



# SWM 5000

Instruction manual



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# 1. Technical data

Subject to modification!

<b>Measuring unit SWM 5000</b>	
Measuring range	0 – 99.9 Vol.-% soil moisture 0 – 60.0 °C soil temperature
Operation	4 keys: ON / OFF, MODE, SELECT, OK
Housing	splash-proof according to IP40, EN60529
Dimensions	83 x 180 x 55 mm (w x h x d)
Weight	0.3 kg
Operating temperature	0°C to +40°C (display in the status line of SWM)
Display	graphical display, 54 x 32 mm, 128 x 64 pixel, transfective, contrast adjustable
Connector	5-pin plug (DIN 41524) with bayonet catch
Power	9 VDC block battery
Battery reserve	display in %, auto-off at < 2%
Service life	> 4 days of continuous operation > 200 days in data logger mode - automatic switch-off in case of weak battery
Operating modes	continuous, time, data logger mode
Data logger	for max. 3441 measurements with recording of Sensor-Pos*, moisture, temperature, date, time; data export via smartphone app
Cycle time	max. 24 h, adjustable in 1 min steps
Meas. time	2 s for moisture and temperature
Calibration	in air (0%) and water (100%), if necessary
Zero point	in air (0%) for correction of 0-point display
Clock	internal quartz clock with menu-driven setting of date, time, data logger cycle time
Languages	German, English, Russian

\* only with app sync with access to smartphone location data

Probes	SWP 5000-1 with 1 sensor for moisture + temp. SWP 5000-3 with 3 sensors for moisture + temp.
Signal-LED	in the keypad, for indication of Bluetooth connection between cell phone and SWM 5000
Smartphone operation	Connection via Bluetooth, automatic pairing, range 10m, parallel operation to the SWM, data retrieval from the SWM, control functions, data storage. See separate operating instructions (in the app).
Smartphone app, free of charge	SWM Companion ©, available for Android and iOS
App functions	calling up and display of all functions as on the measuring instrument itself (=> parallel operation)
Warranty	2 years

<b>Measuring probes SWP 5000</b>	
SWP 5000-1	Probe with 1 sensor at 90 cm for manual measurement. Stainless steel tube with handle and holder for measuring unit SWM 5000.
Dimensions	Length: 1000 mm. Diameter: 20 mm. 100 mm marks for measuring the insertion depth.
SWP 5000-3	Probe with 3 sensors at 90, 60, 30 cm for automatic measurement by means of a pick-up device for a hydraulic press on a tractor.
Dimensions	Length: 1000 mm. Diameter: 30 mm.
<b>Moisture</b>	
Measuring range	0.0 to 99.9 %
Resolution	0.1 %
Accuracy	5 % from measured value
Storage temperature	-20 to +80 °C
Measuring temperature	0 - 60 °C
Data logging	capacitive
Measurement method	FDR = Frequency Domain Reflectometry

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Calibration	together with measuring unit SWM 5000
Zero point	together with measuring unit SWM 5000
<b>Temperature</b>	
Measuring range	0.0 to +60.0 °C
Resolution	0.1 %
Accuracy	0.5 % absolute
Storage temperature	-20 to +80 °C
Measuring temperature	0.0 to 60.0 °C
Data logging	analogue
Measurement method	analogue
Delay time	about 2 min until the correct display
Calibration	not necessary
Zero point	not necessary

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## **2. General information**




The contents of this manual were carefully verified and have been compiled to the best of our knowledge. However, the Manufacturer does not accept liability for possibly contained statements in this manual. In no event will the manufacturer be liable for direct, indirect, special, incidental or consequential damages resulting from any defect or omission in this manual, even if advised of the possibility of such damages. In the interest of ongoing product development, the manufacturer reserves the right to make changes in this manual and the products it describes at any time, without notice or obligation. Revised editions can be found on the manufacturer's website.

### **2.1. Safety information**

Please read the entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.



Make sure that the protection provided by this equipment is not impaired. Do not use or install this equipment in any manner other than that specified in this manual.

