water content } [\%] = (mass_{water} / mass_{wet}) * 100$$

The unit is %w


Example: 1kg wet wood that contains 500g water has a water content of 50%.


5.5 Characteristics and materials

Characteristics			
rEF	Reference characteristics		
d.45	Wood, density = 450 kg/m ³		
d.50	Wood, density = 500 kg/m ³		
d.55	Wood, density = 550 kg/m ³		
d.60	Wood, density = 600 kg/m ³		
d.65	Wood, density = 650 kg/m ³		
d.70	Wood, density = 700 kg/m ³		
d.75	Wood, density = 750 kg/m ³		
d.80	Wood, density = 800 kg/m ³		
d.85	Wood, density = 850 kg/m ³		
d.90	Wood, density = 900 kg/m ³		
d.95	Wood, density = 950 kg/m ³		
d.99	Wood, density = 1000 kg/m ³		
GrP	GRP (glass-fibre reinforced plastic)		
ISO	Light insulation materials, e.g. Styrofoam		

You can find a list of different types of wood and their corresponding characteristics d.xx in the addendum.

The materials are selected with these keys:

material selection upwards: press 

Material selection downwards: press   at the same time

ACHTUNG: The use of inappropriate characteristics can cause faulty measurements!



5.6 Zeroing function



It is recommended to run regularly the zeroing function for best measuring results:

Hold the device in the air as shown in the left picture and press key "hold" for 2 seconds.

You can easily see whether the zero point is ok with the "rEF" characteristics. If the device shows at air a value <0.5 or >0.5 or blinking "-" with "rEF" characteristics you have to run the zeroing function.

ATTENTION: Please pay attention not to influence the zeroing function with your hands.



The best way to ensure this is shown left.

NOTE: The zeroing function of the GMK 210 adjusts the zero-point for both 10 mm and 25 mm at the same time.

6 Operating-Modes „Measuring Mode“ and „Detector Mode“

The device has two operating modes:

1. Measurement (curves: dEt oF)
2. Detector (relative measurement with adjustable alarm threshold : dEt on)

The modes can be switched via the configuration menu.

6.1 Measuring Mode

In the measuring mode (Configuration: dEt oF) material can be measured precisely.

There are material curves available. The display is done in absolute unit (%u or %w). An appropriate rating is shown as a bar graph or as an acoustic signal.

6.2 Detector Mode

In the detector mode (Configuration: dEt on, material selection is fixed: “dEt” = rEF curve) can be searched very comfortably for moist spots with high resolution and adjustable alarm threshold („dEt SCL“), metal structures, beams in plasterboard, etc. The measurement is relative (only rEF-curve! Display in „digit“ = no unit)

After the detector mode is enabled (Configuration: dEt on), a reasonable alarm threshold (=sensitivity „dEt SCL“) should be chosen, examples:

- Search for structures under drywall: 10
- Search for trouble spots on the hull: 10
- Search for wood or metal studs in plasterboard 5

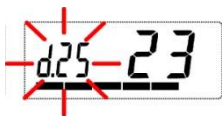
The alarm threshold determines at which display value maximum humidity is rated (over bar display and beep)

Procedure:

Place the unit on a reference point (dry) and perform a zero calibration by pressing the “hold” key until 0.0 is displayed (~ 2 seconds).

Slowly scan the area -> if increased moisture is detected, the alarm signal and corresponding bar graph will signal this additionally to the changing display value.

Additional warnings in the detector mode:



Depth switch setting of 10 mm: A measuring in the depth of ~25 mm is a much more moist, than the value shown in display.



Depth switch setting of 25 mm: : A measuring in the depth of ~10 mm is a much more moist, than the value shown in display.

7 Wood Measuring

Choose material corresponding to your type of wood according to the table in addendum A.
Example: You want to measure Scots pine -> select material d.50

Best results are obtained if you measure crossways to the wood's grain. (see right picture)

Unplanned and wrinkled surfaces cause too low measuring results!

NOTE: Wood is a natural product. Its density fluctuates due to the tree's growth and flaws (knots, cracks, resin pockets, etc.). This may lead to measuring errors up to several %u, because the measurement depends on density.

If your kind of wood is not listed in addendum A, you have to know its density (dry): for example a wood of density 0.68 kg/dm^3 is measured with material d.70 (approximate actual density to the next material 0.52 ->d.50, 0.53 -> d.55)



8 Measurement of Other Materials

The device has not saved characteristics for all materials. But even if there is no characteristic curve for your material you can do significant **relative measurements**.

