iMETOS 3.3

Extended manual

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Table of Content

Welcome among iMETOS 3.3 users!

Thank you for choosing an iMETOS for monitoring soil moisture or environmental data. The iMETOS 3.3 has been designed to monitor data with wide variety sensor sets. Like all products of the iMETOS family it measures, logs and sends the data to the Internet.

iMETOS 3.3 systems will be mainly used for:

- Microclimatic data monitoring for Farming decision.
- Soil moisture monitoring with volumetric or tensiometric sensors.
- Irrigation monitoring with flowmeter, pressure switch, tube pressure, pH and E.C.
- Frost alarms via SMS with 3 inputs for high precision PT1000 temperature sensors: Air, Dry bulb and Wet bulb.
- Rain, flood & snow monitoring with rain gauge, pressure transducers and ultrasonic sensors.
- Disease models forecasting with basic sensor set such as leaf wetness, temperature and relative humidity sensors, rain gauge.
- Hyper localized weather forecast corrected with local measurements.

Among all the many new features you will find:

- Firmware update “over the air”
- Real Time Operating System (RTOS)
- Extended data and program memory
- On-board modem for GSM, CMA, UTMS
- Self location with on-board GPS
- Native USB port
- Access point for remote wireless sensor node

1. YOUR iMETOS 3.3

The basic iMETOS consists of one stainless steel holder with the box containing the electronics, the battery, the solar panel and the dual antenna. In the package with the iMETOS you will also find two clamps to mount it on the pole. If you ordered a wind speed sensor you will find the three-cup wheel and the allen key to fix it to the axis of the sensor; if you also ordered the wind direction sensor, you will find a ”T” shaped holder with two clamps. Taped to the solar panel you will find a label with the unique serial number and the keys that enable the access to the FieldClimate platform.

You will find the battery mounted inside the station. The rain gauge is mounted on the right side of the station. The solar panel, the radiation shield with temperature and relative humidity sensor and the global radiation sensor will be connected with the main electronic box and have to be mounted on the holder.

Other sensors, like wind speed, wind direction, leaf wetness, soil temperature, wet and dry bulb temperature you will find connected to the main electronic box with 3m or 5m long cables.

Picture 2: iMETOS IMT280

1. Temperature and relative humidity sensor with radiation shield; 2. Global radiation sensor; 3. Dual antenna (GPS/communication); 4. Rain gauge; 5. Logger and modem; 6. Power supply (solar panel and battery); 7. Wind speed sensor.

The selection of sensors, connected to your iMETOS, depends on the model you have ordered as below.

iMETOS® IMT180

Air Temperature and Relative Humidity sensor and Rain Gauge.

iMETOS® IMT200

Air Temperature and Relative Humidity sensor, Rain Gauge and Leaf Wetness sensor.

iMETOS® IMT280

Rain Gauge and all the sensors for Evapotranspiration calculation: Air Temperature and Relative Humidity, Global Radiation and Wind Speed.

iMETOS® IMT300

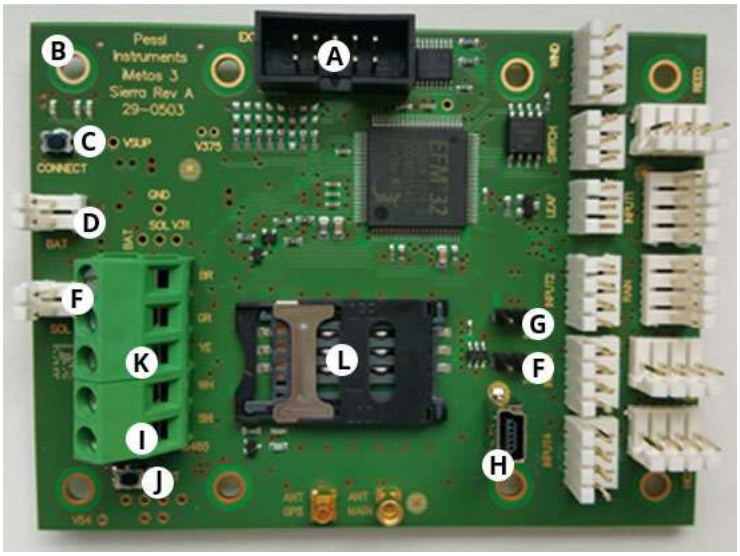
Sensors for Evapotranspiration and Disease Models calculation: Air Temperature and Relative Humidity, Rain Gauge, Global Radiation, Wind Speed and Leaf Wetness.

Picture 2: iMETOS 3.3 – Main sensor variations.

