

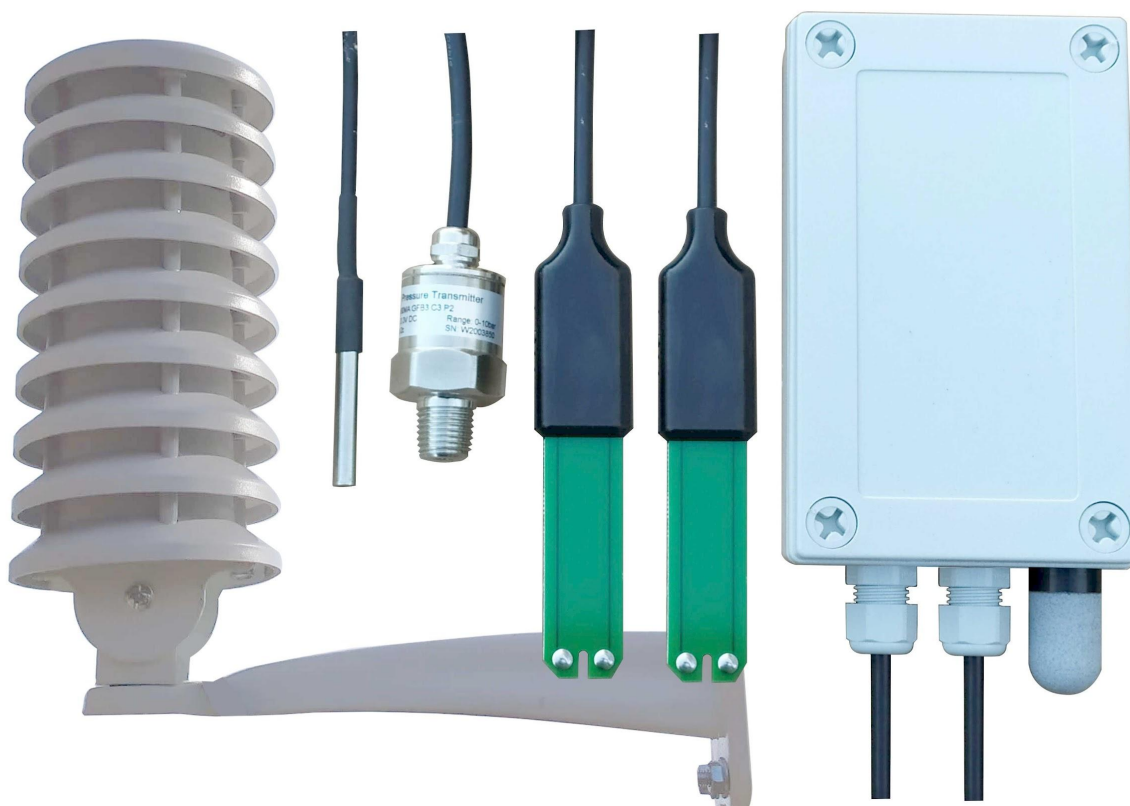


## PM-IO-6-WIFI IO Module

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### FEATURES

- Optional Single or Double Tinovi Soil Moisture/Beta version EC/Temperature sensor option
- Optional BME280 Air Temperature/Humidity/Pressure sensor option (Not waterproof, not for outdoor)
- Optional OPT3001 light lux sensor option
- Optional 12v booster pulse solenoid reverse switch output option
- Pulse counter for utility meter reporting
- Water leak detector and valve close output trigger
- Dust and waterproof IP67
- Android application for Bluetooth LE setup
- Configurable HTTP URL and Authorization header for JSON data post
- Configurable MQTT connection parameters
- Up to 50m range with indoor WiFi router





## PM-IO-6-WIFI IO Module

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### ELECTRICAL PROPERTIES

	Min/Sleep	Typical	Max
Supply voltage (VCC), V	2.5	3.6	6
Working current (VCC=3.6V), mA	Sleep 22uA	22	150
Operating Temperature Range, Celsius	-20	25	70

Sensor sleep mode consumes 20 uA, Active mode consumption 30-150 mA. Required battery is **3.7v 18650**. Or **26650** if configured additionally. After power up sensors wait 20 seconds for Bluetooth configuration session connection from android application. If none is not connected, device turns off Bluetooth hardware and starts normal operation. Device should be restarted, before attaching to Bluetooth for configuration, it means battery should be removed or reset button pressed.

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### PHYSICAL PROPERTIES

dimensions 80x130x35

Soil Sensor cable length 1.4m or optional up to 5m

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### SOIL SENSOR MEASUREMENT PROPERTIES

Soil Sensor	Resolution	Range /avg Tolerance
Dielectric permittivity ( $\epsilon$ ) (Temperature corrected)	0.1 $\epsilon$	1 (air) to 80 (water) /5%
Volumetric water content - VWC calculation from Dielectric permittivity $\epsilon$ . $VWC = 0.002974 * \text{pow}(\epsilon, 2) + 0.07424 * \epsilon - 1.295$ ;		
Beta version EC, Electrical Conductivity (mS/m) <b>(0.1 mS/m = 1 uS/cm)</b>	0.1 mS/m	0...300 mS/m 20% 300...800 mS/m 40%
Temperature (°C)	0.1°C	-20 to 70°C/3%



## PM-IO-6-WIFI IO Module

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Degree of water saturation in the soil	0.1%	0 – 100% /8%
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### COMMANDS

To enter commands you need to connect to the device via bluetooth and switch to the log tab, the upper side there is the command entry line.

Key	Meaning
tare	Set weight cell to 0
scale <divisor>	Set scale divisor, you need to issue 'scale 1' to reset scale divisor, read scale on 1kg weight, and input this number in command.
ph <#> <pH>	<p>pH (ADC) calibration 2 points. You need solutions with for example pH 4 and pH 7.</p> <ol style="list-style-type: none"><li>1. Submerge sensor to pH 4.0 solution and write command 'ph 0 4.0'</li><li>2. Submerge sensor to pH 7.0 solution and issue command 'ph 1 7.0'</li></ol> <p>This will add 2 point calibration for pH sensor, line function via these 2 points will be used to calculate values from ADC reading.</p>
adcp <x0 y0 x1 y1>	<p>Adc (pH) points if calibration is known, Where:</p> <p>x0 - pint 0 ADC reading y0 - point 0 return (Y) value x1 - pint 1 ADC reading y1 - point 1 return (Y) value</p> <p>Line function via these 2 points will be used to calculate values from ADC reading.</p>
restore	Do not use this unless you do not know how to configure all data, because this will reset all device data to default values.

