WCM-control

Version 5.0

User manual

Table of contents

1. Introduction

This water content meter (WCM-control) was developed especially for measuring the water content (WC), the conductivity (EC) and the temperature (T) in stone wool substrates used in cultivation under glass. The new series of water content meters can also be used with other brands and types of stone wool substrates. As the meters have only been tested for use with Grodan stone wool products, Grodan does not guarantee results obtained with other substrates. The meter is very user-friendly, allowing growers to easily carry out routine measurements. In addition to individual measurements (WC, EC, and T), the meter can also determine an average value as well as the standard deviation per block measured (section or irrigation zone) when used in multimeasurement mode. When used with the data logging function, the meter records the measurements (WC, EC, and T) as a function of time. In both the multimeasurement mode and the logging mode, the measurements can be displayed visually by transferring the data to the computer with the help of the graphics programme included. This Grodan handheld meter differs from previous models due to its logging functions: communicate, clock, start logging, stop logging and graphics programme on CD-rom. The meter can be recognized by the infrared eye on the side of the meter and the text 'WCM-control' stamped on the meter. When using this new generation of WCM meters, you should select the proper slab type. This allows you to use the meter for all types of stone wool. For the most up-to-date user manual for the WCM-control with this model number, go to www.grodan.com and look under 'Services'.

2. Parts

2.1 Meter parts

The WCM-control includes the following:

1. Recording unit
   On the front side:
   a) Screen (fig. 1 A)
   b) Keys for START, ▲, MENU ▼ (see fig. 1.B-C-D-E)
   On the back:
   a) Battery compartment (fig. 2.A). with four rechargeable and replaceable batteries (fig. 2.B).
   b) Elastic band to enable you to easily hold the meter in your hand while measuring (fig. 2.C).
   On the side:
   Left side: sender eye for infrared (fig. 1.1).

   At the bottom:
   a) Cable with plug and play connector for quickly changing sensor (fig. 1.F).
   b) Connector for mains voltage adapter (fig. 2.D).
   On the top:
   a) Three holes to protect the sensor pins when the sensor is not in use (fig. 2. E).
2. Sensor unit, consisting of:
   a) Grey box with electronic components (fig. 1.G).
   b) Cable (fig. 1.F).
   c) Stainless steel pins (fig. 1.H).

2.2 Parts included

Voltage adapter (fig. 3):
The batteries can be recharged in the meter by connecting the supplied mains voltage adapter to the connection point at the bottom of the meter.

Carrying case (fig. 4):
Store the meter and the parts you are not using in the specially designed case to prevent any damage to the meter.

Software:
With the CD-ROM, you can install the graphics programme on the computer. This CD-ROM is included in the carrying case.

Infrared sender/receiver (fig. 6):
The infrared sender/receiver sends the data from the water content meter to the computer.

User manual:
With complete instructions and a laminated Quick Guide for quick start-up.

Warranty:
This should be sent in immediately after receipt, so that we can register your user information. In addition, you will receive future information about the water content meter.

3. Instructions for use

3.1 General

Be careful when using the sensor. The pins are very sharp!

When you are not using the meter, always place the sensor pins in the top part of the meter. After use, it's best to store the meter in the case it came in. The meter itself should not be opened. This invalidates the warranty and influences the factory settings. Treat the meter with care. The electronic elements of the meter are sensitive to shocks, moisture, dirt and large changes in temperature. Do not expose the meter to exreme sunlight (in the car and in the greenhouse). During the period that the meter is logging data measurements from the substrate, we advise you to store the meter in the case and to close the case except for a small opening between cover and case. Make sure no water can fall on or enter the case or the meter as a result of drip outlets, faucets, outlet drains from the slabs, or run-off from the gutters (for example after heavy rainfall).

In order to ensure that the water content meter operates properly, you should take the conditions into account as specified in table 1. The housing of the water content meter should be kept dry and clean.

Attention:
In the event of large temperature differences, allow the meter's temperature sensor the time and opportunity to acclimatize, in order to gain current readings.

3.2 Charging the batteries

Before using the new meter, you should charge it for a period of 12 hours.

Rechargeable batteries slowly lose their charge if they are not used for a long period of time. As a result, the batteries need to be charged if the meter is new and if the meter has not been used for several weeks. In that case, the adapter should stay on for 12 hours, even if the screen shows that charging is completed. The water content meter contains rechargeable nickel metal hydride batteries (NiMH 1.2V 1800mAh minimum). You can recharge the batteries with the adapter that is included. When replacing batteries, keep the above in mind.

