OPERATING MANUAL

GMI 15 plus

Moisture Indicator

for non-destructive capacitive measurements

H68.0.03.6C-03

senseca

Table of contents

1 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 Safety

2.1 Intended Use

The device is designed for measurements of moisture (%u) of materials with flat surface and a thickness of at least 10mm.
The measurement takes place at an insulated measuring spot at the rear side of the device.

Applicable for:
- wood
- concrete
- etc.

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

Personnel which starts up, operates and maintains the device has to have sufficient knowledge of the measuring procedure and the meaning of the resulting measured values, this manual delivers a valuable help for this. The instructions of the manual must be understood, regarded and followed.

To be sure that there is no risk arising due to misinterpretation of measured values, the operator must have further knowledge in case of doubt - the user is liable for any harm/damage resulting from misinterpretation due to insufficient knowledge.

The manufacturer will assume no liability or warranty in case of usage for purposes other than the intended one, ignoring this manual, operating by unqualified staff as well as unauthorized modifications to the device.
Use the device carefully and according to its technical data (do not throw it, strike it, ...)
Protect the device from dirt.

2.2 Safety signs and symbols

Warnings in this document are labeled with the following 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 points out processes which can indirectly influence operation, possibly cause incorrect measurement or provoke unforeseen reactions at non-observance.

2.3 Reasonably foreseeable misuse

To prevent malfunction of the device, personal injury and material damage, the device is designed exclusively for use as described in the chapter "Intended Use".

- This device must not be used at potentially explosive areas!
- The device must not be used at a patient for diagnosis or any other medical purpose!
- 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!

Any failure to comply with these instructions could result in death, serious injury and material damage.

The measuring principle implies that both water and metal are influencing the display value. Eventually existing metal structures may have negative effect to the measuring, please consider the Measurement Basics (chapter 6).

2.4 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 advise 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 climatic conditions other than those stated under "Specifications". If the device is transported from a cold to a warm environment condensation may cause 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. 

If there is any risk involved in running it, the device has to be switched off immediately and must 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 Product Description

3.1 Scope of supply

The scope of supply includes:

- GMI 15 plus
- 9V - battery
- Operating manual
- Test protocol

3.2 Operation and maintenance advice

Battery powered supply:
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.

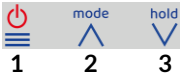

The battery must be taken out when storing the device above 50°C.
We recommend taking out the battery if the device is not used for a longer period of time.

4 Display and Control Elements

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
Key 2:	**mode up** Material selection: upwards, see chapter 6.4
Key 3:	**Hold down:** press briefly: The currently measured value is “frozen” (hold-function), “HLD” is displayed press for 2 sec.: **Zeroing function (**see chapter 6.5**)**
Keys 2 & 3 together:	**sort down** Material selection: downwards, see chapter 6.4

4.3 Measuring spot: rear side

The entire dark grey surface must lie on the measured material without any air gaps.
The area “25 mm” (dark grey) indicates the area under which measurements are primarily taken.

5 Start of Operation

Switch the device on with the key.

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

5.25 if a slope adjustment has been made (see chapter 11)

The device is ready for measuring afterwards.

6 Measurement Basics

6.1 Measuring field & depth

The device measures by means of an electric field (capacitive measuring method), which propagates from the rear side downwards.

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

The specification of 25 mm for the penetration depth is just an approximate value. 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.

The area under which the measurement is predominantly taking place is marked on the rear side.

For precise measurements not only the marked measuring spot but the device's entire rear side must lie flat on the measured material. If there is an air gap between the device and the material the measured value will be too dry!

Here are some examples for measurements that are not precise at all (measured value too dry in all cases):

False: wrinkled surface (extreme example!)

False: unsteady surface

False: material too thin

6.2 Moisture rating ('WET' - 'MEDIUM' - 'DRY')

In addition to the measuring value there is a moisture rating via a bar graph. For most applications, the decision 'wet or dry' is easy and comfortable and no longer has to be deduced from literature and tables.

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

6.3 Holding the device

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!

6.4 Characteristics and materials

Material	
rEF	Reference characteristics
HoL	Wood, density = 550 kg/m^3
bEt	Concrete (density ≈ ca. 2.2 to/m^3)

In the appendix there is a table with the assignment of which wood species correspond to the specified density. Other types of wood can also be measured, but a higher deviation than specified is to be expected.
The materials are selected with these keys:

Material selection upwards: press mode ∧.

Material selection downwards: press mode ∧ hold ∨ at the same time.