### JSON DATA MESSAGE

You may configure to device http/https post ("Content-Type", "application/json") to configure the endpoint for receiving device data. Data is sent by http POST request containing single level JSON message containing fields:



## PM-IO-6-WIFI IO Module

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Key	Meaning
id	Device ID base on MAC address
set	Setup byte (on water leak trigger changed)
bat	Bat percent
rsi	RSSI signal strength
s0_e25	Soil Sensor 0 Dielectric permittivity at 25c
s0_ec	Soil Sensor 0 Electric conductivity
s0_temp	Soil Sensor 0 Temperature
s0_vwc	Soil Sensor 0 Degree of water saturation in the soil
s1_e25	Soil Sensor 1 Dielectric pemitivity at 25c
s1_ec	Soil Sensor 1 Electric conductivity
s1_temp	Soil Sensor 1 Temperature
s1_vwc	Soil Sensor 1 Degree of water saturation in the soil
w_press	Water pressure if pressure sensor present
b_temp	Air temperature if BME280 air sensor present
b_hum	Air humidity if BME280 air sensor present
b_press	Air pressure if BME280 air sensor present
lux	Light LUX if OPT3001 Light sensor present
pulse	Pulse counter output
s_temp	Sht35 sensor temp
s_hum	Sht35 sensor humidity
scale	Load cell data reading
adc	Adc input data reading

### CONTROL MESSAGE

Device support binary base64 encoded POST response.  
HEX to base64 converter [link](#)  
Control message contains 1st command byte followed by value:



## PM-IO-6-WIFI IO Module

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1. 0x01 + device sleep time (data sending interval) adjustment. Message should contain 5 bytes, 1st byte is 0x01 and following 4 bytes is unsigned 32-bit integer time in seconds to sleep. For example sending HEX 010000000A or "AQAAAAo=" base64 will set interval to 10 seconds, but 0100000E10 or "AQAADhA=" base64 will set interval to 3600 secs = 1 hour.
2. 0x02 + data config byte :
  - a. Bit 0 - enable Tinovi PM-WCS-3-I2C Soil sensor
  - b. Bit 1 - enable BME280 air temp - humidity sensor
  - c. Bit 2 - enable OPT3001 light lux sensor
  - d. Bit 3 - 2nd soil sensor
  - e. Bit 4 - enable pulse counter
  - f. Bit 5 - reserved
  - g. Bit 6 - Water Leak detector flag - leak detected
  - h. Bit 7 - read only -valve status
3. 0x03 + 0x01 or "AQ==" base64 -valve ON or 0x00 "AA==" base64 - valve off
4. 0x04 + 2-byte valve pulse time millis
5. 0x05 + 4-byte max valve on time millis, 0 -disabled
6. 0x06 + 2-byte valve trigger ON VWC limit
7. 0x07 + 2-byte valve trigger OFF VWC limit
8. 0x08 + 4-byte pulse counter offset (pulse counter not supported)
9. 0x09 + 1-byte water leak valve OFF trigger enable =1 , disable =0
10. 0x0A + 1-byte sensor number 0 or 1 - if soil moisture present - calibrate AIR
11. 0x0B + 1-byte sensor number 0 or 1 - if soil moisture present - calibrate WATER
12. 0x0C + 1-byte sensor number 0 or 1 + 2 byte EC value - if soil moisture present - calibrate EC. Example sending 0C0585 will calibrate sensor for 1413 uS/cm
13. 0x0D + 4 byte valve open time in seconds - valve will be closed after this time (device will sleep all that time and close valve on wake up)
14. 0x0E + 1 byte HTTP posting data format 1 = OUT\_JSON or 2 - OUT\_BIN\_BASE64
15. 0x0F + 1 byte over air firmware update check cycles skip, default 10, if you posting messages once in 5 min, then FOTA check will be in 10 x 5 = 50 min intervals.



## PM-IO-6-WIFI IO Module

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### VALVE CONTROL

Valve controller switch max output continues current is 0.5A, (1A max pulse). Battery max current draw is almost 3 times more than your load current, if you apply 0.5A load current, your battery should support 1.5A current. Switch Supports reverse polarity latching relay. In open direction Red wire is Positive, Black negative, but in close direction Black - Positive and Red - Negative. Valve may be controlled via downlink messages, send 0x0301 to open valve, and 0x0300 to close valve. Device remembers last valve status sends it in read only setup byte bit 7: if setup bit 7 is set, then valve is open, if bit is cleared - valve is closed state. (See payload decoder sample- parameter "valve" - indicates valve status 0-close, 1-open). See CONTROL MESSAGES section for other valve control commands. An alternative to a booster dedicated 12v battery for the switch may be used. That allows up to 3A current via switching circuit from battery.

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### WATER LEAK DETECTOR

Water leak detector on the trigger will interrupt device sleep and send a message immediately with a water leak flag enabled in settings byte. It will repeat sending this flag (then will reset the flag. If valve OFF on water leak trigger is enabled, then valve off will be triggered). 2 electrode water leak detector is supported, triggered when resistance between electrodes is less than 250 kOhm. A water leak detector uses Green and White wires.

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### SOIL SENSOR CALIBRATION

Sensors are already factory calibrated, but in case needed they may be recalibrated using an Android application.

Hold sensor(the sensor should be clean and dry) in air and issue this command **air**, response OK.

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

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

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

#### PM-WCS-3-I2C soil sensor DP CALIBRATION ON ANDROID APP

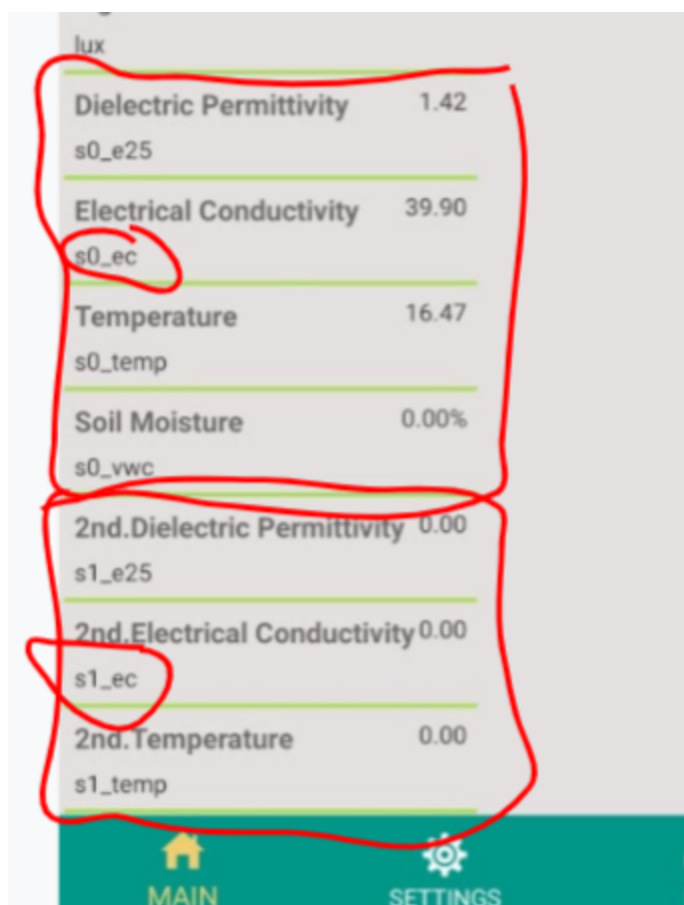
1. open the application and connect the device to the phone app
3. go to the app SETTINGS tab,
4. hold sensor(the sensor should be clean and dry) in the air – click button AIR
5. submerge sensor in the water or soil with water, click button WATER
6. go to the MAIN tab click read to test calibrated values

#### PM-WCS-3-I2C soil sensor Beta version Electrical Conductivity EC calibration on the Android APP

connect the device to the app.