When the adapter is turned on, the text "CHARGER CONNECT" appears on the screen. After a few seconds, the text "FAST CHARGE" appears in the screen. This means that the batteries are not fully charged. If the batterries are used properly the user can store about 2300 measurements. If the batteries are half full, only about 150 measurements can be taken before the batteries have to be recharged. Charging the batteries takes about 4 hours. After the meter has been adjusted, the batteries can be charged in the interim period, but not while taking measurements. After the batteries are fully charged, the text "READY" appears on the screen. The adapter then switches to slow charging and can be removed. During normal use, the amount of charge left in the battery can be read off under the menu item "BATTERY STATUS". If the water content meter does not work when the START or MENU key is pressed, it is likely that the batteries do not have sufficient capacity to start the meter. In that case, you should charge the batteries. If the meter then still doesn't work, refer to chapter 7 "Error codes". If the battery charge falls below a certain level while measurements are being taken, the text "ERROR 4" appears on the screen. You should then charge the batteries as described above.

3.3 Measuring

For taking measurements, choose representative slabs. The sensor pins should be inserted vertically into the stone wool slabs (fig. 5). If the pins are inserted at an angle of less than 90°, the bottom of the stone wool slab will not be measured correctly. In such a case, remove the sensor from the slab and insert it properly at another location in the slab. Never insert the pins at a position in the slab already used previously. The pins may then not make a good connection with the substrate, resulting in unreliable measurements.

Attention:
You will get reliable measurements only if the pins are inserted into the slab correctly (fig. 5). In order to get uniform measurements, the sensor should be inserted 10 to 15 cm from the growing block and perpendicular to the longest axis of the slab.

3.4 Menu options

After pressing the MENU key, you can select one of the following functions:

- EXIT MENU = INDIVIDUAL MEASUREMENTS 1
- SLAB TYPE 2
- BATTERY STATUS 3
- START MULTIMEASUREMENTS 4
- STOP MULTIMEASUREMENTS 5
- STATISTICS 6
- START LOGGING 7
- STOP LOGGING 8
- COMMUNICATE 9
- CLOCK 10
- LANGUAGE 11
- QUICK OFF 12

By pressing the keys ▲ (higher or accept) and ▼(lower or refuse), you can browse through the various menu options. You can confirm your selection by pressing the MENU key.

Attention:
Not all the above options appear on the screen at the same moment. By scrolling up or down with the arrows ▲ and ▼, you can access the various functions.

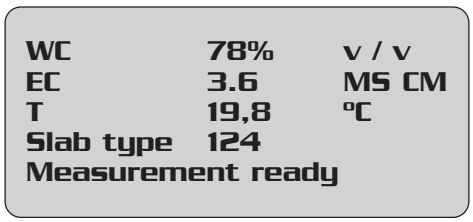
3.4.1 EXIT MENU = INDIVIDUAL MEASUREMENTS (see Quick Guide)

3.4.1.1 INDIVIDUAL MEASUREMENTS

Working procedure:

1. Place the sensor as described in 3.3.
2. To start making a single measurement, press the START key once. The following text will then appear on the screen of the water content meter:

The water content meter will then start measuring. During the measurement, dots are visible on the screen moving from left to right, and after a while the results appear on the screen as follows:



When making an individual measurement, the result remains visible on the screen for about 1 minute. After the measurement, the sensor can be immediately placed in a different stone wool slab. If you again press the START key, the water content meter will immediately begin with a new measurement. If no additional measurement has begun within 1 minute after the last measurement, the meter will automatically switch itself off in order to save the batteries. If you again press the START key, the meter will again start measuring.

3.4.1.2 EXIT MENU

With this function, you can leave the active menu. The water content meter then returns to the basic settings for individual measurements. If you press the MENU key during a measurement, the meter will immediately display the menu overview.

Attention:
If the logging function is active, it is not possible to select the MENU option "exit menu".

3.4.2 SLAB TYPE

Every slab type has a unique moisture distribution. In order to obtain the best results from your WCM-control meter, you must set the meter to your slab type. After choosing SLAB TYPE in the menu, you can use the arrows ▲ and ▼ to enter the number of your slab type. After entering the proper number, click on MENU in order to program the meter and return to the menu screen. In this way, you can use the new meter for various types of substrates.

Note:
As the pins on the WCM are 7 cm long, you can obtain measurements in most slab types by inserting the pins from above. For certain types of slabs, such as those that are 10 cm high as well as blocks, the pins must be inserted into the substrate from the side.

