



## PM-WCS-3-USB USB Capacitive soil moisture, temperature, EC sensor

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### FEATURES

- Android and Raspberry Pi client demo software.
- Dust and waterproof
- Low cost and easy to use.
- Fairly accurate readings
- Calibration functions for EC and Dielectric permittivity
- USB CDC-ACM virtual COM port and 115200 baudrate





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### ELECTRICAL PROPERTIES

	Min/Sleep	Typical	Max
Supply voltage (VCC), V	2.5	5	6
Working current (VCC=3.6V) , mA	-	12	14
Operating Temperature Range, Celsius	-20	25	70

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### PHYSICAL PROPERTIES

Sensor dimensions 114 x 24 x11  
Cable length 2.4m

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### MEASUREMENT PROPERTIES

	Resolution /avg Tolerance	Range
Dielectric permittivity ( $\epsilon$ ) (Temperature corrected)	0.1 $\epsilon$ /5%	1 (air) to 80 (water)
Electrical Conductivity (mS/m)	0.01 mS/m /20%	0...300 mS/m
Temperature (°C)	0.1°C /3%	-20 to 70°C
Volumetric Water Content (%) calculated from dielectric permittivity by Topp equation (Topp et al, 1980): $\theta = 4.3 \cdot 10^{-6} \epsilon^3 - 0.00055 \epsilon^2 + 0.0292 \epsilon - 0.053$	1%	0 - 100% VWC



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### CONNECTION

Sensor is equipped with standard 2.4 or 3 meter long USB 2.0 cable. You may connect lots of sensors using USB hub. To identify sensors there is option to set unique 8 character device id and application id.

On linux sensor will be detected as /dev/ttyACM0 ... /dev/ttyACMx

For linux permissions settings please [consult](#)

On Linux you may use minicom utility to access sensor.

For windows PuTTY may be used.

We recommend Android mobile [application](#) for sensor setup

### SENSOR CALIBRATION

Sensors are already factory calibrated, but in case needed they may be recalibrated using USB terminal interface as described for device specific commands.

Put sensor in to water and issue command **water**, response OK.

Hold sensor in air and issue this command **air**, response OK.

For **ec** <uS/m> calibration put sensor int to liquid and set right sensor reading value in uS/m.

We recommend Android mobile application for sensor setup and data reading/storage

#### SENSOR CALIBRATION ON ANDROID APP

1. remove battery, attach to phone
2. open application & wait for USB connected status or connect
3. go to SETTINGS tab,
4. hold sensor in the air – click button AIR
5. submerge sensor in the water or soil with water, click button WATER
6. go to MAIN tab click read to test calibrated values

### DATA FORMAT

PM-WCS-3-USB data output prints comma separated values (CSV) sequenced as described below.

1. Dielectric permittivity (  $\epsilon$  ) (Temperature corrected) resolution: 0.1  $\epsilon$  (avg. Tolerance 5%) and range 1 (air) to 80 (water)
2. Electrical Conductivity (mS/m) resolution: 0.01 mS/m (avg.Tolerance 20%)
3. Temperature (°C) resolution: 0.1°C(Tolerance 3%) and range: -20 to 60°C
4. Volumetric Water Content (%) resolution:0.1% (avg.Tolerance 5%) and range: 0 – 100% VWC Note: VWC is calculated from dielectric permittivity by Topp equation (Topp et al, 1980):  $\theta = 4.3 \cdot 10^{-6} \epsilon^3 - 0.00055 \epsilon^2 + 0.0292 \epsilon - 0.053$

Optionally you may setup EPOCH time (Table below command: “time”) in seconds and there will be time parameter added in front.



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Command	Response	Explanation
<b>read</b>	sensor data	request response sensor data reading
<b>millis &lt;period&gt;</b>	OK	sensor will start report data repeated by set-up period in milliseconds, this option may be used to redirect data to log file.
<b>time &lt;Epoch&gt;</b>	OK	setup current Epoch time in seconds - need to set-up after any power loss of the sensor.
<b>int &lt;int. sec.&gt;</b>	OK	set USB offline memory write interval in seconds
<b>mem</b>	<data>	get offline data accumulated (max 320dp)
<b>appid &lt;appId&gt;</b>	OK	set appId
<b>devId &lt;devId&gt;</b>	OK	set devId
<b>info</b>	config vals	print this parameter setup values.
<b>ver</b>	<version>	print device type and version number
		<b>CALIBRATION</b>
<b>air</b>	OK	Set device to air and execute air calibration
<b>water</b>	OK	Set device to water or soil with water and execute water calibration
<b>ec &lt;uS/S&gt;</b>	OK	Set device to calibration liquid and set proper EC value <b>!! use uS/S no mS/S</b>



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### WRITE TO CSV

You can write simple script to start log sensor USB data to CSV file. This sample is written for Raspberry Pi, Debian, Ubuntu linux, before executing script you have to install minicom: `sudo apt-get install minicom`

```
#!/bin/bash
#sensor serial port name
PT="/dev/ttyACM0"
sudo stty -F $PT speed 115200 cs8 -cstopb -parenb -echo raw
#setup current time
echo -ne "time $(date +%s)\r" > $PT
#set time period 5 seconds in milliseconds and start logging
echo -ne "millis 5000\r" > $PT
#flush some output
timeout 2s cat $PT
#print output to file
cat $PT > swout.csv 2>&1 &
```