**BT READ**

1. Press BT READ . Remember the s0\_ec(or s1\_ec dependig to which slot are connected the soil sensor) value



2. Submerge the sensor EC contacts (the stainless steel rivets on the end of the sensor) in your calibration solution.



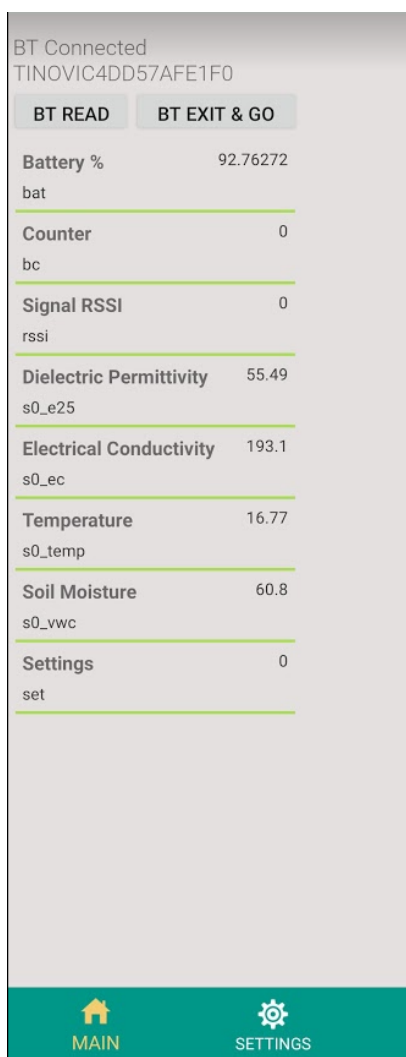
**BT READ**

3. Press BT READ . remember the s0\_ec value. For this uncalibrated sensor in the picture below the s0\_ec value is 193.1 and s0\_temp is ~17 Celsius





## PM-IO-6-WIFI IO Module



4. Open the **SETTINGS** tab and type here your calibration solution value at 17 Celsius (it should be written on your calibration solution bottle uS/cm). In the picture below the uS/cm at 17 Celsius is 1199.



ATION

°C	°F	μS/cm
0	32.0	776
5	41.0	896
10	50.0	1020
15	59.0	1147
16	60.8	1172
17	62.2	1199
18	64.4	1225
19	66.2	1251
20	68.0	1278
21	69.8	1305
22	71.6	1332
23	73.4	1359
24	75.2	1386
25	77.0	1413
26	78.8	1440
27	80.6	1467
28	82.4	1494
29	84.2	1521
30	86.0	1548
31	87.8	1575

5 999567 670533

INDUSTRIAL USE ONLY.  
tinovi.com

SET CLIENTID \_\_\_\_\_

SET USER \_\_\_\_\_

SET PASS \_\_\_\_\_

1. To calibrate s0 sensor type 0  
To calibrate s1 sensor type 1

SET SUB \_\_\_\_\_

TEST MQTT

2. Type your calibration solution value

Soil Moisture Sensor

# 0 calibrate: AIR WATER

# 0 calibrate: EC 1199  $\mu$ S/m

Upload:

3. Press EC button

UPLOAD LOADED:20 AV

MAIN SETTINGS LOG

1 2 3 -

4 5 6 \_

7 8 9 <

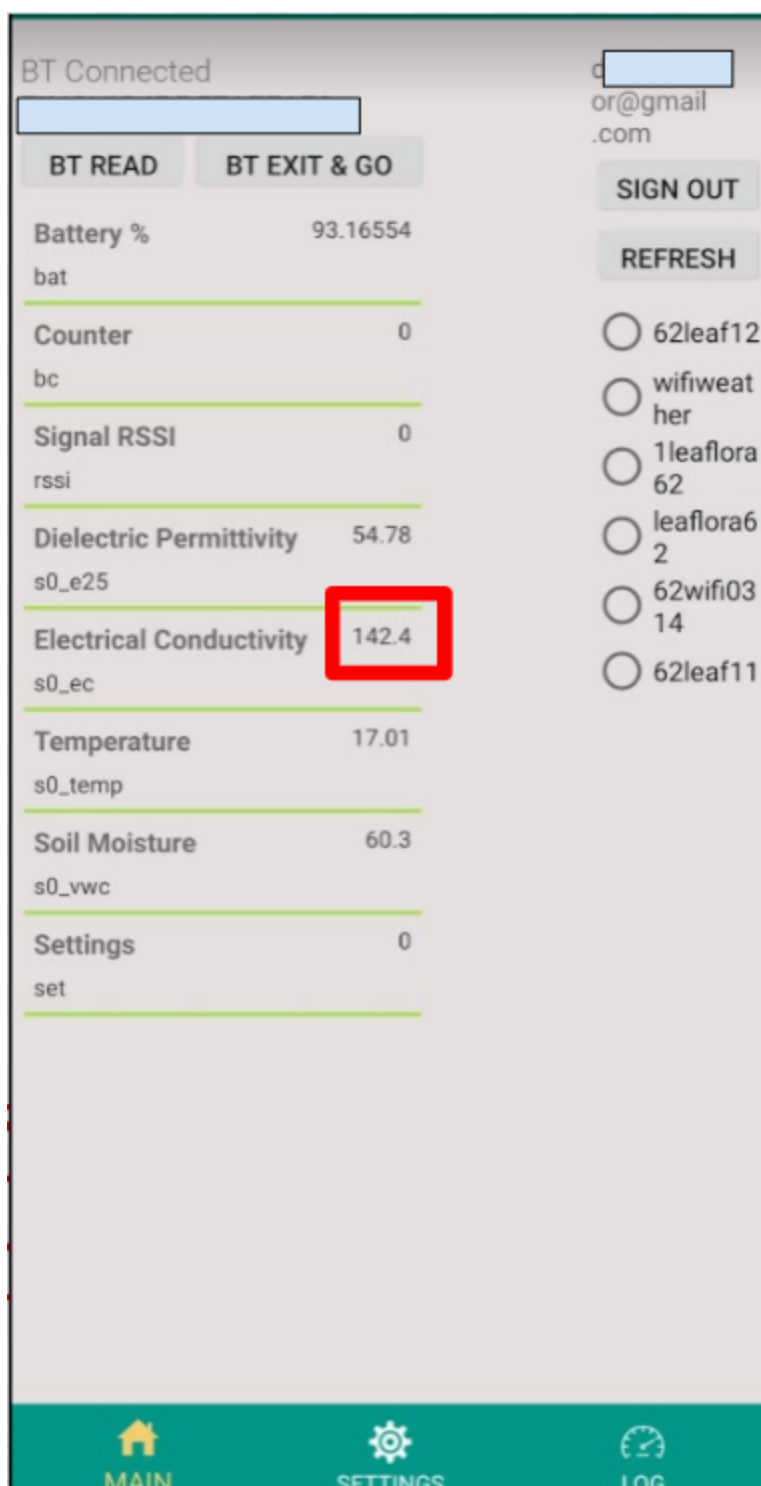
, 0 . <

5. Press the EC button.

6. Go to the MAIN tab and press the BT READ

BT READ

button and see the calibrated EC value



(press the BT READ button more than one time).  
142.4 is the calibrated value.

7. take out the sensor from the calibration solution. Dry the sensor EC contacts. Press BT READ. In Air should be 0..50.