We recommend the material "rEF" (dimensionless digit-value, intentional no %u or %w display) for this purpose.

For example if you want to evaluate water damage you can measure surely dry spot and an evidently wet one (identifiable by salt efflorescence, water spots, mould growth, etc.). Then you can compare the other measuring values with them and get the moisture distribution of your measuring area or find the reason for the moisture penetration.

You do not need absolute values (%u or %w) for this.

NOTE: Please consider that the configuration of the measured wall (cavity block, cement joints, reinforcements, etc.) may also influences the measuring values.

9 Rating of Motor Homes and Caravans

Normal humidity should not cause serious problems at faultless and correctly used motor homes and caravans.

However, the following problems can occur due to increased humidity:

- mildew together with its smell nuisance and health risks
- damage to materials (wood rots, metals oxidize, "aluminum corrosion", ...)

The humidity can occur from different sources:

- from the outside: rain water or splash water gets into the structure through leaks in the vehicle's hull
- from the inside: leaky installations and condensation water from humidity disposal of the passengers, cooking, potted plants, ...

To maintain the value of the vehicle it is important to detect and remove increased humidity as soon as possible.

The device can detect humidity in structures long before it is visible for human eyes (water patches). Although the device can even look "into" materials, it does not destroy or damage them. Exception: metal. If metal structures are very close to the sensor area the device displays too high values in most cases. Therefore metallic rods, reinforcement, aluminum insulation blankets, metal wires etc. can cause problems.

9.1 Materials and design

It is important to know the design of your motor vehicle/caravan for well-grounded ratings.

Depending on the actual design there may be different weak points and spots, most likely for water entry from outside.

Following questions should be answered:

- Where are critical points like connection between wall and roof, windows, doors and gates, shower trays, sealings, gorges)
- Are the damages from accidents /repaired areas
- Is it a wooden framework construction? Especially common for older models.
- Is the hull a sandwich construction? Made of what materials?
- Where are metallic rods/reinforcements? Where are metal wires and pipes?

9.2 Defining measuring points for continuous inspection

We recommend to define some measuring points from begin on and check and record them regularly (at least every ½ year). Humidity risks and impending damages can be recognized very early then.

Defining the measuring points

The measuring points should be determined deliberately.

Especially weak points (edges/welds, windows, doors, etc.) should be monitored.



*An overview of three possible weak points:
roof sealing, window sealing and assembly weld upper to lower trailer body
The reason here: old and porous window sealing*

Consider the properties of water:

- water normally flows downwards: water accumulations at the side walls have most commonly their reason above the spot.
- water flows faster through gaps than through bulky materials, i.e. water can move along rods, cables, etc. to accumulation spots

Absolute moisture (characteristic) and relative measurements

The device can display absolute material moisture if a suitable characteristic curve is selected and the measured component is bulky enough (at least thicker than ~8mm). In this case the moisture can be immediately rated (bar graph and buzzer).

Note: There are cases in which a precise absolute moisture measurements (in [%]) and the ratings based on this measurements cannot be performed. However, a relative measurement may be still possible: therefore the displayed measuring value is compared to an value measured at a definitely dry spot of the same material. A displayed value considerably higher than that reference value indicates a corresponding measuring point with most likely increased humidity.

Measuring at bulky components (parts of the wooden framework, etc.)

Select e.g. "wood characteristic". Measuring depth 10 or 25mm, depends on thickness



Caravan floor: massive flake board, little protected

Measuring at thinner layers, rating of "sandwich"-construction

For wood veneers/parquet: "wood characteristic". For GRP-layers (alcove, etc.) "GRP-characteristic".

Select measuring depth 10mm to rate the material and 25mm to detect moisture behind the layer.

Measuring at insulations

Older models are often isolated with simple polystyrene -> measurable water accumulations can occur.

Attention! Here relative values are more relevant, because for insulation materials only very small display values are measured.

Suggested setting, if it is measured directly on insulation: "ISO", 25 mm.



Insulation and metal framing of an older caravan

Sandwich

Up-to-date sandwich constructions use mainly high-quality “closed-pore” insulation materials. This reduces moisture problems in plane areas, in open pore foams, there can be significant amounts of water.

Suggested settings for sandwich like picture:

- d.45, 25 mm for evaluation of Insulation
- (- d.60, 10 mm for evaluation of plywood)

Please keep in mind: metal constructions below plywood can show extremely to high display values, wooden frames also may show to high values, but with suggesteted setting above, no moisture warning will result.