3.4.3 BATTERY STATUS

This function displays the current charge of the battery. The number is an indication of the remaining capacity. "STATUS FULL" (voltage > 540) means that the meter has the capacity to make over 2300 measurements. "STATUS HALF" (voltage 450 to 500) means that about 150 measurements can still be made. The meter needs a minimum voltage in order to be able to make a measurement; "STATUS HALF" therefore does not mean that

the meter can make half the number of measurements as it can with fully charged batteries. "STATUS LOW" means that you should charge the batteries. A few individual measurements can still be made, but for multimeasurements and logging measurements, the batteries should preferably display "STATUS FULL".

Attention:
For logging measurements and more than one multimeasurement, we recommend to charge the batteries beforehand. The measurements already carried out, remain stored in the memory when the batteries run empty.

3.4.4 MULTIMEASURE

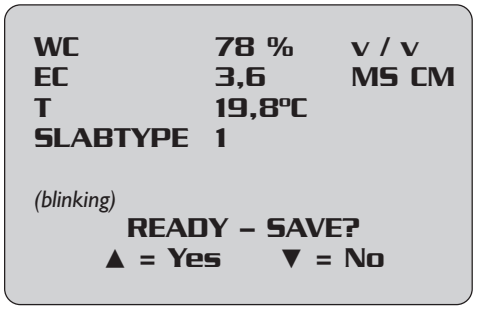
(See Quick Guide)
With this function, you start making multimeasurements. You can make a pre-selected number of measurements per irrigation zone or block. These measurements are saved. With the function STATISTICS, you can calculate the average value (WC, EC, and T) and standard deviation for the block that has been measured. When carrying out multimeasurements, you can use the STATISTICS function to obtain a direct display of the average value and standard deviation per block measured. In addition, you can use the graphics programme on the PC to import these measured values per block measured into an Excel spreadsheet.

3.4.4.1 START MULTIMEASUREMENTS

You select the number of measurements per block beforehand. After this number has been confirmed, the water content meter will automatically be set to begin with the multimeasurements. When doing multimeasurements, you can store a maximum of 250 measurements. This means 250 measurements in one block or 1 measurement in each of 250 blocks. The default setting of the meter is for 25 measurements in 10 blocks.

1. To start the multimeasurements, press the MENU key once. The following text will then appear on the screen of the water content meter:

   The menu will then appear in the screen; see subsection 3.4.
2. Select "START MULTIMEASUREMENTS" with the cursor and confirm the selection by pressing the MENU key. Next, choose the size of the block.
3. With the ▲ and ▼ keys, you can modify the size of the block.
4. Confirm your choice with the MENU key. The water content meter will indicate the maximum number of blocks that can be measured.
5. You start the first measurements by pressing the START key. The meter will then display the following text on the screen:



6. If you press the ▲ key, the measurement will be saved.
7. If you don't want to save the measurement, then press ▼.
8. To start the next measurement, press the START key again. You can repeat this procedure until you want to stop the multimeasurements or until the maximum number of 250 measurements has been reached.
9. Before and after every measurement that is saved, the number of measurements and the block are shown on the screen.
10. At any time during or after the blocks of multimeasurements, you can, by pressing the MENU key, evaluate the results. With the help of the STATISTICS function, the measurements done until then are evaluated, after which you can continue with the same series of multimeasurements. If various types of slabs are being measured in the same greenhouse, then the slab code can only be changed prior to starting the first measurement in each new block.
11. It is only possible to change the slab type before commencing the first measurement of each new block.

Attention:
The WCM-control meter saves the multimeasurements in the memory until they are manually erased. In this manner, it is possible to transfer these measurements later to the PC (see Chapter 4.5, Transferring data to computer). Try to make sure, when conducting a measurement session in the logging measurement or multimeasurements mode, that the memory is emptied at the beginning. If the logging function is in use, it is not possible to do multimeasurements.

3.4.4.2 STOP MULTIMEASUREMENTS

You can turn off the multimeasurement function by selecting:
1) QUICK OFF in the menu screen;
2) STOP MULTIMEASUREMENTS in the menu screen.

In order to stop, answer the question MULTIMEASUREMENT OFF with the arrow ▲ for yes. By activating this function, however, you delete all multimeasurements in the memory. If you want to continue with the multimeasurements, select the arrow ▼ for no.