## PM-IO-6-WIFI IO Module

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### ANDROID APP

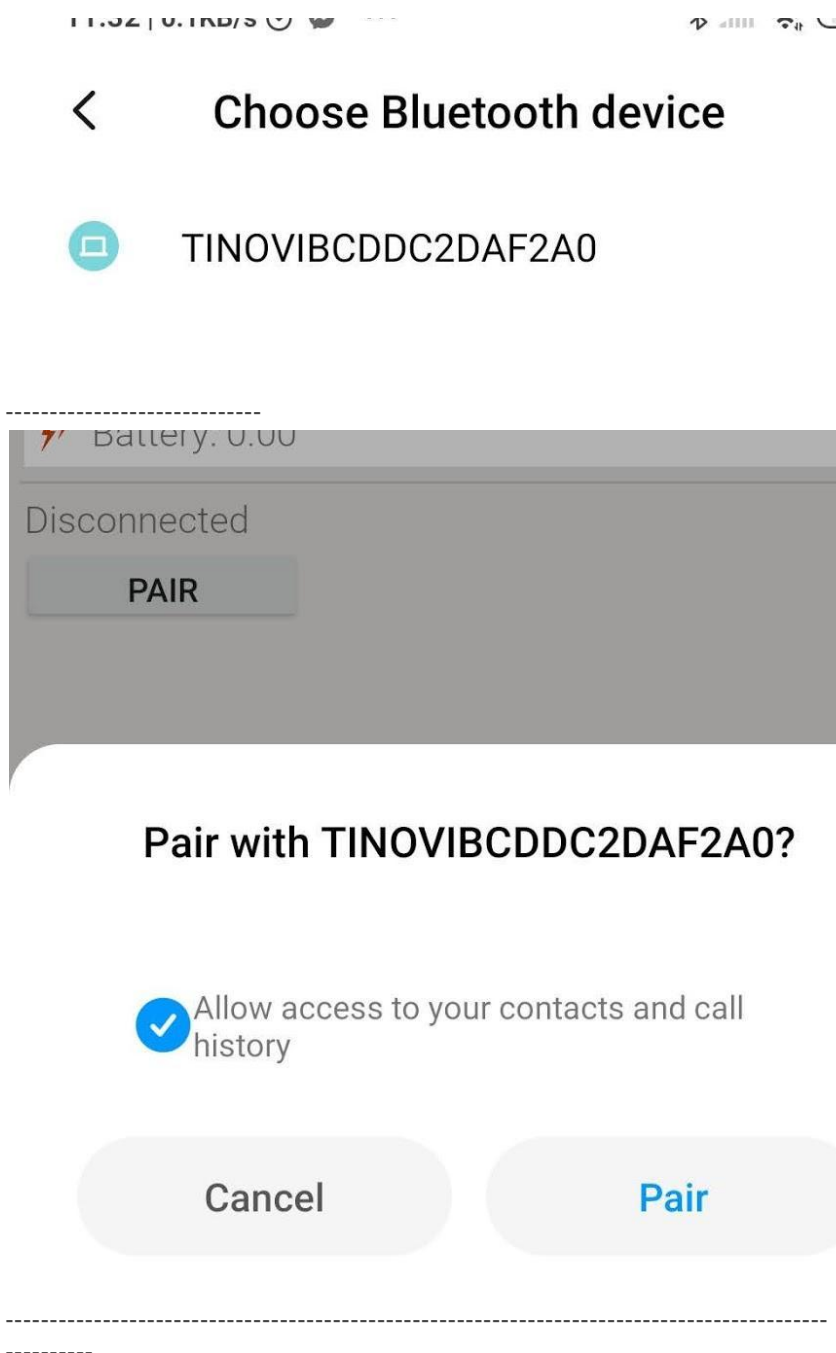
<https://play.google.com/store/apps/details?id=com.tinovi.wifi&hl=en>



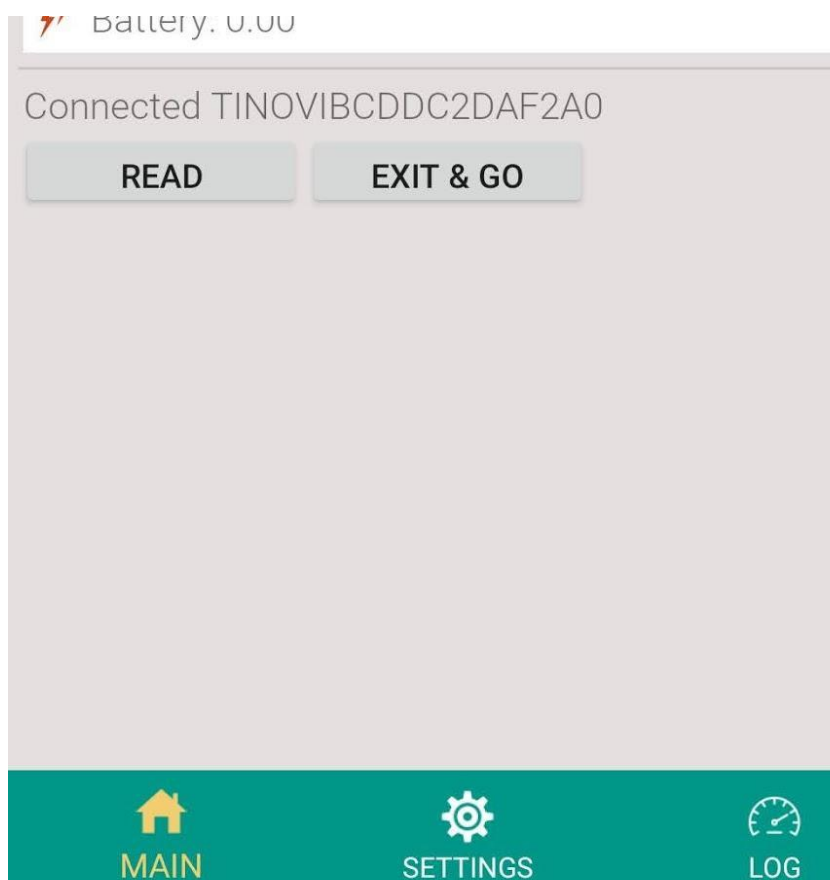
Android application lets you configure and calibrate soil moisture sensors for your device.

1. Your phone should support Bluetooth..
2. Turn on Bluetooth on your phone
3. Restart device by pressing restart button on device main board or removing and replacing battery.
4. Press the pair button and choose TINOVIXXXXXXXX device (pair with device, if adding for the first time).





5. Wait up to 5-10 second while application shows Connected TINOVIXXXXXXXX in main page, if no connection, repeat restart device and pair operation. Device may be restarted by removing, replacing battery or clicking the button in PCB board left bottom corner, when battery looks upwards.



**The device and phone app are connected if you see the device's bluetooth name TINOVIXXXXXXXXXX and EXIT & GO button. And when you press the READ button the device LED should blink and installed sensor data should appear.**

6. Click read in the MAIN page to read sensor values for the test.
7. Switch to the SETTINGS tab to setup your device
8. In the WiFi section input your access point's SSID and pass and click according SET... buttons. SSID and PASS max length is 50 symbols.
9. Input your backend URL to let the sensor post data. Url max length is 150 symbols. Press the "SET URL" button.
10. You may press the "TEST" button, to check connection and URL, **but** unfortunately this does not work with SSL (HTTPS), In case HTTPS it will show Url connection failed, code -1. So if WiFi is OK, you may try the EXIT & GO button in the MAIN page, to exit Bluetooth configuration mode and let the device connect to your URL.
11. For Azure HTTPS you need to add auth SAS Token for auth header in the App, see docs how to generate SAS Token:  
<https://docs.microsoft.com/en-us/cli/azure/ext/azure-iot/iot/hub?view=azure-cli-latest#ext-azure-iot-az-iot-hub-generate-sas-token>  
OR via Visual Studio Code:  
<https://docs.microsoft.com/en-us/azure/iot-hub/iot-hub-mqtt-support>