Alternatively the detector mode can be recommended instead of measuring mode:

please refer to 6 Operating-Modes „Measuring Mode“ and „Detector Mode“



Example sandwich: aluminum - insulation - plywood

9.3 Measuring intervals / times

Inspections by the specialist retailer at regular intervals (annually) are common for new caravans/motor vehicles to preserve leak tightness warranty. This is reasonable, but with costs! Defects can lead to massive humidity damage within only little time. For example mildew can form within few month.

Therefore responsible measuring times are for example:

- immediately after long usage (e.g. together with final cleaning)
- at longer standing phases, especially at not-roofed areas: every 3 month
- immediately after frost season
- during usage: regularly

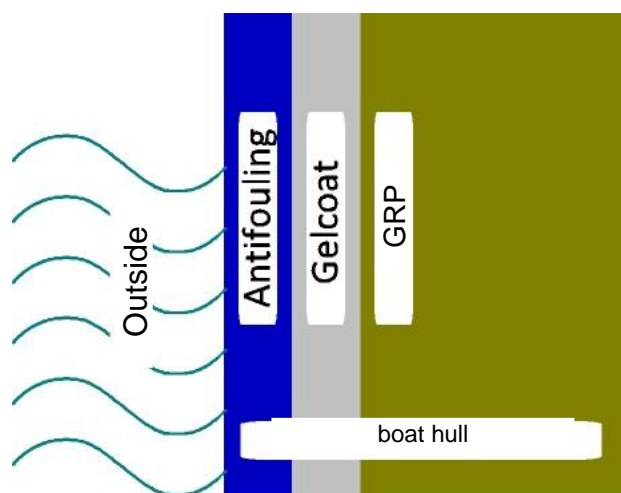
9.4 Repair

If there is a spot with critically moisture then:

- **rectify the cause:** (replace sealing / supply sealing material ...)
This have to be done professionally and with adequate materials and tools.
The repairs should be done at a qualified garage or ask for the advice from an expert.
- **dehumidify**
e.g. with standard air dehumidifier or with alternating heating and venting
Please consider (heating): preferable use electric heating but no simple gas heaters. Gas heaters produce humidity and there is the danger of suffocation!
Close doors and windows (or only slightly opened) during heating.
Please consider (venting): Open doors and windows as wide as possible for rapid air exchange
- **monitoring**
Check the corresponding parts/spots for a longer period (record values!) to make sure that ALL causes are rectified and the repair has been successful.

10 Rating of GRP boat hulls

10.1 Design principle of GRP hulls



The load-bearing material of GRP boats is **G**lass-fiber **R**einforced **P**lastic. This plastic is extremely robust, but water can enter to the laminate structure due to osmotic and capillary effects and damage it permanently: The material gets deformed and unstable.

A **gel coat** layer protects the GRP laminate from water entering.

Antifouling: Paint coat protecting against growth of algae/bivalves etc.

If water has entered the GRP structure it can be measured very easily nondestructively with the GMK 110 without any further tools.

The device detects water inside the GRP structure by means of a capacitive measuring principle. Water has a relatively high permittivity. Examples for different permittivity values:

Vacuum/air	1
Polyester- and Epoxy resin	~ 3...4
Glass-fiber	~6...7
Water	~80

ATTENTION: Structures containing carbon fibers or structures with metallic/graphitic coatings.



Metallic elements will also cause increased display values.

10.2 Procedure

Recommended settings:

- Measuring mode, characteristic "GrP", %u, measuring depth 25mm.
- or detector mode "dEt" %u, measuring depth 25mm (refer to chapter 6.2)

NOTE: Sometimes a wood characteristic (e.g. d.50) is used. Although this is not generally senseless, you have to keep in mind that in this case the displayed values (in %) can only serve as comparative values but not as absolute values. The electric properties used by the device for measurement are different for wood and GRP! Remember this problematic especially if you want to compare values of different devices!

The surface of the hull must be dry for measurement. Humidity on surface will cause unrealistic high display values!

Additionally wait at least 2 days after the boat has lifted out of water before starting a measurement: the antifouling can contain a large amount of water without causing any damage, but the measurement would be falsified.



It is reasonable to assume the hull above waterline containing almost no water. Thus perform a **reference measurement above waterline**. Values below 2% should be expected.