1.1 iMETOS 3.3 BOARD DESCRIPTION

Interface:

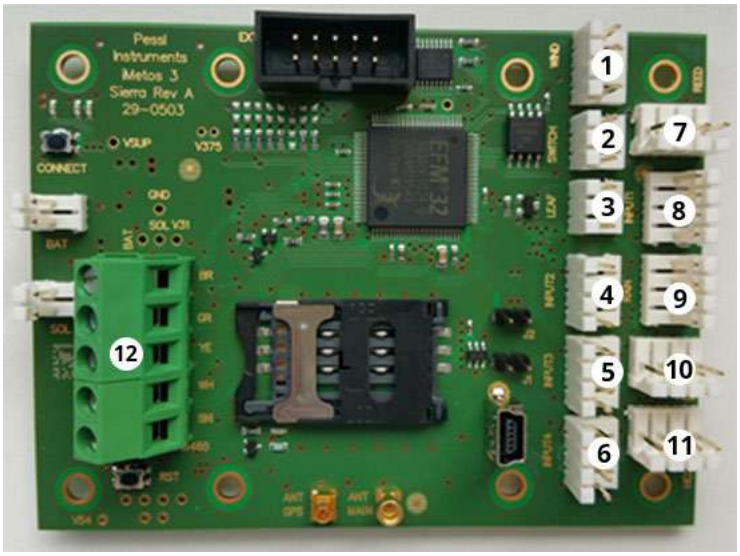
A) Extension board connector iMETOS 3 1ozn
B) LED indicators
C) Connect button
D) Battery connector
E) Solar panel connector
F) Jumper 1
G) Jumper 2
H) USB connector
I) Boot jumper
J) Reset button
K) Antenna connector



Picture 3: iMETOS 3.3 board – interface

Sensor inputs:

1) WIND iMETOS 3 2ozn
2) SWITCH
3) LEAF
4) INPUT 2
5) INPUT 3
6) INPUT 4
7) REED
8) INPUT 1
9) RAIN
10) HC2 B
11) HC2 A
12) Direct PIbus (chain) input



Picture 4: iMETOS 3.3 board – sensor inputs.

1.2 PROCESSOR

- 32bit ARM cortex M3 processor (Energy Micro EFM32)
- Real time operating system (RTOS)

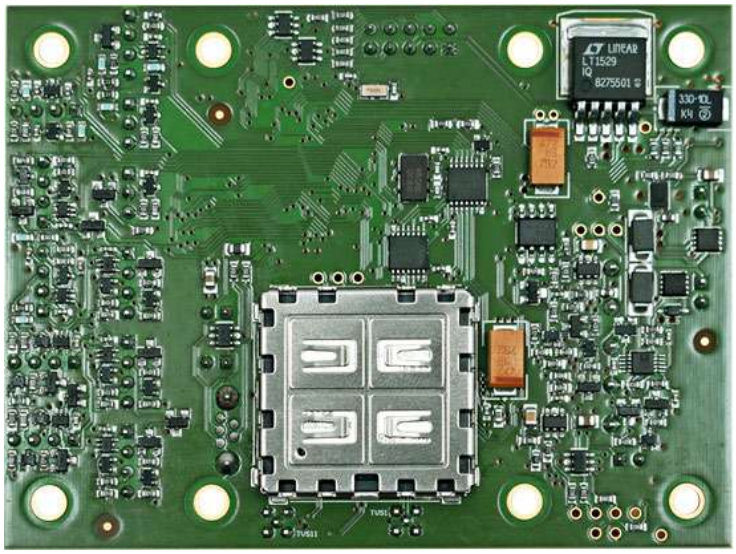
1.3 MODEM

1.3.1 LTE (4G) VERSION

Sierra Wireless AirPrime HL embedded modules offer unprecedented scalability between 2G/3G/4G, low-power consumption with up to 10Mbps download data speed.

One of the following modem is mounted on the socket of the board, as each region has different network parameters:

- HL7692: For EMEA region (Europe). It is a 4G-LTE Cat-1 module with fallback to 2G-GSM/GPRS/EDGE. Supported frequency bands are 4G-LTE B3, B8, B20 and 2G-900/1800
- HL7618: For North America region (USA – Verizon carrier). It supports 4G LTE frequency bands B4 and B13.
- HL7688: For North America Region (Canada – AT&T carrier) with fallback to 3G. Supported frequency bands are: 4G-LTE B2, B4, B5, B17 and 3G-B2/B5.



Picture 5: iMETOS 3.3 PCB backside with the socket where the modem is mounted.

1.3.2 UMTS (3G) VERSION

- For GSM/GPRS/EDGE/3G, i.e G2 networks:
  - ◊ Sierra Wireless AirPrime SL808x Series a self-contained E-GSM/DCS/GSM850/PCS-GPRS/EGPRS 900/1800/850/1900/ WCDMA 800/860/900/1900/2100 quad-band module. SIM cardholder.
- For CDMA/EVDO networks (U.S. of America): Cinterion PCS3. Not SIM cardholder.
- GPS included

1.4 EXTERNAL FLASH MEMORY

The external flash memory is an Adesto AT45DB641E (8MB).