3.4.5 STATISTICS

If you use the STATISTICS function, an overview of the saved multimeasurements performed until then will appear on the screen. Using this menu function, you can also evaluate the interim results during or after the multimeasurements. The results of one block are displayed per screen. The average value and the standard deviation for WC, EC and T are calculated. By pressing the ▲ and ▼ keys, you can browse through the various blocks that have been measured.

Attention:
In order to obtain statistically reliable average values, try to carry out 25 measurements per measurement block.

3.4.6 START LOGGING

(See also Quick Guide)
By pressing MENU, you can activate the LOGGING function (unless the LOGGING function is already active). With this function, you can carry out measurements during a specific time period and with a measurement frequency selected beforehand. With the help of the CDROM included and the infrared cable, you can later transfer these measurements to the PC in the form of a graphic or a list of data.

Attention:
During logging measurements, check that the clock is correctly set (see 3.4.9 CLOCK).

Capacity of logging memory
With this function, the meter can carry out a maximum of 2300 measurements. These measurements are stored in the memory with the date and time included. In order to achieve this, you must start logging with an empty memory (i.e. the old measurements are not saved). Answer the questions "MEMORY NOT EMPTY" and "CLEAR MEMORY" with Yes ▲. If you want to save the old series of measurements, answer this question with No ▼.

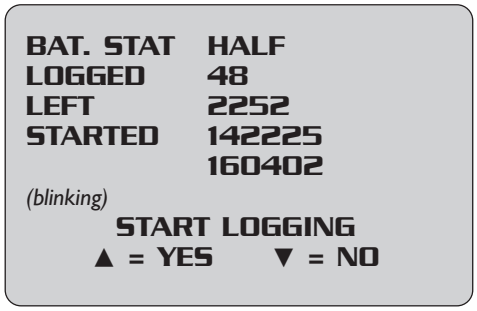
However, when the memory for logging measurements is full, the older measurements will be overwritten by the new measurements. Take this into account when selecting the measurement period and measurement frequency of the water content meter.

Attention:
If measurements are done every minute over a period of three days (3 x 24 x 60 = 4320 measurements), only the last 2300 measurements will be saved. In such case it is best to adjust the measuring frequency or the measuring period.

Manually setting the starting time for a series of logging measurements, date and time:

Start logging
You set the time and date of the first measurement in the same manner as you set the clock (see 3.4.7 CLOCK). You can postpone the first measurement for a maximum of one month and a minimum of three minutes. After you set the starting time, you must set the measuring frequency (interval). The interval can be set to 1, 2, 3, 5, 10, 15, 20, 30, 45 and 59 minutes. After you set the proper interval using ▲ and ▼, you must confirm this with the MENU key. Next, you set the number of days to be measured in the same manner, and confirm this with the MENU key. The screen will then show the number of measurements to be carried out with the settings selected. During the measuring period, after the meter has carried out the number of measurements set, it will automatically stop logging and shut down.

Attention:
The first measurement must begin a minimum of three minutes later than the time at which you set the meter.



Example of logging measurement:

Bat. stat:	half	= battery status (full, half or low)
Logged:	48	= number of measurements logged
Left:	2252	= number of measurements still to be logged
Started:	142225	= starting time for logging measurements in hours/min./sec.
	60402	= starting date for logging measurements in day/month/year

"START LOGGING"
"▲= YES" "▼= NO"

At the bottom of the screen, the following text will blink on and off "START LOGGING" alternately with "YES" (▲) and" NO" (▼). If you choose "YES", the meter will automatically begin in logging measurement mode. If you choose "NO", the programme will return to the basic menu.

When the LOGGING function is activated, the text "START LOGGING" will appear at the bottom of the screen, followed by the line:

The first six figures indicate the time (hours, minutes, sec.); the next four figures indicate the date (month, day); the last figures indicate the number of the measurement made (maximum 2300). These last figures appear after every measurement.

Carrying out multimeasurements when in logging measurement mode
In order to carry out multimeasurements, the logging function must first be stopped. It can later be turned on again. If the meter is turned on during a period when measurements are being logged, then the same LOG OVERVIEW will appear on the screen as when logging measurements are started. Please note, however, that the meter can then only be used in manual mode; logging measurements can no longer be made. You can again activate logging measurement mode only after you turn off manual measurement mode (individual or multimeasurements).

3.4.7 STOP LOGGING
You can interrupt logging measurements when turning on the meter by pressing the MENU key twice. The text "MENU" appears on the screen, and with the "arrow ▼" the cursor moves to "STOP LOGGING". After you press the MENU key, the questions "LOGGING OFF" appears. If you answer with "YES" (▲), logging mode is stopped. The meter will also stop logging once the number of measurements set beforehand has been carried out. The measurements remain stored in the memory.