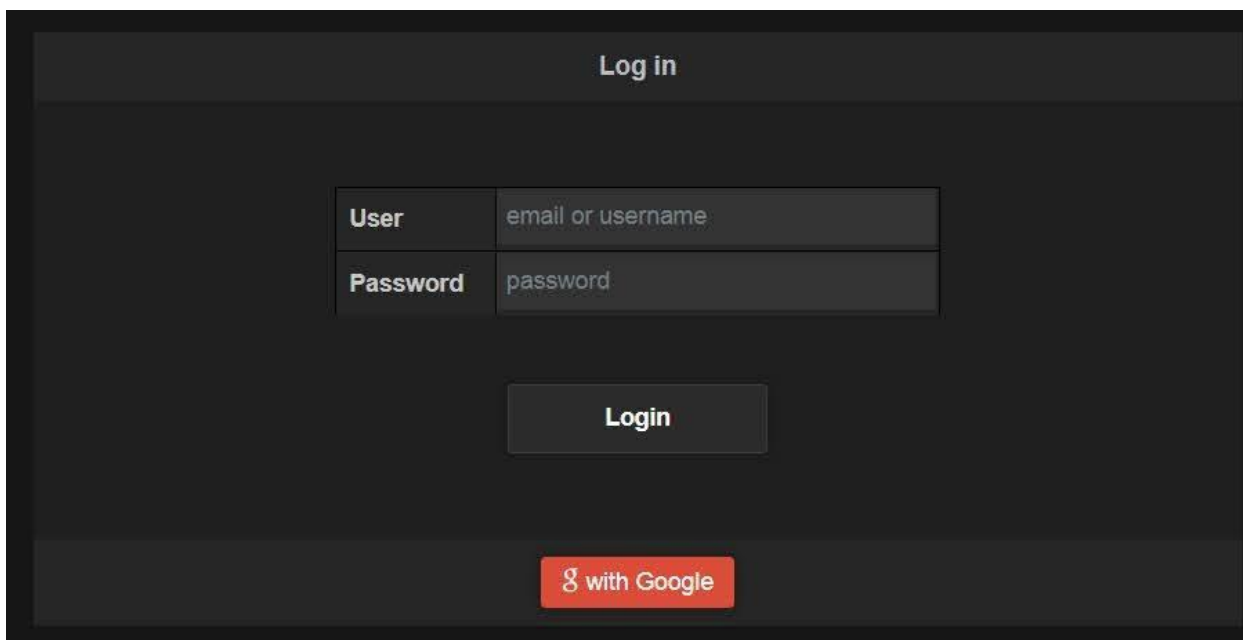
## PM-IO-6-WIFI IO Module

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- [#for-azure-iot-tools](#)
12. For Azure MQTT:  
<https://docs.microsoft.com/en-us/cli/azure/ext/azure-iot/iot/hub?view=azure-cli-latest#ext-azure-iot-az-iot-hub-generate-sas-token>  
<https://weblogs.asp.net/morteza/how-to-send-mqtt-messages-to-an-azure-iothub-by-mqttfx-client>
  13. Alternatively for demo purposes we have developed our own dashboard for device testing. To register the device to Tinovi dashboard, you should authorize with your google account (only first time you open the application, then this button will disappear), input device name and click "REG TINOVI" button. This action will generate and set a device URL for posting data to <https://www.tinovi.com/graf/> There you also may login with your google account.

- 
14. Log in to the graphic platform use the same google account you use for Tinovi WiFi

application. Press  button







Sign in - Google Accounts - Google Chrome

accounts.google.com/o/oauth2/auth/identifier?response\_type=c...

Sign in with Google

# Sign in

to continue to [zerverio-4ab68.firebaseio.com](#)

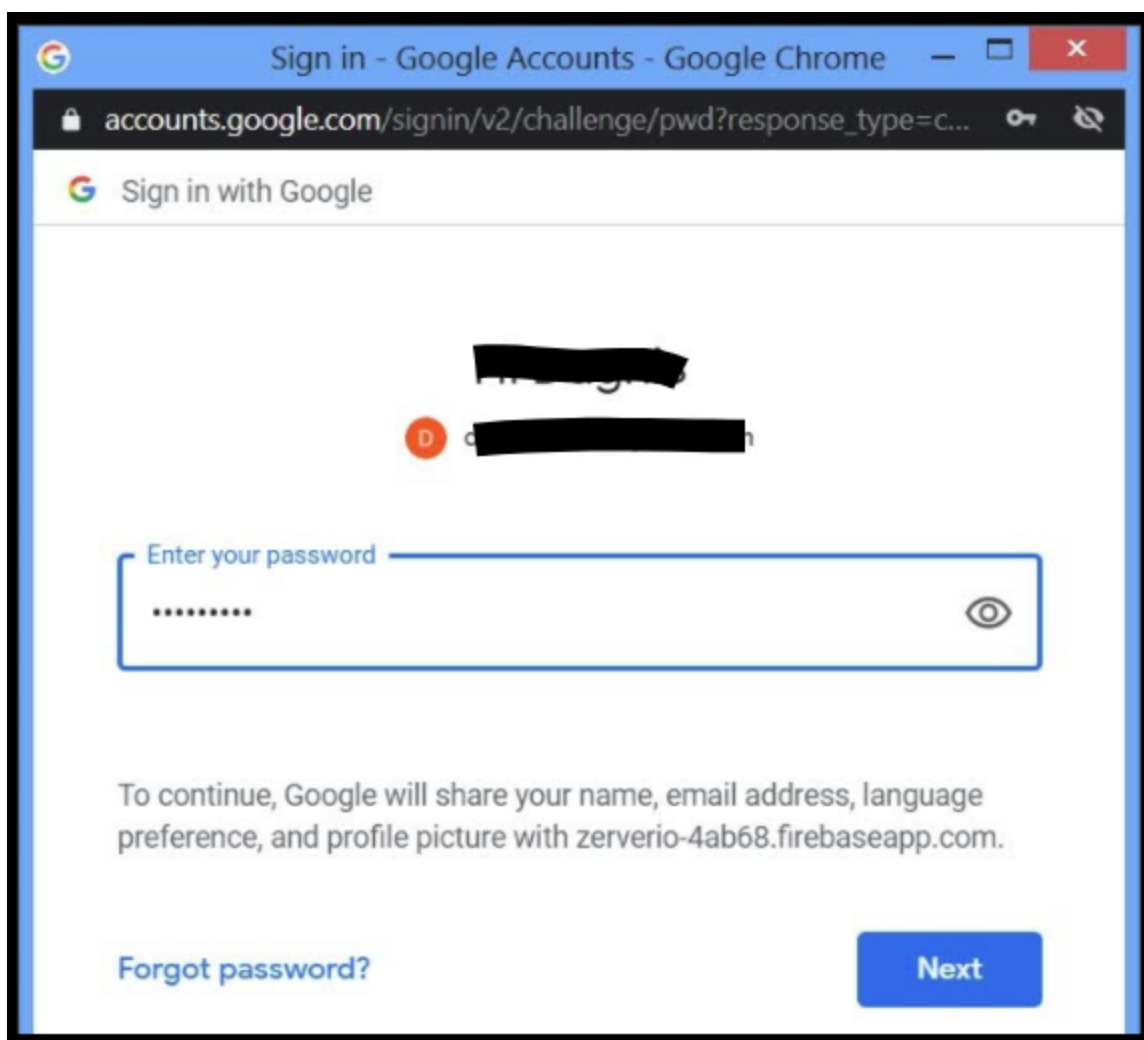
Email or phone

[Forgot email?](#)

To continue, Google will share your name, email address, language preference, and profile picture with [zerverio-4ab68.firebaseio.com](#).

[Create account](#) [Next](#)

Type your google account email.