Below waterline the values will be higher, especially if the boat has been in water for a long time. This must not mandatory be problematic. However, if the measuring value exceeds 3% there should be further investigations.

Areas with pimples or water accumulations not seen from the outside cause considerable higher measuring values.

It is important that the boat hull is well dried-up before a new antifouling is attached or if the boat gets reconstructed.






The following procedure may be helpfully to monitor the dry-up of the hull:













Search for crucial measuring spots (visible damages, keel/rudder connections, other areas with increased measuring values) and mark them with water-proof marker.

Record the values at that measuring spots.

11 Configuration of the device

Follow these instructions to configure the functions of the device:

- Switch the device off.
- Press  and keep it pressed, while turning the device on (press  shortly). Release the sort-button not before the first parameter “P.oF” is displayed.
- Set parameter with up  or down .
- Jump to the next parameter by pressing .

Parameter	Value	Information
	 	
	Detector Mode <i>factory setting: oF</i>	
	<i>oF</i>	Device measures absolute humidity parameters (%) – material curves are available
	<i>on</i>	Device operates as a detector (relative measurement only) with adjustable sensitivity
 	Detector Mode: Sensitivity <i>factory setting: 10</i>	
	5 ... 100	Sensitivity of the bar graph and acoustic signal Set value corresponds to maximum rating via bar / acoustic signal
	Auto Power-Off (turn-off delay) <i>factory setting: 20 min</i>	
	1 ... 120	Auto Power-Off (turn-off delay) in minutes. If no key is pressed for the time adjusted here, the device is automatically switched off (adjustable 1 ... 120 min)
	<i>oF</i>	Auto power-off is deactivated (continuous operation)
	Display unit <i>factory setting: %u</i>	
	%u	Measuring value displayed in moisture %u
	%w	Measuring value displayed in water content %w
	Backlight <i>factory setting: 5</i>	
	<i>oF</i>	No backlight
	5 ... 120	Backlight turns automatically off after 5 ... 120s (battery saving)
	<i>on</i>	Backlight always on as long as device is switched on
	Acoustic signal <i>factory setting: on</i>	
	<i>oF</i>	No acoustic signal
	<i>on</i>	Acoustic signal for moisture rating
	Auto Hold <i>factory setting: oF</i>	
	<i>oF</i>	Auto Hold deactivated: pressing hold-key freezes measuring and releases it again
	<i>on</i>	Auto Hold activated: hold-key starts new measuring, the display will be ‘frozen’ as soon as a stable measuring value was detected.
	Restore factory settings	
	<i>no</i>	Parameters are not changed to factory settings.
	<i>Go</i>	ATTENTION: All parameters are changed to factory settings.

Press  again to store changed settings, the device restarts (segment test).






NOTE: If there is no key pressed within the menu mode within 2 minutes, the configuration will be cancelled, the entered settings are lost!




12 Adjustment

The accuracy can be checked with the **testing probe PW 25** (optional accessories).
 Select the material “rEF” and run the zeroing function (see chapter 5.6).
 Lay the device onto the testing cube. If the device displays a different value than the value printed on the cube for the device, you can use the slope correction to adjust the device:

$$\text{Displayed value rEF} = (\text{measured value rEF} * (1 + \text{slope correction} / 100))$$

Follow these instructions to adjust the device:

- Switch the device off.
- Press  and keep it pressed, while turning the device on (press  shortly).
 Release the hold-button not before the first parameter “5.10” is displayed.
- Set parameter with up  or down .
- Jump to the next parameter by pressing .

Parameter	Value	Information
	 	
5.10	Slope correction for measuring depth 10 mm	<i>factory setting: of= 0%</i>
	oF -19 ... +19	Value of slope correction in %
5.25	Slope correction for measuring depth 25 mm	<i>factory setting: of= 0%</i>
	oF -19 ... +19	Value of slope correction in %


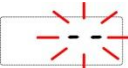



Press  again to store changed settings, the device restarts (segment test).

NOTE: If there is no key pressed within the menu mode within 2 minutes, the configuration will be cancelled, the entered settings are lost!

13 Accuracy Inspection: Adjustment /Update Service

You can send the device to the manufacture or retailer for adjustment and inspection. Moreover the manufacturer can do the latest software update. This ensures that future improvements are provided to owners of older devices in a cost-saving way. You can display the current software version if you do not release the on/off button after you switched the device on, but hold it for more than 5 seconds. (i.e. “r. 1.0”)

14 Error and System Messages

-  Value exceeding measuring range, value too high
-  Value below display range, (value < 19)
-  System error – the device has detected a system error (device defective or not within working temperature)
-  The blinking bAt display indicates low battery voltage, device will continue to work for a short time.
-  The battery is consumed and has to be changed. Measurements are no longer possible.