The memory is split into several blocks:

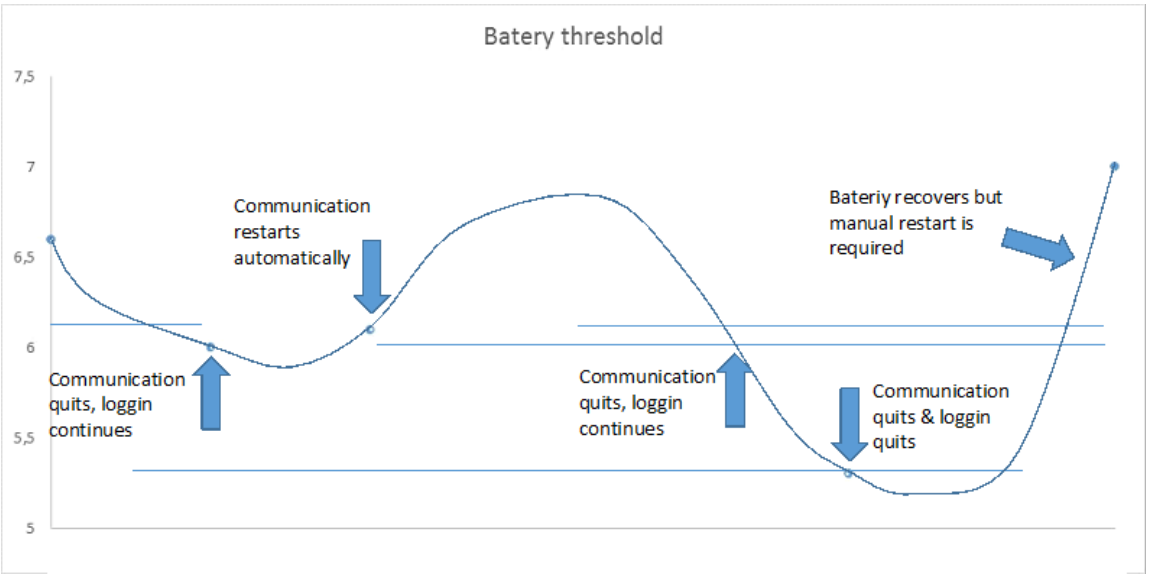
- 6MB reserved for weather data in Base64 format (i.e. the measured data), implemented as circulating memory (i.e. when memory is full, the oldest data is overwritten with newer data)
- 1MB reserved space for firmware update over the air
- 1MB reserved for configuration, performance and behaviour, including:
- Station settings
- APN tables (Acess Point Names with MCC, MNC, username and password)
- Backup (serial number and similar important settings that normally are not changed)
- Sensor image stores the configuration of the set of sensors connected to the iMETOS 3.3. This info will be re-checked automatically every day at midnight so newly connected sensors will be detected and included in the logs. Manual update of this part of the memory can be done by pressing the reset button (J in picture 1)
- Event history (information about communication network and internal parameters, detailed description is given later on in this manual)

1.5 POWER SUPPLY

The 6V-4Ah battery is connected to the iMETOS 3.3 board in the specific connector (D in the picture 1), the solar panel is connected to the solar panel connector (E in the picture 1).

Both power inputs are monitored by the iMETOS 3.3 in the same way as the rest of the sensors.

Note: jumper on pins between D and E connector is not needed in last board revisions. The iMETOS 3.3 will automatically change operational mode according with the charge level of the battery following these rules:
a) If battery drops to 6V, data logging continues, but data transmission quits until battery recovers adequate charge level supplied from the solar panel.
b) If battery recovers the voltage value of 6,1V (before reaching the threshold of 5,3V), iMETOS 3.3 restarts data transmission without manual intervention.
c) If battery reaches the limit of 5.3V iMETOS 3.3 enters sleep mode and also stops data logging. To escape from sleep mode manual reset will be needed after the battery recovers the proper charge level.



Picture 6: Battery threshold

1.6 SIM CARD HOLDER

In GPRS, UTMS, LTE (i.e. GSM G2, G3, G4) networks a SIM card from a provider is needed. To insert or remove a SIM card:

1. Slide the metal part towards the left to unlock the holder (see picture below)

2. Open the holder from the right side and insert or remove the SIM card

3. Close the holder

4. Lock the holder by sliding the metal towards the right.

Picture 7: How to deactivate PIN request.

Warning: Please always check that the PIN request for the SIM is disabled.