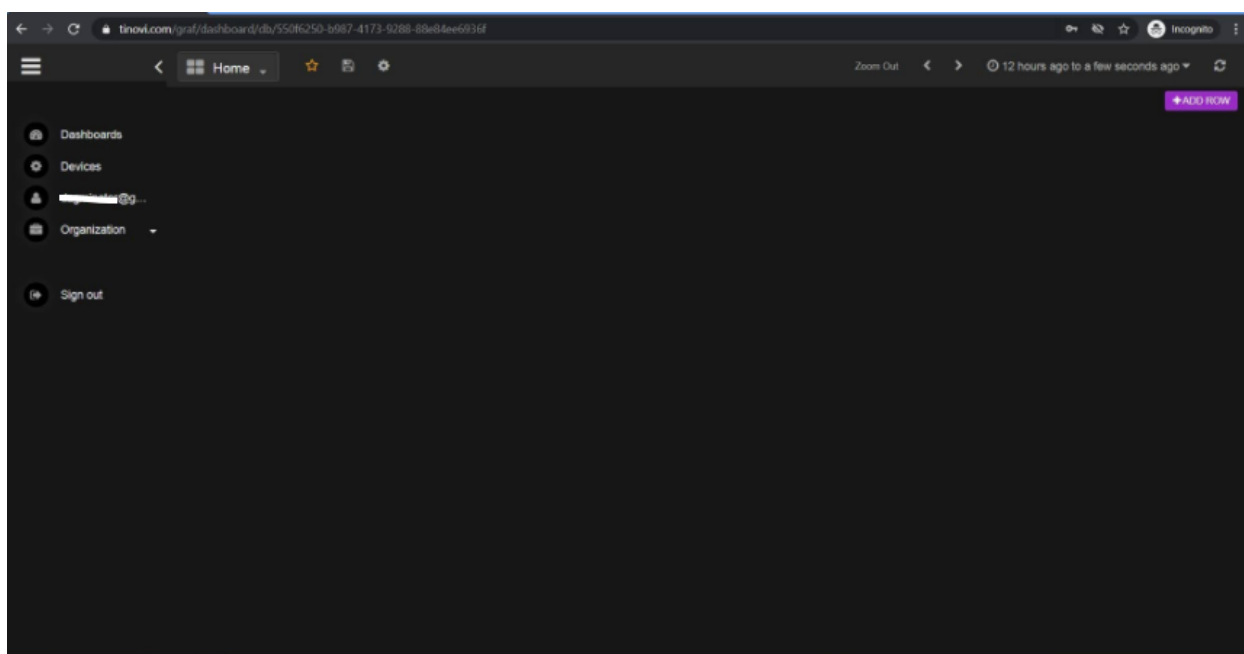
And password. Click Next.

You will be redirected back to tinovi.com/graf platform.



## PM-IO-6-WIFI IO Module

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15. Connect the device to Tinovi WiFi application as described above(paragraph 1 to 7).
16. To configure the device to send data to Tinovi graf platform go to app settings tab and make 8 steps picture below.



## PM-IO-6-WIFI IO Module

The screenshot shows the settings interface of the PM-IO-6-WIFI IO Module. A red arrow points to the 'READ SETTINGS' button. A blue box highlights the sensor selection area with the text 'Check which sensors will be read and press SET CONFIG'. Below this, the 'SET CONFIG' button is visible. Further down, the 'SET PULSE CNT.' field is set to 0. The 'Sleep:' section shows 'SET SLEEP SEC.' set to 10. The 'WiFi:' section contains fields for 'SSID' (labeled 2) and 'PASSWORD' (labeled 4). A blue box labeled 1 points to the SSID field, and another labeled 3 points to the password field. Below these is a 'Sign In' button with a Google logo, highlighted by a red box and labeled 5. A blue box labeled 6 points to the 'REG TINOVI' button. Below that, the 'SET URL' field is populated with 'http://tinovi.com/api/v1/dp/json/wifinode42400000' and labeled 8. The 'SET AUTH H' field is empty. The 'Output Format' section has 'JSON' selected (indicated by a red dot) and 'BINARY' unselected. A 'TEST' button is present. The bottom navigation bar shows 'MAIN', 'SETTINGS' (active), and 'LOG'.

17. ==1. Type your 2.4GHz router SSID. 2. Press SET SSID. 3. Type the router WiFi password. 4. Press SET PASSWORD. 5. Press google sign in button and proceed to sign in. 6. In this field figure out(create) the name of the device. 7. Press REG TINOVI button.




## PM-IO-6-WIFI IO Module

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8. Press the SET URL button.

18. Press  button and check if all settings are saved.

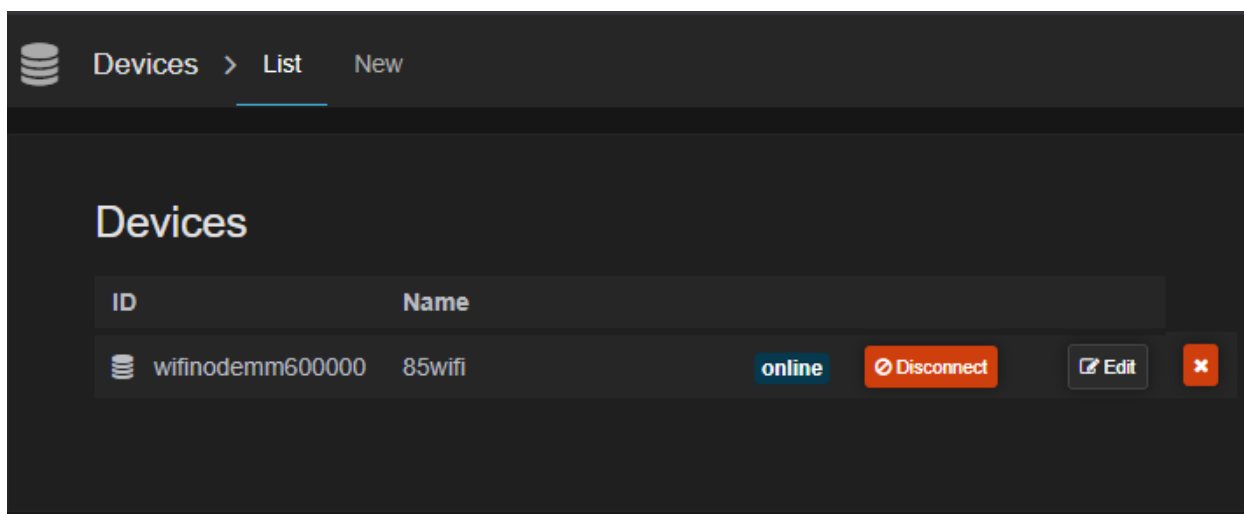
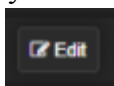
19. Now go to the app MAIN tab and press  button.

The device will turn off the Bluetooth and disconnects from the phone app, then the device goes to the working mode: wake up for a few seconds to read and send sensor data to the graph platform server, then goes to sleep mode for time typed in the app SET SLEEP SEC. field.

20. Now go back to the internet browser graph platform. Click on the Devices menu. You should see your device in the list.

If not see the device check your device setting again, check if the device onboard LED blinking with the SET SLEEP SEC. interval. Check if the device appears on your WiFi internet router DHCP client list. Make shoor you have a 2G internet router.

21. Click the Edit button.





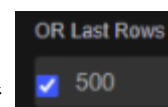
## PM-IO-6-WIFI IO Module

22. Click Device console tab

Name	Val
bc	1357
s0_temp	17.99
s0_e25	1.35
bat	98.53953
rsi	-64
set	1
s0_ec	38.2
s0_vwc	0

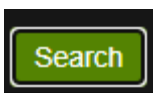
Wait a SET SLEEP SEC time to see sensor actual values.

23. Go to Data Search tab and check the checkbox below “OR Last Rows “



and

press the



button



## PM-IO-6-WIFI IO Module

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< Devices > List Edit

wifinodemmm600000 Edit Device Device Console Data Search Status Report

From

2020-08-25 @ 03 : 09 : 59 . 224

To (set now)

2020-08-25 @ 15 : 09 : 59 . 225

OR Last Rows

☒ 500

Output Format: Table Search Invalid date or range

Wait a minute while information downloads from the server and appears on your screen.