The use of inappropriate characteristics can cause faulty measurements!

The device is an indicator, not a precision measuring device. More accurate measurements can be obtained with the GMK 100 or GMK 210 devices with more selectable characteristic curves.

6.5 Zeroing function

For the best measuring results, it is recommended to run the zeroing function regularly:

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

You can easily see whether the zero point is ok with the “rEF” characteristic. If the device shows at air a value <0.5 or >0.5 or “Er.4” with “rEF” characteristic, you must run the zeroing function.

Please pay attention not to influence the zeroing function with your hands. The best way to ensure this is shown on left.

7 Wood Measuring

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

Unplaned or wrinkled surfaces result in measurements that are too low!

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, it can be measured, but an increased measurement error is to be expected.

8 Floor screed Measurement

NOTE: Floor screed dries patchy and therefore areas may be differently wet. A big amount of water has to be released upwards (evaporate) before you can tile it. The floor screed has to be drier if a vapor-tight covering should be used as if it would be with a diffusion permeable covering. Therefore, the moisture rating of the device can only be a first approximate value and the decision whether the floor is ready for further covering or not cannot be based only on this rating.

Reinforcements (iron) or floor heating near the surface may cause erroneous measuring results. Please consider chapter 10.2 CM-moisture.

9 Measurement of Other Materials

Should materials other than screed or wood be measured, you can do significant **relative measurements**.
We recommend the material "rEF" (dimensionless digit-value) for this purpose.
For example, if you want to evaluate water damage you can measure a 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) for this.

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

10 Additional Information to Moisture Measurement

10.1 Moisture *u*

The displayed material moisture is the most common measuring unit for material moisture measuring (relating to oven-dry mass)
Water content w is normally used for combustibles (i.e. wood briquette).

Moisture u (relating to oven-dry mass)

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

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

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)

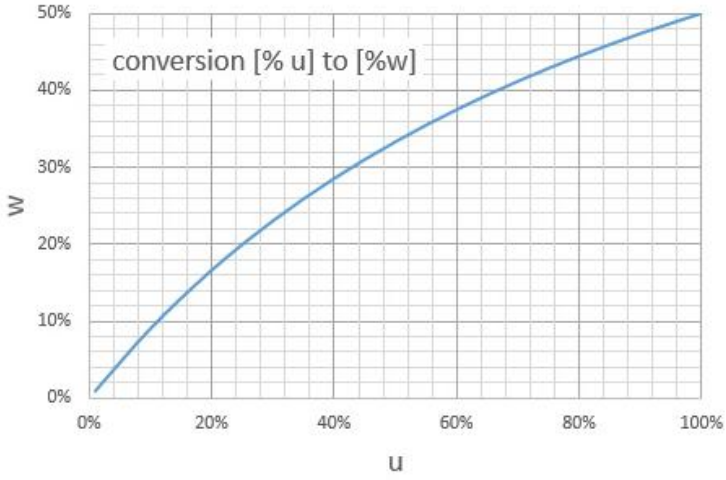
Example: 1kg of wet wood that contains 500g water has a moisture u of 100%.

In rare cases Water content w is used

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

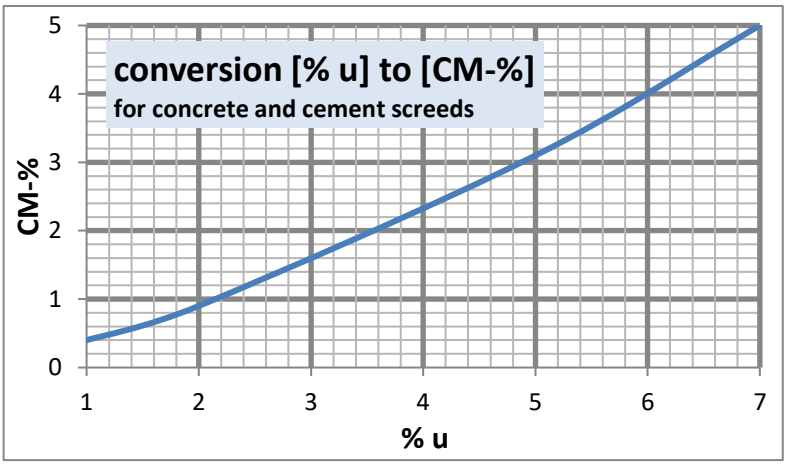
or: $$water\ content\ w\ [\%] = (mass_{water} / mass_{wet}) * 100$$

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



10.2 CM-Moisture

The CM-moisture (unit [CM%]) is often used for materials like floor screed. This moisture rating is correlated to the moisture u: it is calculated by the same equations. It is measured by the CM-method (destructive testing with high complexity). It is the only accredited measuring method (besides the time-consuming oven-dry method) for floor screed measurements in Germany.