1.6.1 HOW TO DEACTIVATE PIN REQUEST

This can be done using:
- a GSM handset device or
- directly with the USB<=>PC connection (From Firmware version 4.0 and later, it is possible to do it via terminal menu. Find a detailed description in the section USB communication)

1.6.2 USING UNUSUAL SIM CARDS

We have prepared an extanded table of Internet connection settings for various cellular service providers worldwide, which is present in the device memory (we are adding new providers all the time). You can check if your provider is in the table with sending email to: support@metos.at

It might happen that your iMETOS is one of the first devices set up with a specific provider. In this case, you will need to set these parameters with your PC via USB port or sending SMS with correct settings to the station:

To set new APN settings send a special SMS to the station, with APN settings, its username and its password. Before sending the SMS insert SIM card into your device. The SMS with APN settings has the following form:

! SerialNr 0 APN,USERNAME,PASSWORD !

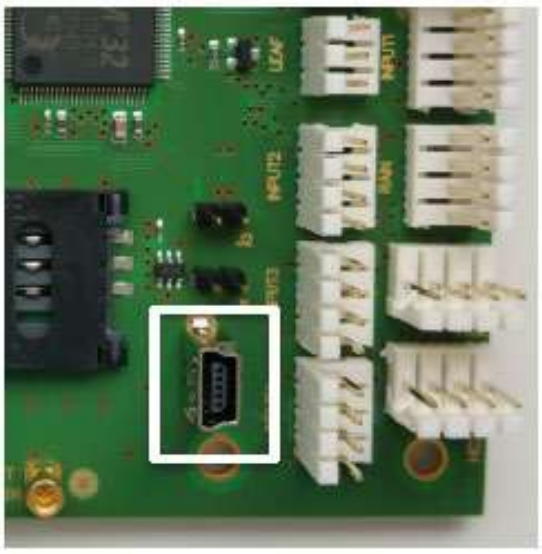
! 00000D1C 0 gprs.zain.bn,(*),(*) !

APN: Access point name
Username: Username for this APN (often empty)
Password: Password for this APN (often empty)

Picture 8: APN

1.7 USB PORT

Direct communication PC <=> iMETOS 3.3 is possible with a standard USB/mini-USB cable, using any terminal program. On below picture you can see a mini-USB connector on iMETOS 3.3 board.



Picture 9: USB port on iMETOS 3.3 motherboard

USB driver must be installed on the PC and a terminal program is required (we suggest TeraTerm, but you can also use any other one). You will find the USB driver for all operative systems at:www.silabs.com

Note:
For non-Windows users:
- Drivers: www.silabs.com

For Windows users:
- Drivers and Terminal at: www.metos.at

For iMETOS 3.3 Pessl Instruments has develop an specific terminal program named “PI Firmware uploader” witch combines on site firmware updating capabilities with serial terminal connection to the iMETOS 3.3, you can find it at: www.metos.at

Via USB connection user can perform the following tasks on-site
1. Fully update the iMETOS firmware
2. Check all sensors
3. Get report and events from the unit
4. Follow detailed communication process
5. Retrieve stored data in binary form
6. From Firmware version 4.0 and later check network signal strength and unlock SIM card
A detailed description of USB communication is given in the section USB communication with PC.

1.8 JUMPERS

There are 4 sets of open pair of pin in the iMETOS 3.3 mother board (see below picture).

Picture 10: Jumpers

Power jumper: it is not needed anymore on boards with Revision B. If you connect the battery and you do not see LED lights turn on, then try to add jumper on this pins, as some of the first boards needs it.

Jumper 1: on the board it is labeled as "J1". When you put jumper on this pins, you will be able to access terminal menu of the board with your PC.

Jumper 2: on the board it is labeled as "J2". When you put jumper on this pins, you will be able to access the modem through terminal directly. This is intended and used only by iMETOS developers.

Boot jumper: on the board it is labeled as "BOOT". Jumper on this pins is needed when you want to manually upload new firmware to the board with PI Firmware Up-Loader application. More on this is available in the Uploading firmware page.

Warning!!
Jumper 1 and jumper 2 function is conditioned to the connection of the USB cable. Without cable they are ignored. This is not the case of the BOOT jumper if you forget to remove this jumper the station will not go into normal mode of operation and you will have to return to the station and fix this inconvenience manually.

1.9 LEDS AND BLINKING CODE

iMETOS 3.3 has a set of 3 LEDs on top left on the motherboard and an additional LED under the SIM card holder. The top left row gives information about the running processes, and the stand-alone LED indicates the operation of a modem (see picture below).

Picture 11: LEDs

When the battery is plugged to the board all three LEDs in the lower row turn on for an instant. After this the GPRS connection with FieldClimate starts and the LEDs give information about the different stages of this process.

Important note:
Complete monitoring of the communication process should be done after every installation by connecting the PC to the iMETOS 3.3. How to do this is described in detail on page USB communication with PC.

Modem (stand alone LED just under SIM card holder):

- Green LED: on, during the connection process to the GSM network, blinking slowly (short on and long off) when it is connected to the GSM network.