3.4.8 COMMUNICATE
With the help of this function, the measurements logged by the hand meter can be exported to the graphics software programme on the computer. To do so, the hand meter must be turned on and the "COMMUNICATE" function must be activated in the MENU by pressing the MENU key.

Attention:
The hand meter must be turned on and set to menu function "COMMUNICATE" in order to export the measurements logged to the graphics programme on the computer. Communication is not possible if MULTIMEASURE has been started.

3.4.9 CLOCK
In the screen, you can go to the clock function by using the ▼ key. By pressing MENU, you activate the clock function. This is not possible in logging measurement mode. With this function, you can display the date (year, month, day) presently set as well as the time (hours, minutes, sec.). If desired, you can change these. You can change the time by pressing START. Using the ▲ and ▼ keys, you can change the blinking time displayed. To change the next parameter, press MENU. After you get to the year and again press MENU, you will be returned to the original menu overview.

Attention:
Take daylight saving time into account

3.4.10 LANGUAGE

You can choose any one of several different languages. The languages available are Dutch, English, German, French, Danish, Spanish, Italian, Polish and Russian. All menu functions are displayed on screen in the language selected. Confirm the language selected with the MENU key.

3.4.11 QUICK OFF

With this function, you turn the meter off. If you choose this option from the menu while the logging function is still active, logging is continued. If you choose this option while making individual measurements, the meter will shut down after one minute. During multimeasurements or if the statistics function is active, this will take 30 minutes. If any of the other menu functions are activated, the meter will shut down after two minutes.

4. PC instructions

4.1 System requirements

The PC used must comply with the following system requirements:

- A COM port that is available and working; make sure that no other peripherals - such as electronic agenda, Revo or I-pacq - automatically claim this port. These programs must be closed down when reading out the water content meter.
- 2.5 MB of free space on the hard disk
- 16 MB of internal memory

The operating system required is Windows 95 or higher.

4.2 PC

The infrared eye included is meant to be connected to a free COM port on the computer (COM 1 or 2). Make sure that the port is properly configured on the PC. When transmitting data, the infrared eye on the computer should point towards the infrared eye on the hand meter. The infrared eye (dark red rectangle) is located on the left side of the hand meter opposite the screen. In order to work properly, the distance between both infrared eyes should be between 2 and 20 cm (The IR eye can also be connected via the USB port, as long as you use a USB-RS232-interface cable for doing so). When measurement data is being transmitted, the "COMMUNICATE" option in the MENU of the hand meter should be activated.

4.3 Installing software

By placing the CD-ROM in the CD-ROM player, you automatically start the installation of the "GRODAN WCM control" software. The software installation can also be started manually by clicking the "SETUP.EXE" file of the CDROM. The "GRODAN WCM Logging" software will then be automatically installed on your PC (C:\program files\grodan\wcm graphic\ WCMcontrol.exe). Make sure that you fill in the user information so that installation can take place. Shortcut keys will be placed on the desktop and in the start menu for starting up the GRODAN WCM Logging function.
You can remove the software from the system via START > SETTINGS > CONTROL PANEL > add/remove programs. After selecting the GRODAN WCM graphic (=Logging) software, click "Add/Remove".

Attention:

When there is no free COM (serial) port available on the PC, it is also possible to connect the IR sensor to a free USB port. However, this necessitates the purchase of a universal USB to serial cable and the corresponding software. These are available from standard computer/electronics shops. A "free" serial port can then be chosen (usually COM 5) by clicking on the "system" icon on the task bar in the WCM Control graphs programme and then selecting "configuration".

In the event that there is no free COM (serial) port available on the PC, it is also possible to connect the IR sensor to a free USB port. However, this necessitates the purchase of a universal USB to serial cable and the corresponding software (cost: approx. € 40). These are available from standard computer/electronics shops (more information on digiconnect.nl). A "free" serial port can then be chosen (usually COM 5) by clicking on the "system" icon on the task bar in the WCM Control graphs programme and then selecting "configuration".

4.4 Software options

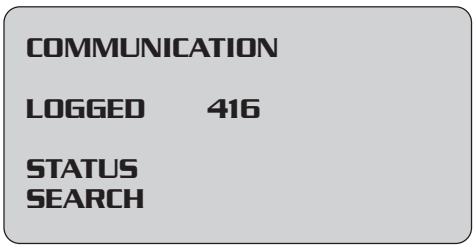
With the GRODAN WCM control software, you can export the measurements logged by the meter to the computer, display them in a graphic, or, if you wish, export them to an Excel file or e-mail them. In addition, individual multimeasurements can also be exported into an (Excel) table.