The values measured with the CM-method and with the oven-dry method (%u) may differ for some materials. Especially for building materials containing **cement** CM-measurements will always get lower values than oven-dry measurements. The conversion is material-dependent, because the differences between both values depend on the used product.

The conversion shown in the picture above is a practicable approximation.

For **gypsum**, **gypsum plaster** and **anhydrite screed** the value %u equals approximately the CM-value.

11 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 6.5).
Lay the device onto the testing cube. If the device displays a different value than the value printed on the cube for the GMI 15, you can use the slope correction to adjust the device:

Displayed value rEF = (measured value rEF * (1 + slope correction / 100))

Follow these instructions to adjust the device:

- Switch the device off.
- Press hold and keep it pressed, while turning the device on (briefly press ⏻).
  Release the hold-button not before the first parameter "5.25" is displayed.
- Set parameter with up mode or down hold.
- Jump to the next parameter by pressing ⏻.

Parameter	Value	Information
Button ⏻	**Buttons** mode ∧ hold ∨	
5.25	**Slope correction for measuring**	*factory setting: oF = 0%*
	oF / **-19 ... +19**	Value of slope correction in %

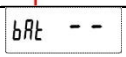
Press ⏻ again to store changed settings, the device restarts (segment test).

NOTE: If no key is pressed for more than 2 minutes, the configuration will be canceled. Any changes made up to that point will not be saved!

12 Accuracy Inspection: Adjustment /Update Service

You can send the device to the manufacturer 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”)

13 Error and System Messages

Er. 1	Value exceeding measuring range, value too high
Er. 4	Value below display range
Er. 7	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 depleted and must be changed. Measurements are no longer possible.

14 Disposal

Separation by material and recycling of device components and packaging must take place at the time of disposal. The valid regional statutory regulations and directives applicable at the time must be observed.

NOTE

The device must not be disposed of with household waste. Return it to us, freight prepaid. We will then arrange for the proper and environmentally friendly disposal.

Private end users in Germany have the possibility of dropping off the device at the municipal collection center.
Batteries must be removed beforehand!
Please dispose of empty batteries at the collection points intended for this purpose.

15 Technical Data

Measurement	
Method	Capacitive (=dielectric) measuring method, non-destructive
Depth	Approx. 25 mm
Materials	Curves for wood and screed, additionally reference curve for high-resolution relative measurements
Resolution	0.1 %; for more than 19.9 %: 1 % (%u)
Range	Material moisture (u): 0.0 … 100% (wood), 0.0…~8.0 (concrete)
Moisture rating	Display: Rating of the moisture in 6 levels from WET to DRY
Accuracy	The achievable accuracy depends significantly on the application and the properties of the measured material!
Display	2 displays for material and measured value
Hold function	Press button to freeze current value.
Working temperature	-5 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: more than 2500 hours for alkaline battery)
Used battery display	“bAt” displayed if battery used, warning: “bAt” blinking
Auto off-function	Device will be automatically switched off after 120 min if not operated for longer time
Housing	Impact-resistant ABS plastic housing, front side IP65
Dimension	Approx. 106 x 67 x 30 mm (H x W x D)
Weight	Approx. 145 g incl. battery
Directives & standards	The instruments confirm to the following European Directives: 2014/30/EU EMC Directive 2011/65/EU RoHS Applied harmonized standards: EN 61326-1:2013 emissions level: class B emi immunity according to table A.1 Additional fault: <1% EN IEC 63000:2018

Addendum A: Wood types table

english	lat.	charact.
Bossè	Guarea cedrata	HoL
Cedar, White	Melia azedarach	HoL
Cherry, Wild-	Prunus avium	HoL
Larch, European-	Larix decidua	HoL
Larch, Japanese-	Larix kaempferi	HoL
Larch, Western-	Larix occidentalis	HoL
Maple, New Guinea	Flindersia pimentelianan	HoL
Maple, Sycamore-	Acer pseudoplatanus	HoL
Meranti, White-	Shorea hypochra	HoL
Meranti, Yellow-	Shorea multiflora	HoL
Pine, European Black-	Pinus nigra	HoL
Rosewood, N. Guinea	Pterocarpus indicus	HoL
Tiama	Entandrophr. angolense	HoL

For woods not listed, larger deviations are to be expected.

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