Processor (from left to right, top left row of LEDs):

- Green LED (left): USB cable is plugged (except when in boot mode – i.e. the boot jumper I is plugged on BOOT pins)
- Yellow LED (center): indicates one of the following:

1. In boot mode (plugged jumper): Pessl bootloader is installed 2. in terminal mode (plugged jumper 1) the meaning of the LED is given on the screen of the terminal program in the PC3. 3. in normal/scheduling mode (without any jumpers):

a) if the modem is on: modem blink code:i. short on – long off: waiting for modem, network found, SIM card is active

on————on————on————on————on————on————on————on————on————on

ii. short on – short on – long off: connected to GSM
on-on————on-on————on-on————on-on————on-on————on-on————on-on
iii. short on – short on – short on – long off: connected to FieldClimate
on-on-on————on-on-on————on-on-on————on-on-on————on-on-on————on-on-on
iv. short on – short on – short on – short on – long off: data has been sent and commands from the server have been received.
on-on-on-on————on-on-on-on————on-on-on-on————on-on-on-on————on-on-on-on

b) If the modem is off: the measurement process is in progress, it will light a few seconds every 5 minutes.

Tip:
Put all the attention in the center LED of the second row if you see the sequence of four blinks then you will know that the upload has been successful, if the sequence is not completed the red LED aside will light the take note of the last blinking mode before to identify the error.

Red LED (right):
1. communication error (if modem is on)
2. serious system error (if modem is off)

In both cases you will need to connect the iMETOS 3.3 to the PC and use PI Firmware uploader to make the diagnostic and extract useful information to send to support@metos.at

1.10 TEST POINTS

In the iMETOS 3.3 board there are several test points for convenience during service, they let the user access different voltages with no need to unplug or removing anything.

Picture 12: Test points

GND: common ground

BAT: battery voltage

SOL: solar panel voltage

VSUP: internal voltage supply 6V

V31: internal voltage supply 3.1V (processor, hygroclip sensors...)

V54: internal voltage supply 5.4V (sensor inputs...)

Example: if you wish to measure battery voltage, you can measure it with Voltmeter on GND and BAT test points.

1.11 SENSOR INPUTS

1.11.1 SENSOR IDENTIFICATION

There are 12 direct sensor inputs on the iMETOS 3.3 board, supporting up to 600 sensors units.

Main sensors:
Some sensors have to be connected to specific inputs dedicated to them:

- **WIND**: wind speed sensor
- **LEAF**: leaf wetness sensor
- **RAIN: rain gauge**
- **HC2** (two inputs): hygroclip sensors (air temperature and relative humidity)
- **SWITCH input**: any switch-type sensor can be connected (e.g. another leaf wetness sensor, tilt sensor, a presostat...).
- **REED input:** any reed-type sensor can be connected (e.g. another rain gauge, flow counter, tilt sensor ...)

Sensors connected to these inputs as well as the battery and solar panel voltage measurement are referred to as “main” sensors.

INPUT 1-4:

INPUT 1-4 can be used for connecting either
1. Individual sensors (any of the complete range of PI_duty_sensors: Global radiation, temperature, wind direction, barometric pressure, water level, weighting cells....)

2. PI_bus chains of modules with sensors.

On these inputs, the type of a connected sensor (or whether a chain is connected) is automatically recognized based on Pessl Instruments proprietary chain protocol.

Different temperature sensors are based on the same IC and consequently the iMETOS 3.3 does not distinguish among them. Therefore default inputs have been reserved for each of this temperature sensors as follows:

- INPUT 1: air temperature
- INPUT 2: dry bulb temperature

- INPUT 3: wet bulb temperature
- INPUT 4: soil temperature

Example:
If a dry bulb temperature happened to be connected to input 4 it will receive the name of "soil temperature" but this will be only the default denomination and the user can change it later without further consequences on FieldClimate portal (This is then at your Account in FieldClimate.com / iMetos settings / names).

Sensors connected directly to the INPUT 1-4 are referred to as "duty-cycle" sensors because data is transmitted by means of the pulse width. Examples are temperature, global radiation, wind direction, and barometric pressure (a complete list is on appendix I).

A PI_bus chain is recognized by its characteristic frequency of 750 Hz. Sensors of the chain are recognized by identifiers (see next page Sensor Identification).In addition to the possible chain inputs on INPUT 1-4, the iMETOS 3.3 has one dedicated input for chain.