## PM-IO-6-WIFI IO Module

<

Devices

>

List

Edit

wifinodemmm600000

Edit Device

Device Console

Data Search

Status Report

From

2020-08-25 @ 03 : 09 : 59 . 224

To (set now)

2020-08-25 @ 15 : 09 : 59 . 225

OR Last Rows

☒ 500

Output Format: Table

Search

Invalid date or range

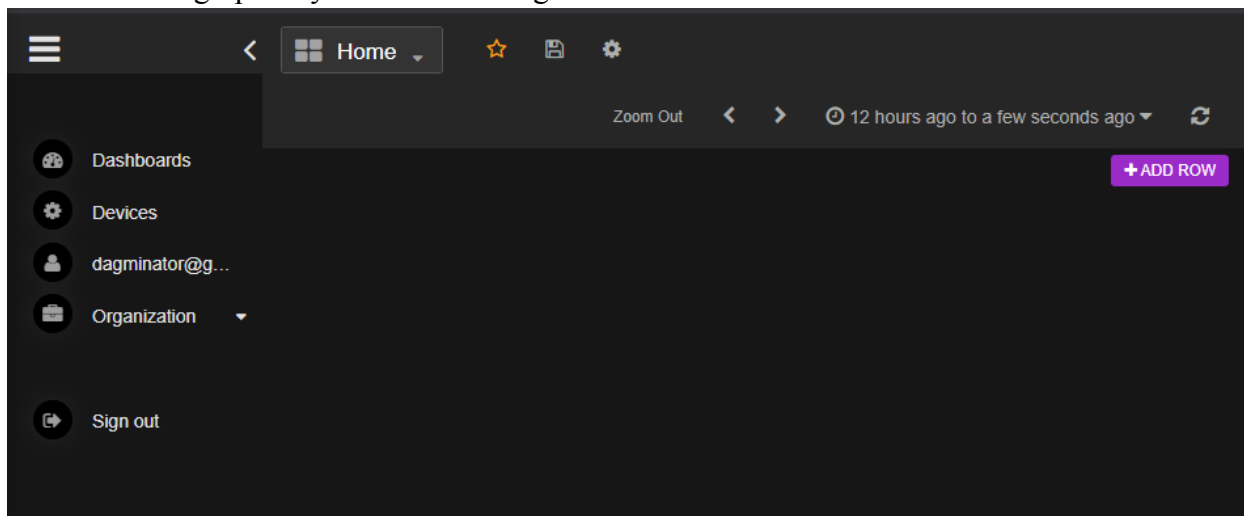


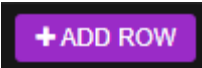



## PM-IO-6-WIFI IO Module

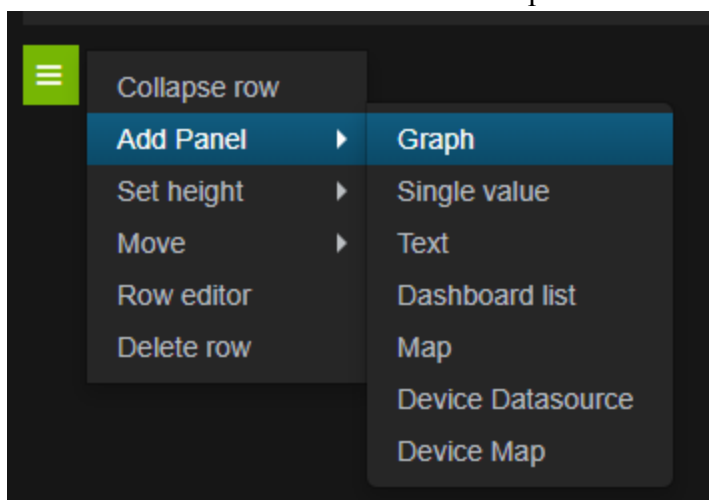
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24. To see data on graphics you need to configure the dashboard. Go to the Dashboard menu.



25. Press  button.

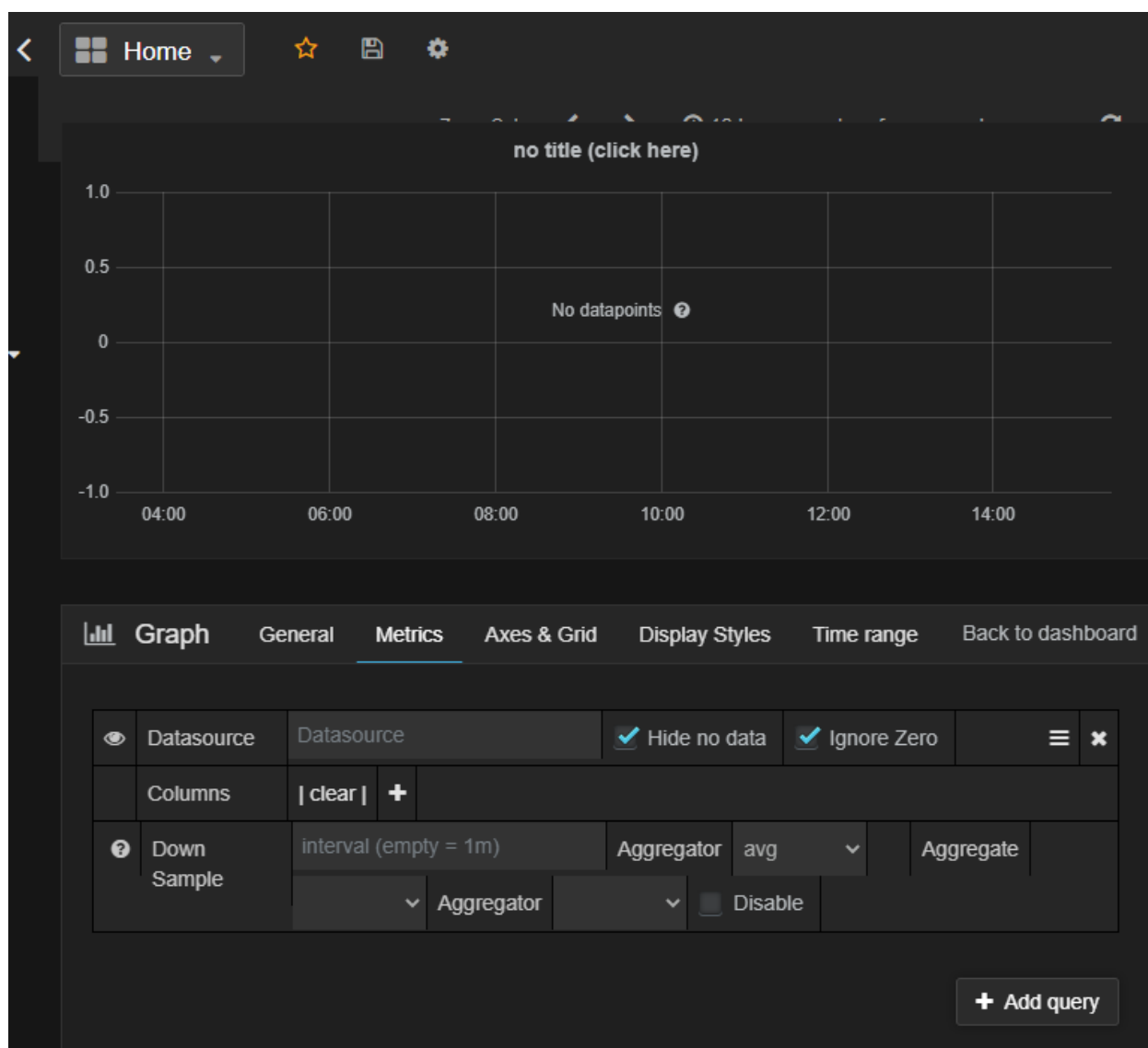
26. Press on  row menu button left top side.



Choose Add Panel > Graph from the menu.