### 2.1.1. Use of hazard information

 <b>DANGER</b>
Indicates a potentially or imminently hazardous situation, which, if not avoided, will result in death or serious injury.
 <b>WARNING</b>
Indicates a potentially or imminently hazardous situation, which, if not avoided, could result in death or serious injury.
 <b>ATTENTION</b>
Indicates a potentially hazardous situation that may result in minor or moderate injury.
<b>REFERENCE</b>
Indicates a situation, which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.

### 2.1.2. Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. A symbol on the instrument is referenced in the manual with a precautionary statement.

	Electrical equipment marked with this symbol may not be disposed of public disposal systems. Electrical equipment users must return old or end-of-life equipment to the Manufacturer for disposal at no charge to the user.
	This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.

## 2.2. Product overview

The SWM 5000 is a handheld instrument for measuring soil moisture in vol.-% (= volumetric water content) and temperature in ° C by means of a 1m long stainless steel probe.

It has a 5-pin interface with a recessed lock in accordance with DIN 41524 for connecting the probe SWP 5000-1 or SWP 5000-3.

The probes are automatically recognized and the measurements are displayed as a one- or three-fold result in the graphic display.

The operation is menu-driven via

- the graphic display and the keyboard of the instrument
- a smartphone (Bluetooth connection) with the "SWM Companion" app.

The SWM 5000 can be operated either on the unit via keyboard and display, or by the smartphone or in parallel of both.

The soil moisture is determined by means of the Frequency Domain Reflectometry (FDR). This method uses the property of the water to change the value of an electrical capacitor relatively linearly and thus the frequency of a high-frequency oscillator. FDR has the advantage that both solids (sand, loam, compost etc.) located in the soil and the electrical conductivity of the water (salinity) have only a small influence on the measurement result and can be compensated.

Both the humidity sensor with its high-frequency oscillator and the temperature sensor are located at the appropriate place in the probe, they are embedded in synthetic resin and thus protected against the intrusion of solids and moisture. Already at the sensor, the measurement results are converted into digital values and routed via a data bus line to the SWM 5000, where they are evaluated, converted and displayed in the data logger with sensor position, humidity, temperature, date and time saved.



## Handheld unit SWM 5000



A = Display

B = Keypad with LED

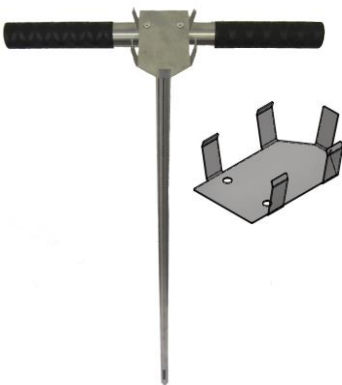
C = 5-pin plug for the probe

D = Battery holder

E = Battery cover

F = 9V battery

## Probe SWP 5000-1 for manual measurement



Probe with holder



Probe tip with sensor



Complete unit

### 3. Starting

Insert the supplied 9V block battery into the holder in the battery compartment on the rear side of the instrument. Pay attention to the correct polarity. To open the battery compartment, press the push mechanism in the center of the bottom and at the same time slide the gray compartment from the center to the outside.

Connect the 5-pin plug of the probe SWP 5000 to the socket of the SWM 5000 handheld unit and fix the bayonet catch by turning it.

Now plug the SWM 5000 unit into the provided holder on the SWP 5000 probe, making sure that the lower retaining clip is guided through the plastic strap of the SWM 5000 housing.

#### **Possible operation modes:**

##### **Time operation + Data logger ON**

For automated measuring and recording in a fixed cycle time (→ stationary measurement);

the instrument shows the measured value for 30s in the display before it switches off until the cycle time is reached again.

##### **Time operation + Data logger OFF**

For manually controlled measuring and recording (→ mobile measurement), the instrument shuts off automatically after switching on for 30 seconds.

##### **Continuous operation + Data logger OFF**

For manually controlled measuring and recording (→ mobile measurement), the instrument remains on standby until it is actively switched off by the user.