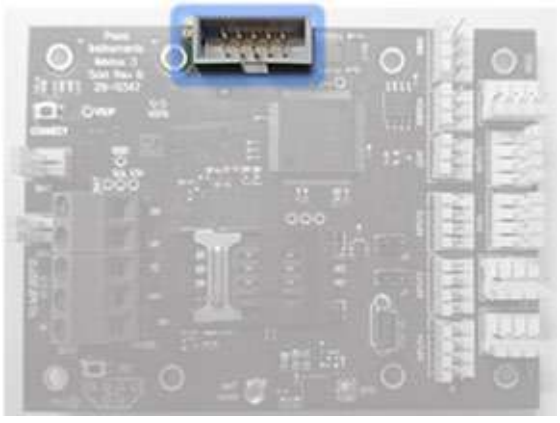
Warning!!
To connect a chain to INPUT 1-4 a 485-to-duty-cycle converter is needed in the connector of the bus (as in previous iMETOS boards), the bus cable can't be connected directly.

Direct chain input: In addition to the possible chain inputs on INPUT 1-4, the iMETOS 3.3 has one dedicated input for every chain.

Note: The PI_bus chain input has no need of any 485 to duty converter, the bus cable is connected directly.

Extension board connector:
To the extension connector one of the following extensions can be connected:

- **Aquacheck** for soil moisture probes (not John Deere probes) and with the necessary changes for ultrasonic wind speed sensors (only channel A)
- **SDI12 – 1 input** for 1 soil moisture probe
- **SDI12 – 2 inputs** for soil moisture probes and ultrasonic wind speed sensor (only channel A)
- **Modbus**: for ultrasonic snow depth sensors
- **RS485**: two more PI-Bus channels
- **Radio nodes AP Board** for interfacing the iMetos33 station with radio nodes stations



Picture 13: Extension board connector.

1.11.1 SENSOR IDENTIFICATION

MAC-Address:
Every sensor has to have a different proper and unique identification (unique ID), this is the MAC address or chain channel number (assigned by iMETOS).

Chain_channel number:
The chain_channel number identifies the position of a sensor on the iMETOS 3.3. It is made up of the chain number and the channel number of the sensor.

The chain number is assigned according to the input connector:

Chain 0 = Main sensors + HC2 + Duty sensors

Chain 1 = Chain at input 1

Chain 2 = Chain at input 2

Chain 3 = Chain at input 3

Chain 4 = Chain at input 4

Chain 5 = Chain at dedicated input (RS485)

Chain 6 = Extension board input A / Radio node sensors

Chain 7 = Extension board input B

Chain 8 = Radio node sensors

The **channel number** of any sensor connected to the PIbus is assigned according to the position of the sensor on the chain node and the proximity of the node to the iMETOS. For RadioNode is assigned in chronological order of peering with the iMETOS. The channel numbers of Chain 0 are given in the following table:

Sensor:	Input Name:	Channel	Description
Any Duty Sensor	Input1	0	Duty sensor at input1
Any Duty Sensor	Input2	1	Duty sensor at input2
Any Duty Sensor	Input3	2	Duty sensor at input3
Any Duty Sensor	Input4	3	Duty sensor at input4
Solar panel	SOL	4	Solar panel of the station
Rain sensor	RAIN	5	Rain (precipitation) sensor at RAIN input
Wind speed	WIND	6	Wind speed sensor at WIND input
Battery	BAT	7	Battery of the station
Leaf wetness	LEAF	8	Leaf wetness sensor at LEAF input
Any Reed Sensor	REED	9	Any reed-type sensor at REED input
Any Switch Sensor	SWITCH	10	Any switch-type sensor at SWITCH input
HC2 Serial Number - A		13	Hygroclip serial number at input HC2-A
HC2 Temperature - A		14	Hygroclip temperature at input HC2-A
HC2 Humidity - A		15	Hygroclip relative humidity at input HC2-A
HC2 Dew point - A		16	Hygroclip dew point at input HC2-A
HC2 Serial Number - B		17	Hygroclip serial number at input HC2-B
HC2 Temperature - B		18	Hygroclip temperature at input HC2-B
HC2 Humidity - B		19	Hygroclip relative humidity at input HC2-B
HC2 Dew point - B		20	Hygroclip dew point at input HC2-B
GPS_Latitude		21	Hygroclip dew point at input HC2-B
GPS_Longitude		22	Hygroclip dew point at input HC2-B
GPS_Altitude		23	Hygroclip dew point at input HC2-B
GPS_Precision		24	Hygroclip dew point at input HC2-B

The **chain_channel number** is then calculated as Chain number * 2000 + Channel number

Examples:

a) Direct connected sensors
Wind speed sensor connected to WIND input: Chain = 0, Channel = 6 —› Chain_channel = 6 (as result of: 0·2000+6=6)

Global radiaton sensor connected in input sensor connected to input_1: Chain = 0, Channel = 1 —› Chain_channel = 1 (as result of: 0·2000+1=1)

b) Pibus conneted sensors
Last (*) sensor in a PIbus chain with 4 sensors connected to input 3:

- Chain = 3, Channel = 4 —› Chain_channel = 6004 (as result of: 3·2000+4=6004)

Third (*) sensor in a PIbus chain with 18 sensors connected to dedicated input:

- Chain = 5, Channel = 3 —› Chain_channel = 10003 (as result of: 5·2000+3=10003)

Sensor code:
The sensor code specifies the sensor type, in Appendix 1 one you will find the complete list at the time of this edition. An example of codes are:

Code	Sensor	Code	Sensor	Code	Sensor
0	Air temperature [C]	20226	EAG Relative Humidity [%]	32769	PH [-]
1	Relative humidity [%]	20227	EAG Soil moisture [%]	32770	Conductivity [ms/m]
2	Solar radiation [W/mm]	20228	Eag soil salinity [VIC]	32771	PHC battery [mV]
3	Brightness [Min]	20482	Chain counter []	33025	Diameter [mm]
4	Leaf Wetness [Min]	20483	Air temperature avg [C]	33296	Yara S1 [-]
5	Wind speed [m/s]	20484	Air temperature min [C]	33297	Yara R1 [-]
6	Precipitation [mm]	20485	Air temperature max [C]	33298	Yara R2 [-]
7	Battery [mV]	20486	Air temperature Dgt [C]	33299	Yara Head Temp [C]
16	Soil temperature [C]	21009	Wind speed time [sec]	33300	Yara PLD1 T1 [C]
21	Dew Point [C]	21010	Wind speed max [m/s]	33301	Yara PLD2 T2 [C]
25	Vapor press deficit [kPa]	21011	Wind speed aver [m/s]	33302	Yara R1D [-]

Picture 14: Example of codes

2. START UP YOUR iMETOS

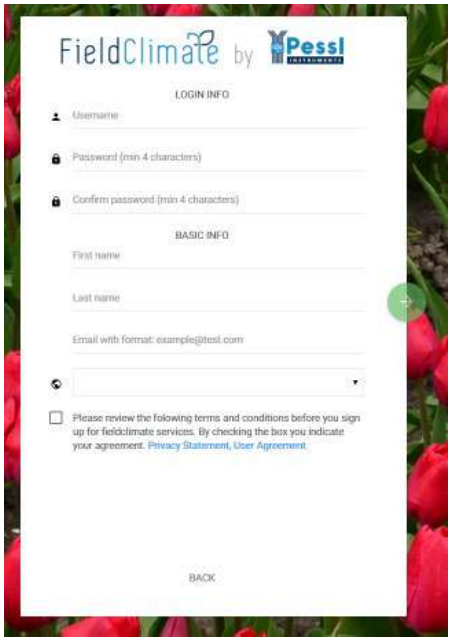
2.1 USE YOUR iMETOS

FieldClimate is the web service you are intended to use your iMETOS with. It allows you to see the data in graphs or tables. It provides interfaces for automised downloads and it provides a powerful decision support system for plant protection and irrigation.

2.2 REGISTER YOURSELF AS A USER ON FieldClimate.com

To use the services on FieldClimate it is necessary to register as a user first. Click the plus (+) button to add a new user.

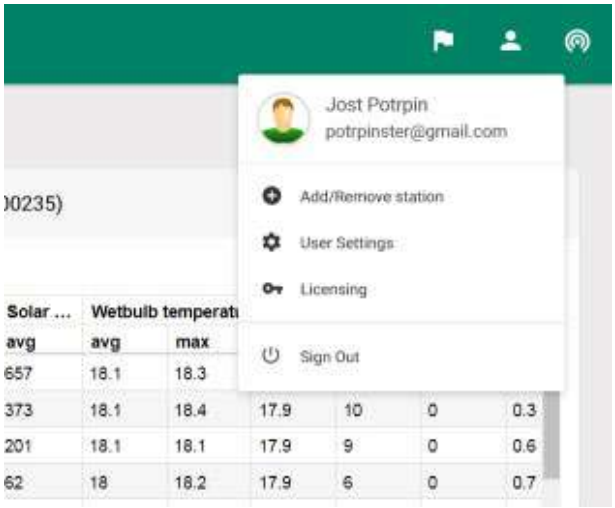
The registration screen which comes up, asks you for a username and a password and it needs your email address as well as your postal address and some information about the company. Please note you will have to enter the real email address. An acknowledge email is send to your inbox and its containing link that has to be used to activate the newly created user account on FieldClimate.