4.5 Transferring data to computer

Logged measurements
If you wish to export the logged measurements from the hand meter to the computer, then first use the shortcut key on the desktop or the shortcut key in the start menu to start the GRODAN WCM Logging programme. Via START > SETTINGS > CONTROL PANEL > SYSTEM > COM PORT, you can select which COM port you want to use (make sure that all other programmes using this COM port are not active, and check whether any other peripherals are claiming this port; otherwise you will not be able to open the COM port). In order to import data from the hand meter, click FILE > IMPORT > HANDMETER or click the icon . Before doing so, the COMMUNICATE function in the MENU of the hand meter must be activated. In addition, the infrared eye of the computer must be pointed towards the infrared eye of the hand meter, and the distance between both eyes should be approximately 2 to 20 cm. The COMMUNICATE function in the hand meter must be activated before the blue bar displayed on the bottom of the screen for "IMPORTING MEASUREMENTS DATA" has been completely filled.
If data import is not successful, the text "COMMUNICATION ERROR" will appear on the screen. This can be due to one of the following reasons:
- the meter is not turned on;
- the meter is not set to "COMMUNICATE" in the MENU;
- the infrared connection is not working properly; the distance between the infrared eyes is too small or too large.

If all the conditions have been complied with, again click FILE > IMPORT > HANDMETER or click the icon .

If the COMMUNICATE function on the hand meter is activated, the number of measurements saved ("LOGGED:") and the status of the meter will be displayed on the meter screen, for example:



"STATUS SEARCH":
The water content meter will try to contact the computer. Once contact is established, "hand meter found" appears on screen. If the blue bar on the computer screen is at its end, and the hand meter still displays STATUS SEARCH, make sure that the infrared eye on the computer is pointing towards the infrared eye of the hand meter, adjust the distance between both eyes and again click the icon in the GRODAN WCM Logging programme or on FILE > IMPORT > HANDMETER. As soon as the counter next to STATUS DATA on the screen of the meter is running, the measurement data are transmitted and imported into a standard graphic with the GRAS.exe programme.

Transfer of multimeasurements
The transfer of the multimeasurements takes place in the same manner as the transfer of logged data from the WCM-control to the PC (see paragraph above). The data are displayed, per measurement, in columns in the graph (in the now empty graph). The data can also be sent by e-mail or exported to Excel for further processing.

4.6 Screen management
Once the logged data are imported from the meter, they are, by default, displayed in the form of a graph. Beneath this graph, a table is displayed containing the numerical values per measurement. With the help of IMAGE > DIVIDE, you can move the graph upwards and view it. In addition, you can also delete individual measurements by selecting a measurement with the cursor and pressing the DELETE key.

This modification is then also implemented in the graph.

<u>Saving measurements</u>
You can save measurements via FILE > SAVE or via SAVE AS or by clicking the floppy icon in the menu bar. If you want to save various measurement data files, we suggest creating a separate folder for that purpose and giving the measurement files different names. By default, the data files are giving names consisting of the measurement date (year, month, day) of the first measurement in the file. You can change the name.

Exporting to EXCEL

You can export the (saved) numerical values into Excel by clicking FILE > EXPORT TO EXCEL. After you export the data, the Excel file can be found in the same folder as the original file. In order to further process the data in Excel, you must take several actions to ensure that each measurement (date, time, measured values for WC, EC and T) is placed in its own cell. The new file into which you have exported the data has the same name as the original file but with the extension .CSV. The new file contains the exported measurement data in the 'Comma Separated Value' format, which can be read by Excel. If you double-click the CSV file, it will automatically be opened in Excel. Of course, you can also start Excel manually, and then open the relevant CSV file using the menu in Excel. When Excel opens the CSV file, it automatically places all the data in only one column (column A). In order to place the data in several columns, you first select column A by clicking the A above the column. The column then becomes 'blue'. Then from the DATA menu, select TEXT TO COLUMNS. A wizard will then appear which will help you to distribute the measurement data over several columns. In this wizard, you should choose the comma as separation symbol. After you make use of the wizard, the data will be distributed over several columns. You can then save the file as a normal Excel spreadsheet via FILE > SAVE AS.