**Further information in “3.2. Keypad“**

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### 3.1. Display

The instrument is switched on with the ON / OFF key. For 3s, the following greeting appears:

<b>SWM 5000</b>	<b>Name of the instrument</b>
<b>v1.19 - Bluetooth</b>	<b>Software version</b>
<b>STEP Systems GmbH</b>	<b>Manufacturer</b>
<b>www.stepsystems.de</b>	<b>Website</b>
<b>Made in Germany</b>	<b>Country of origin</b>

Afterwards, the display shows the working surface with the last settings and previously entered data:

<b>95% BAT</b>	<b>14:09</b>	<b>21.4 °C</b>	<b>Status line</b>
<b>TIME OPERATION</b>			<b>Time / Continuous mode</b>
<b>BLUETOOTH off</b>			<b>Bluetooth connection to cell phone</b>
<b>DATALOGGER manually</b>			<b>Memory for manual measurements</b>
<b>DATASETS 67</b>			<b>67 datasets stored</b>

Operation is menu based via the graphic display and the membrane keypad with four buttons. Alternatively, the operation can also be done with a smartphone via the "SWM Companion" app.

## 3.2. Keypad

### 3.2.1. Key ON / OFF



With ON / OFF the meter is switched on. Upon prolonged pressing, the greeting is shown for a corresponding length of time, e.g. to read the information without haste.

The measuring instrument can be switched off again at any time with the same key, e.g. to stop a setting initiated with MODE. This feature is disabled only during the measurement or when transferring data to the smartphone via Bluetooth.

### 3.2.2. Key MODE (-)

With MODE various setting and adjustment functions are selected. When the desired mode is displayed, it can be selected with SELECT for further adjustment. When setting date, time, contrast, language, this key is used to gradually decrease the value to be set.

#### **MODE 1: ADJUST OFFSET**

*Correction mode for a possibly small zero offset when measured in air (0%). The process can be carried out as often as desired.*

- 1. Select with SELECT or continue with MODE 2*
- 2. As instructed, hold the probe in the air and start with OK*
- 3. Afterwards the instrument returns to the waiting position*
- 4. The process can be carried out as often as desired*

**MODE 2: CALIBRATION**

Calibration is always required after replacement of the instrument or probe or after prolonged use.

1. Select with **SELECT** or continue with **MODE 3**
2. As instructed, hold the probe in the air and start with **OK**
3. As instructed, hold the probe in water and start with **OK**  
**ATTENTION:** please place the sensor in the center of a large, water-filled container (such as a 10 litre bucket!)
4. Afterwards the instrument returns to the waiting position
5. The process can be carried out as often as desired

**MODE 3: DATALOGGER**

This mode is used to switch on and off the automatic cyclic measurement and to set the cycle time. After each measurement, the result is displayed for 30 seconds as a check. Then the instrument switches off automatically. After the cycle time set in this mode has elapsed, the instrument switches on automatically and the process is repeated.

**DATALOGGER switch ON (automatic measurement):**

1. Select with **SELECT** or continue with **MODE 4**
2. Press "+" to "automat." switch and start with **OK**
3. Set hours **HH** with "+ / -" and confirm with **OK**
4. Set minutes **MM** with "+ / -" and confirm with **OK**
5. Afterwards the unit returns to the standby mode with the following display and automatically turns off after 30s

71% BAT	14:09	21.4 °C	Status line
<b>TIME OPERATION</b> <b>BLUETOOTH off</b> <b>DATALOGGER automat.</b> <b>DATASETS 124</b> <b>NEXT MEASUREMENT:</b> <b>08.05.2018 13:30</b>			<b>Automatic time mode setting</b> <b>Bluetooth connection on/off</b> <b>Autom. mode of datalogger</b> <b>124 datasets stored</b> <b>Next automatic measurement:</b> <b>08.05.2018 at 13:30</b>

**DATALOGGER switch OFF (manual measurement):**

1. Select with *SELECT* or continue with *MODE 4*
2. Press "-" to "manually" switch and start with *OK*
3. Afterwards the unit returns to the standby mode with the following display and automatically turns off after 30s (Time operation)
4. To set continuous operation see *MODE*

95% BAT	14:09	21.4 °C
<b>TIME OPERATION</b> <b>BLUETOOTH off</b> <b>DATALOGGER manually</b> <b>DATASETS 67</b>		



The unit can be switched on and off at any time in order to start a measurement manually with the *OK* key. These measurement results are also stored in the data logger.