## PM-IO-6-WIFI IO Module



On the Metrics tab Datasource field type in the device Name which you create and

6. Type in name REG TINC 7

register the device in app settings.

Press on | clear | to see all metrics corresponding to this device.



## PM-IO-6-WIFI IO Module

Graph General **Metrics** Axes & Grid Display Styles Time range Back to dashboard

Datasource 85wifi ☒ Hide no data ☒ Ignore Zero

Columns | clear | + s0\_ec.85wifi x s0\_e25.85wifi x rssi.85wifi x bc.85wifi x

set.85wifi x s0\_temp.85wifi x bat.85wifi x

Down Sample interval (empty = 1m) Aggregator avg Aggregate

Aggregator Disable

+ Add query

Go to the General tab create your graph panel title.

Graph General **General** Metrics Axes & Grid Display Styles Time range Back to dashboard

General options

Title no title (click here) Span 12 Height

Transparent

Then press on the

Back to dashboard

27. To save Your configuration press on the diskette button on top



28. You can click on individual metrics to highlight them. Hold ctrl to select more than one metric.



## PM-IO-6-WIFI IO Module



29. Mouse select part of the graphic to zoom in



30.



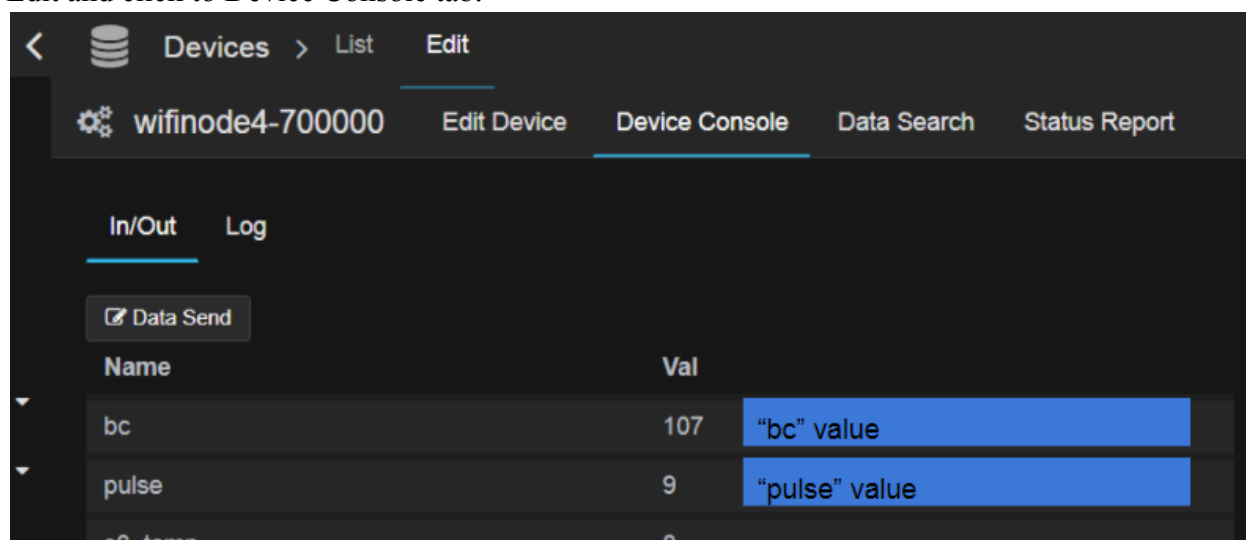
### Test Pulse counter on tinovi.com/graf dashboard

The device has optional pulse counting input. This pulse counter input can be connected to smart meters pulse output, example smart electricity meter or water meter to centralise consumption data or see smart meters data online.

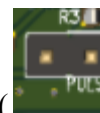
The device reads pulse counter input only while it is in the sleep.

To activate pulse counter input, connect the device to the mobile phone application, go to the settings tab, **check Pulse checkbox** and press SET CONFIG to save. Please take in account that while the pulse counting input is ON the device's battery consumption in sleep is bigger.

Connect the device on the tinovi.com/graf dashboard. Find your device on the device list, click Edit and click to Device Console tab.



There you see the pulse counter value, each time you(or connected smart meter) connect to



short(connect together and open immediately)the red and black wires(this pins on the device board) the pulse counter value increases by one(don't permanently connect these wires, connect and open them just like you click some push button) . For example if the current pulse counter value is x, and if you "click" the pulse input 5 time while the device sleeps, in the next wake up the pulse counter value increases by 5, so you see total value(x+5).

#### In brief

1. wires are open(not connected)



## PM-IO-6-WIFI IO Module

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2. configure the device(check pulse checkbox, wifi and another setting for work)
3. disconnect the device from the phone and let it work "normally" on their battery
4. check that the device is online(online data should changes after the devices LED blink). When the devices LED blink 1 time it's mean that the device wakes up for a few(5..8 seconds) seconds and read sensor data, connect to your wifi router and send the data to the online server(then the device goes to sleep to save the battery power, the sleep time is configured by you in the mobile phone application by each device individually), and then you see these data on your graph dashboard account).

The input "pulse" and "leak" is waiting While the device is in sleep (if the "Pulse" checkbox was checked in that particular device settings).
5. test the pulse and the leak
  - connect-disconnect few times red and black and see what the "pulse" value is changed
  - connect green and white and check if the device is wake up immediately(no waiting for the sleep time end)

The pulse value can be reseted to null when the reset button pressed or battery drone completely. There is a possibility to set a custom value sending a message to the device. Please remember the pulse counter wires always stay opened(not connected together)

### Test Leak detector input wires

To use the device's leak detector input In the devices application settings the pulse checkbox should be checked.  
Setup SLEEP SEC. 30 seconds or more.  
Make sure that the green and white wires are open.  
Press exit&go on the MAIN tab. While the device is in sleep connect and open the white and green wires. The device should wake up one extra time and send data. If the leak detection wires are connected together permanently the device does not go to sleep.

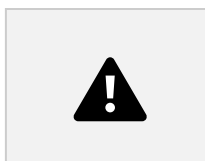
### PM-WCS-3-I2C sensor Expermetal EC, EC calibration

- Connect the device to the app.
1. Press BT READ. remember the s0\_ec value x1
  2. Submerge the sensor EC contacts(the stainless steel rivets on the end of the sensor) in your calibration solution.
  3. Press BT READ. remember the s0\_ec value x2



## PM-10-6-WIFI IO Module

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4. Open the SETTINGS tab and type here  your calibration solution value x3(it should be write on your calibration solution bottle uS/cm)

5. Press the EC button.

6. Go to the MAIN tab and press BT READ button(always press the BT READ button more than one time). remember the s0\_ec value x4.

Now the x4 value should be +/- similar to  $x3 \cdot 0.1$

$x4 \sim x3 \cdot 0.1$

7. take out the sensor from the calibration solution. Dry the sensor EC contacts. Press BT READ. The s0\_ec should be close to 0.

tips: when you calibrate EC the sensor should be submerged in the EC calibration solution, when you calibrate WATER the sensor should be submerged in water.



## PM-IO-6-WIFI IO Module





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## PM-IO-6-WIFI IO Module

19:06



READ SETTINGS

☒ S0 ☐ S1 ☐ Air ☐ Light

SET CONFIG

SET PULSE CNT. 30

Sleep:

SET SLEEP SEC. 20

WiFi:

SET SSID ubnt-local


SET PASSWORD


mydevicename REG TINOV


SET URL http://tinovi.com/api/v1/dp/json/genericamt800000


Output Format ☒ JSON ☐ BINARY

SET OTA CHECK. 10

 MAIN

 SETTINGS

 LOG





## PM-IO-6-WIFI IO Module