Scale of measurements in graphic

Using IMAGE > SCALE, you can set the minimum and maximum values that can be displayed in the graph separately for WC, EC and T.

Removing graphic lines

The check marks next to IMAGE > WC-graph, IMAGE > EC-graph and IMAGE > T-graph determine which lines on the graph will be visible or not.

Overview graphic for 1, 3 and 7 days

On the menu bar, you'll find options for 1 (1 day), 3 (3 days) and 7 (7 days). If you click one day 1, the data over 24 hours will be displayed in a graph from 6 a.m. until 6 a.m. If you click 3, the data over 72 hours will be displayed in the graph, and if you click 7, then 168 hours will be displayed. If more days have been measured than the 1, 3 or 7 that was selected, then you can use the arrows in the menu bar to go back ◄ and forth ►, per day.

4.7 Printing graphics

You can print graphs by clicking the print icon in the menu bar or by clicking IMAGE > PRINT. You can preview a print sample via IMAGE > PRINT SAMPLE. You can modify the print settings via IMAGE > PRINT SETTINGS. The print function determines beforehand the area that will be printed. The graph to be printed is sized so that it will fit into the area to be printed. It's best to print graphs using the A4 and landscape settings, as the ratio between length and width is based on these settings.

4.8 E-mail function

In the following, it is assumed that an Outlook e-mail software programme is installed and available on the computer. If necessary, other email programmes that support the Microsoft Mail protocol can also be used as long as they are available on the PC. If a series of measurements has been imported using the GRODAN PC software, you can mail these measurements via IMAGE > SEND AS EMAIL. E-MAIL is not available (light grey colour) if there is no active e-mail software programme available on the PC. After you select the SEND AS E-MAIL option, an empty e-mail message window is automatically opened with the measurement data file as an attachment. You only need to fill in the name of the addressee in the TO field. The relevant file with measurement data is included in this e-mail message as an attachment. The person receiving this e-mail can open the file only if he has the graphics programme of the logging meter. Otherwise, the file should be sent as an Excel file, so that the addressee can open it and work with it in Excel.

5. Maintenance

5.1 General

Note:
It is best to disinfect the sensor pins before and after every series of measurements. But be careful with using aggressive agents.

The water content meter does not require much maintenance. If the screen or the data cable becomes dirty, clean it with a moist cloth. Never use an aggressive cleanser. If the meter is not working properly, it can be initialized again by charging the meter until a normal text appears on the screen.

5.2 Batteries

The lifetime of rechargeable batteries is limited. Under normal conditions, the batteries can be recharged 1000 times. If the capacity of the batteries becomes insufficient, you can replace them with nickel metal hydride batteries of the same size and capacity (1.2 V - 1800 Ah). If one of the batteries is defective, the adapter can detect this, and the following message will appear on the screen:

In that case, check the contacts of the adapter, and check the contacts and the type of the batteries. Try recharging again. If necessary, the water content meter can also work on normal non-rechargeable batteries. In that case, be sure NOT to turn on the adapter, as this can result in irreparable damage. When replacing the batteries, replace all four batteries at the same time.

5.3 Calibration

The meter does not need to be calibrated. If you have any doubts, you can check the calibration by holding the pins in the air or under water. The meter should then read 0% and 100% respectively (with a margin of 5%). If you get incorrect measurements, please contact your supplier.

5.4 WCM models

Older types of sensors (from before 31 December 2003 - check the series number on the back side of the meter beginning with 2003 and lower) will not work with the newer type of WCM-control or vice versa. If they are nevertheless connected, the system will not function, but the equipment will not suffer any damage.
The voltage adapters are identical, and are therefore interchangeable as long as the plug fits.

6. Specifications

6.1 Parameters

The WCM-control meter measures a volume equal to about 10 x 3.5 x 7.5 cm3 (length x width x height).

In this volume, the following parameters are determined:

- The water content (WC) in volume percent (% v/v)
- The electrical conductivity (EC) in mS/cm, calibrated via international standard.
- The water content meter measures the amount of nutrients dissolved in the substrate (by measuring the EC). The measured value will be equal to the value determined with the help of samples taken from the slab.
- The temperature of the slab (T)
  The water content and the electrical conductivity measured are both corrected for temperature.

6.2 Conditions

The water content meter will take correct measurements if the substrate complies with the following requirements:
See table 1 next page

- The sensor pins of the meter are dry and clean when starting the measurement.

If the screen becomes too warm, it can become dark, making it impossible to take a reading. This effect is reversed once the temperature of the screen returns to normal.