Reading the data logger is only possible via a cell phone with Bluetooth. There, the data is available as a CSV file. Please see separate operating instructions.

**MODE 4: CLEAR DATASETS**

Datasets stored in the data logger are deleted and the record counter is reset to 0.

1. Select with *SELECT* or continue with *MODE 5*
2. Go with "+" to "yes" and confirm with *OK*. The records in the Data logger will be deleted
3. Go with "-" to "no" and confirm with *OK*. The records will be not deleted
4. The instrument returns to the standby mode

**MODE 5: DISPLAY CONTRAST**

Different temperatures change the contrast of the display only a little. Nevertheless, a contrast change may be desired.

1. Select with *SELECT* or continue with *MODE 6*
2. Press "+" to set the background of the display darker (max. 42)
3. Press "-" to set the background of the display brighter (min. 27)
4. Adjustments are possible from 27 (bright) to 42 (dark)

5. The instrument returns to the standby mode

### **MODE 6: DATE / TIME**

Date (including leap years) and time (24h format) are controlled by a built-in clock. Time is always displayed in the middle of the status line. As long as a battery is installed, the clock continues to run. Without battery (for example, when changing batteries) the power reserve lasts for about 10 minutes. After that the clock has to be reset.

1. Select with **SELECT** or continue with **MODE 7**
2. Set the day **DD** with "+ / -" and confirm with **OK**
3. Set the month **MM** with "+ / -" and confirm with **OK**
4. Set the year **YY** with "+ / -" and confirm with **OK**
5. Set the hour **HH** with "+ / -" and confirm with **OK**
6. Set the minutes **MM** with "+ / -" and confirm with **OK**

95% BAT	14:09	21.4 °C
DATE / TIME		
Set with +/- => OK		
DD.MM.YYYY	HH:MM	
06.05.2018	14:15	

The time below will be set after the final OK

Position to be set flashes !

### **MODE 7: CONTINUOUS OPERATION / TIME OPERATION**

In continuous mode, the instrument remains switched on, while in the time mode, it automatically switches off 30s after switch on. Selected mode will be saved.

1. Select with **SELECT** or continue with **MODE 8**
2. With current time mode, **CONTINUOUS OPERATION** is displayed. Select with **SELECT**. The instrument immediately returns to the standby position
3. With current continuous mode, **TIME OPERATION** is displayed. Select with **SELECT**. The instrument immediately returns to the standby position

### **MODE 8: LANGUAGE / SPRACHE**

You can choose between German, English and Russian.

1. Select with **SELECT** or go back to **MODE 1**
2. Select the language with "+ / -" and confirm with **OK**

3. *The instrument returns to the standby position and displays now all menus in the language selected*

### **3.2.3. Key OK**

With OK, a measuring process is started, regardless of whether the data logger was set to "manually" or "automat." (see MODE 3).

With the "manual" setting, the measurement result remains in the display for reading until OK is pressed again. Then the value is stored in the data logger.

Likewise, the values set or offered via MODE are confirmed and saved until a new setting is made.

### **3.2.4. Key SELECT (+)**

With SELECT the user can select the currently offered mode for further setting of the instrument.

For date, time, contrast and language settings, this key is used to gradually increase the value to be set.

### **3.2.5. Bluetooth-LED**

The white LED in the middle of the 4 keys flashes at intervals of 2s, as long as there is no Bluetooth connection with the cell phone. It does not flash when connected (connection is established via the "SWM Companion" app).