15 Specifications

Measurement	
Method	Capacitive (=dielectric) measuring method, non-destructive
Depth	2 selectable: approx. 10 mm and approx. 25 mm
Characteristic curves	15 characteristic curves for wood additionally reference curve (rEF) for high-resolution relative
Resolution	0.1 %; for more than 19.9 %: 1 % (for both %u and %w)
Moisture rating	Display: Rating of the moisture in 6 levels from WET to DRY Acoustic: Signal tone, depending on moisture rating
Accuracy	The achievable accuracy depends significantly on the application and the properties of the measured material!
Display	2 displays for material and measured value, backlight
Acoustic signal	Moisture rating via relating acoustic signal
Hold function	Press button to freeze current value.
Working temperature	-25 to 50 °C; 0 to 80 % RH (non condensing)
Storage temperature	-25 to 70 °C
Power supply	9 V-battery type IEC 6F22 (included)
Power consumption (measurement)	Approx. 0.12 mA (battery life time: more than 2500 hours for alkaline battery)
Power consumption (backlight)	Approx. 2.5 mA (Backlight reduces battery life time! Automatic turn off function is selectable)
Used battery display	"bAt" displayed if battery used, warning: "bAt" blinking
Auto off-function	Device will be automatically switched off if not operated for longer time (adjustable from 1..120min)
Housing	impact-resistant ABS plastic housing, front side IP65
Dimension	Approx. 106 x 67 x 30 mm (H x W x D)
Weight	Approx. 135g incl. battery
EMC	The device corresponds to the essential protection ratings established in the Regulations of the Council for the Approximation of Legislation for the member countries regarding electromagnetic compatibility (2004/108/EG), additional error: < 1% FS

16 Disposal Notes



Dispense exhausted batteries at destined gathering places.
 This device must not be disposed as 'residual waste'
 To dispose this device, please send it directly to us (adequately stamped).
 We will dispose it appropriately and environmentally friendly.

Addendum A: Wood types table

english	lat.	charact.
Abachi	<i>Triplochiton scleroxylon</i>	d.45
Afzelia	<i>Afzelia</i> spp.	d.75
Ash, American-	<i>Fraxinus americana</i>	d.65
Ash, European-	<i>Fraxinus excelsior</i>	d.65
Ash, Manchurian-	<i>Fraxinus mandshurica</i>	d.60
Balau, Bangkirai-	<i>Shorea laevis</i>	d.90
Balau, Red-	<i>Shorea guiso</i>	d.85
Beech, European-	<i>Fagus sylvatica</i>	d.65
Bintangor	<i>Calophyllum kajewskii</i>	d.65
Birch, White-	<i>Betula pubescens</i>	d.60
Birch, Yellow-	<i>Betula lutea</i>	d.65
Bossè	<i>Guarea cedrata</i>	d.55
Bubinga	<i>Guibourtia demeusii</i>	d.85
Cedar, White	<i>Melia azedarach</i>	d.55
Cherry, Black-	<i>Prunus serotina</i>	d.60
Cherry, Wild-	<i>Prunus avium</i>	d.55
Cypressus	<i>Cupressus</i> spp.	d.45
Douglas-fir, Common-	<i>Pseudotsuga menziesii</i>	d.50
Douka	<i>Thiagemella africana</i>	d.65
Ebony	<i>Diospyros</i> spp.	d.99
Elm	<i>Ulmus</i> americ. / <i>Ulmus</i> spp.	d.60
Fir, European Silver-	<i>Abies alba</i>	d.45
Fir, Grand-	<i>Abies grandis</i>	d.45
Fir, Pacific Silver-	<i>Abies amabilis</i>	d.45
Fir, Red-	<i>Abies magnifica</i>	d.45
Gum, Sweet	<i>Liquidambar styraciflua</i>	d.50
Hemlock	<i>Tsuga heterophylla</i>	d.45
Hickory	<i>Carya</i> spp.	d.75
Iroko	<i>Chlorophora excelsa</i>	d.65
Jarrah	<i>Eucalyptus marginata</i>	d.75
Jelutong	<i>Dyera costulata</i>	d.45
Jequituba	<i>Cariniana</i> spp.	d.70
Kapur	<i>Dryobalanops</i> spp.	d.60
Karri	<i>Eucalyptus diversicolor</i>	d.85
Larch, European-	<i>Larix decidua</i>	d.55
Larch, Japanese-	<i>Larix kaempferi</i>	d.55
Larch, Western-	<i>Larix occidentalis</i>	d.55
Limba	<i>Terminalia superba</i>	d.50
Linden, American	<i>Tilia americana</i>	d.45
Linden, Common-	<i>Tilia vulgaris</i>	d.50
Locust, Black-	<i>Robinia pseudoacacia</i>	d.70
Magnolia, Cucumber-	<i>Magnolia acuminata/grandiflora</i>	d.50
Mahogany	<i>Swietenia</i> spp.	d.50
Mahogany, African-	<i>Khaya</i> spp.	d.50
Mahogany, Philippine-	<i>Parashorea plicata</i> / <i>Shorea almon</i>	d.50
Maple, New Guinea	<i>Flindersia pimentelianan</i>	d.55
Maple, Sugar-	<i>Acer saccharum</i>	d.70
Maple, Sycamore-	<i>Acer pseudoplatanus</i>	d.55