6.3 Voltage adapter

The meter is supplied with a voltage adapter with a 4 mm jack plug as connector.
Input: 100 - 240 VAC / 47 - 63 Hz / 400 mA
Output: 9 VDC / 1.5 A

6.4 Range and accuracy when measuring in stone wool

see table 1 next page

6.5 CE certificate

The water content meter is CE certified, which means that the meter has been tested and approved in accordance with the following EMC guidelines:
EN61000-6-4 (2001)
EN61000-6-2 (2001)*
EN61000-3-2 (1995) + A1 (1998) + A2 (1998)
EN61000-3-3 (1995)

This does not apply to the voltagae adapter if used with a system other than the water content meter described above.

Attention:
The presence of transmitters in the vicinity that work with radio frequencies can influence the operation of the water content meter.

* = Due to the operating principle of the sensor, deviations are possible in measurements at certain frequencies. The size of the deviation and the relevant frequencies are described in the laboratory documents 03C01265EUT1. If requested, Grodan can send you these documents.

Table 1: Specifications

Parameter	Measuring conditions		Measurement range		Accuracy		Resolution*	
	Min	Max	Min	Max	Min	Max	Min	Max
WG (%v/v)	25%	95%	0%	100%	2.5%	5.0%	0.1%	0.2%
EC (mS/cm)	0	10	0	20	0.1	0.5	0.01	0.02
T (°C)	10	40	0	50	0.5	1	0.1	0.1

* The resolution indicates the smallest interval which can be measured using the meter.

Attention:
The EC measured using the WCM is calibrated via the international standard at 20 °C. Globally, most EC meters are also calibrated at 20 °C. However, in the Netherlands it is more usual to calibrate EC meters at 25 °C, which results in a measurement 10% higher than when taken with a meter calibrated at 20 °C. Therefore, if one compares the EC measured by the WCM with a sample taken from the slab with a syringe and measured with a conventional EC meter, the latter value will be about 10% higher.
Note: The specifications apply when taking measurements in water containing nutrients. Deviations may occur in substrates depending on the type of substrate and the salts present.

7. Error-codes

ERROR CODE	DISCRIPTION
1	EPROM does not work correctly → check connector/plug connection → contact your supplier
2	Adapter or battery error → check the contacts on the adapter → use the adapter supplied → check the contacts and the type of the batteries → try charging again
3	There is no sensor connected or the sensor does not work correctly → contact your supplier
4	Insufficient battery capacity → charge the batteries again → replace batteries by new ones
5	RAM does not work correctly → try a second time → contact your supplier
6	Incorrect adapter → use the adapter supplied
7	Communication does not work correctly → try a second time → meter is not turned on → meter is not set to 'communicate' in menu screen → malfunction in infrared connection → distance between infrared eyes is too small or too large

8. Guarantee: terms and conditions

GRODAN guarantees that the products delivered have been manufactured with the best materials. If nevertheless there are any defects in the products delivered as a result of manufacturing or material faults, then GRODAN will decide to either repair the defects, or to have them repaired, to deliver the necessary parts for the reparation, to completely replace the goods, or to refund the value of the meter but never an amount larger than the value of the meter. This guarantee is valid for a period of 12 months after delivery. Meters older than 5 years can no longer be repaired due to the (lack of) availability and cost of parts and the technical improvements incorporated into new meters. With regards to guarantee and/or complaints related to parts and materials, GRODAN will rely on the liability of the supplier of the parts and/or materials concerned. GRODAN will not accept any liability for other obligations, such as compensation for losses due to the cancellation of the contract. Any complaints under this guarantee should be forwarded in writing to GRODAN within a period of eight days after the damage has occurred. If the customer does not comply with, or does not comply with in a timely fashion, the conditions of the warranty of GRODAN or a related contract, then GRODAN will not be required to fulfil any guarantee or payment as described regarding to the contract. GRODAN reserves all its rights in these matters. Nothing from this publication may be copied or brought into the public domain through printing, photocopying, microfilm or in any other fashion without written prior permission from GRODAN. This also applies to the drawings and diagrams concerned.

GRODAN reserves the right to modify a part or parts of the equipment at any time it chooses without informing the customer beforehand or at the time. The contents of this publication may be changed without prior notice.

For further information regarding settings, maintenance and repairs, we ask you to contact Grodan Customer Service.

Although this publication has been carefully written, GRODAN cannot be held liable for any errors or mistakes in this publication and any of their consequences.

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