## 4. Connection with smartphone

To connect the SWM 5000 to your smartphone, please follow the steps below:



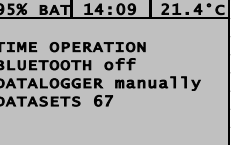

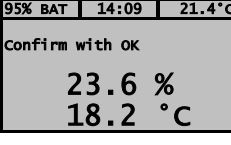
1. Switch on the SWM 5000 basic unit, "Bluetooth OFF" appears on the display
2. Call the app "SWM Companion" (if not already installed on the phone, please download the app for free from the App Store or Google Play)






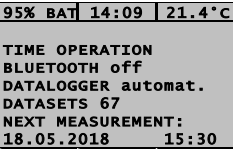
3. Turn on the Bluetooth feature on your smartphone
4. **ATTENTION:** If the smartphone shows available devices, ignore the connection to "SWM 5000", **DO NOT** open !!!
5. Start the app and hold the smartphone close to the SWM 5000 basic unit
6. After successful connection (a few seconds), the display of the SWM 5000 basic unit shows "Bluetooth ON".

## 5. Operation

### 5.1. Mobile measurement of soil moisture


	<p>Connect the SWP 5000-1 probe to the 5-pin socket on the underside of the unit and tighten the bayonet catch.</p>
	<p>Switch on the instrument. After 3s, the display shows the waiting position.</p>
	<p>Depending on the current setting: Select manual measurement (MODE 3: DATALOGGER off), set to time or continuous operation (MODE 7)</p>
<p>Waiting position display</p>	
	<p>Insert the probe SWP 5000-1 into the (soft) soil. By markings on the probe, the insertion depth can be read in 10 cm steps. For harder soils, pre-drill the soil with an auger, if necessary.</p> <p><b>ATTENTION:</b> The sensor on the tip of the probe must be firmly enclosed in the soil, therefore pierce the sensor straight, avoid tilting, pulling or rotating movements before and during the measurement (air gap formation!).</p>
	<p>Start measuring with OK key. After approx. 2s, the measurement result is displayed. Pressing OK again will save the result in the data logger and the instrument will wait for a new measurement (continuous operation) or automatically switch off after 30s (time operation).</p> <p>For measurements without a probe or with a defect one, the two result lines show ----% and ---- °C.</p>

## 5.2. Stationary measurement of soil moisture

	<p>Connect the SWP 5000-1 probe to the 5-pin socket on the underside of the unit and tighten the bayonet catch.</p>
	<p>Insert the probe SWP 5000-1 into the (soft) soil. By markings on the probe, the insertion depth can be read in 10 cm steps. For harder soils, pre-drill the soil with an auger, if necessary.</p> <p><b>ATTENTION:</b> The sensor on the tip of the probe must be firmly enclosed in the soil, therefore pierce the sensor straight, avoid tilting, pulling or rotating movements before and during the measurement (air gap formation!).</p> <p><b>NOTE:</b> Be sure the SWM 5000 is not exposed to bad weather conditions such as rainfall during the measurement period, which may damage the instrument!</p>
	<p>Switch on the instrument. After 3s, the display shows the waiting position.</p>
	<p>Depending on the current setting: Select automatic measurement (MODE 3: DATALOGGER on), set desired measuring cycle; the display will show the next measurement time, after 30s the instrument will switch off automatically.</p>

<p>95% BAT   14:09   21.4 °C</p> <p>Measuring started...</p>	<p>The measuring process starts automatically at the next measuring time and the unit displays the measured value briefly in the display before returning to the status screen. After 30s, the instrument switches off automatically.</p>
<p>95% BAT   14:09   21.4 °C</p> <p>23.6 %</p> <p>18.2 °C</p>	<p>In the automatic measuring mode, an additional measuring procedure can be initiated manually outside of the set measuring cycle: press OK to start a measuring procedure outside of the measuring cycle. After approx. 2s the measurement result will be displayed and saved in the data logger, after 30s the instrument switches off automatically.</p> <p>For measurements without a probe or with a defect one, the two result lines show ----% and ---- °C.</p>

### Care instructions:

	<p>Clean and dry the probe with a piece of cloth before setting the zero point or before re-calibrating. Further measurements can then be carried out immediately.</p>
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## 6. Video HOW-TO-USE

Scan the QR code below to watch the video manual on smartphone or tablet.



YouTube: STEP Systems GmbH