english	lat.	charact.
Mengkulang	<i>Heritiera</i> spp.	d.65
Meranti, Dark Red-	<i>Shorea</i> spp.	d.65
Meranti, White-	<i>Shorea hypochra</i>	d.55
Meranti, Yellow-	<i>Shorea multiflora</i>	d.55
Merawan	<i>Hopea sulcala</i>	d.70
Merbau	<i>Intsia</i> spp.	d.75
Mersawa	<i>Anisoptera laevis</i>	d.60
Messmate	<i>Eucalyptus obliqua</i>	d.80
Oak, Northern Red-	<i>Quercus</i> spp.	d.65
Oak, Sessile-	<i>Quercus petraea</i>	d.65
Oak, Sawtooth-	<i>Quercus</i> spp.	d.65
Oak, White-	<i>Quercus</i> spp.	d.65
Olive	<i>Olea hochstetteri</i>	d.85
Padouk, African-	<i>Pterocarpus soyauxii</i>	d.70
Paldao	<i>Dracontomelum dao</i>	d.65
Pine, Black-	<i>Podocarpus spicatus</i>	d.50
Pine, European Black-	<i>Pinus nigra</i>	d.55
Pine, Loblolly-	<i>Pinus taeda</i>	d.50
Pine, Lodgepole-	<i>Pinus contorta</i>	d.45
Pine, Longleaf-	<i>Pinus palustris</i>	d.60
Pine, Maritime-	<i>Pinus pinaster</i>	d.50
Pine, Norway-	<i>Pinus resinosa</i>	d.45
Pine, Parana-	<i>Araucaria angustifolia</i>	d.50
Pine, Ponderosa-	<i>Pinus ponderosa</i>	d.45
Pine, Radiata-	<i>Pinus radiata</i>	d.50
Pine, Scots-	<i>Pinus sylvestris</i>	d.50
Pine, Sugar-	<i>Pinus lambertiana</i>	d.45
Poplar, Black-	<i>Populus nigra</i>	d.45
Redcedar, Western-	<i>Thuja plicata</i>	d.45
Rengas	<i>Gluta</i> spp.	d.60
Rimu	<i>Dacrydium cupressinum</i>	d.50
Redwood, California-	<i>Sequoia sempervirens</i>	d.45
Rosewood, Brazilian	<i>Dalbergia latifolia</i> / -nigra	d.85
Rosewood, New Guinea-	<i>Pterocarpus indicus</i>	d.55
Rubber Tree	<i>Hevea Brasiliensis</i>	d.50
Sapele	<i>Entandrophragma cylindricum</i>	d.65
Sipo	<i>Entandrophragma utile</i>	d.60
Spruce	<i>Picea abies</i>	d.45
Spruce, Sitka-	<i>Picea sitchensis</i>	d.45
Tiama	<i>Entandrophragma angolense</i>	d.55
Teak	<i>Tectona grandis</i>	d.65
Torem	<i>Manilkara kanosiensis</i>	d.95
Tualang	<i>Koompassia excelsa</i>	d.80
Walnut, Eastern Black-	<i>Juglans nigra</i>	d.60
Walnut, Common-	<i>Juglans regia</i>	d.60
Wenge	<i>Millettia laurentii</i>	d.80



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