Picture 15: Login form

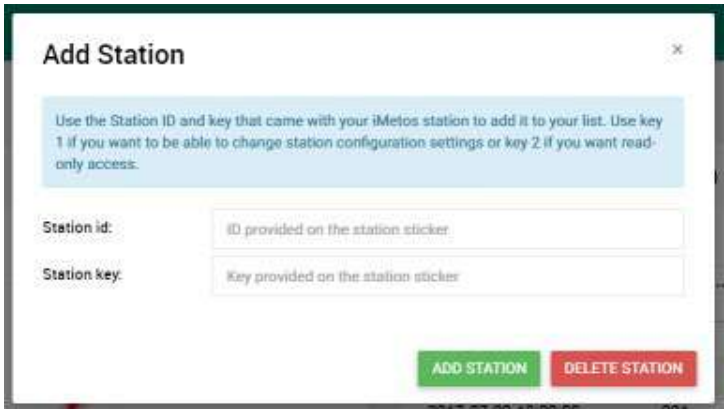
2.3 ADD THE iMETOS TO YOUR ACCOUNT

If you have got the activation email and you activated the account you will be able to enter to FieldClimate. To add your device, open user menu and then press the “Add/Remove station” button.



Picture 16: Add/Remove station

It will ask you for a Station ID number and a station key. Now the little silver colored sticker which came with your device has to be used. This sticker contains two keys. Key 1 gives the power to change all the settings on the device whereas key 2 is only valid to use the data of the system. To be able to set up the device please enter the key 1 here. If you entered the correct key your station list will be enlarged by this device and it can be selected.



Picture 17: Add station

3. INSTALLING THE iMETOS

3.1 INSTALLING CLIMATE SENSORS

Each iMETOS can be expanded to the maximum possible number of sensors. It is equipped with specific inputs for rain, wind speed, leaf wetness, temperature, and relative humidity and for soil moisture probes. Beside this it has 4 digital inputs more which can be used for a range of different sensors and sensor chains.

iMETOS is able to distinguish between the different sensors added to the 4 digital inputs. If we connect global radiation, a photosynthetic active radiant sensor, a wind direction, a barometric pressure sensor or a temperature sensor – they can be detected by their frequency.

- Before connecting a NEW SENSOR to the motherboard, unplug battery and solar panel. Once connected, plug them in again.
- It is recommended to do always a SENSOR TEST before leaving the site to ensure the station reads properly the new sensor.

Solar panel, battery, temperature and relative humidity, global radiation, rain gauge and barometric pressure are part of the main system. There are usually no long cables for these sensors. Wind speed and Wind direction sensors will need a cable because they have to be mounted on the end of the pole. They normally come with 3 m cable. The soil temperature sensor comes with 5 m cable. It has to go to the ground at the desired depth. Leaf wetness comes with 5 m cable. This sensor is mounted in the canopies of trees and vines.

Convection cup and global radiation sensor are mounted on top of the holder. They are dismounted during transportation and have to be mounted after unpacking. Just push them under the 3 screws which are prepared in the housing for each of them and fix the screws with a small screwdriver.

The solar panel might be clapped down for transportation. Screw the 3 screws in and it will be clapped out. On some systems for cooler climate the solar panel can come on a separate holder. In this case please fix this holder on the mounting pole by using the clamps which have been added to the package for this purpose.

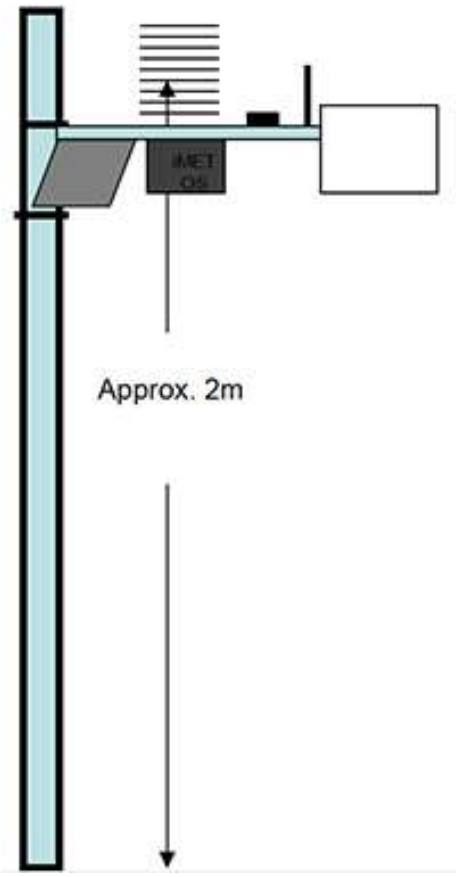
The temperature and relative humidity sensor should be mounted between 1.25 m and 2 m above the ground depending on the crop. This is the standard measurement for these climate factors in agricultural meteorology.

The iMETOS is mounted on the post with two clamps. Make sure that the pole is buried as straight as possible. How horizontal the climate station is mounted can be checked by the little water lens at the rain gauge.

On northern hemisphere the solar panel should be exposed to south and the same the global radiation sensor. The wind direction sensor should point towards north and the wind speed sensor should point towards south again.

The leaf wetness sensor comes with a cable tie to be mounted on a branch of the tree or vine or on the main holder (next to the rain gauge) slightly inclinated. Please mount this sensor in a position with allows the sensor to pick up the early rain and to stay wet in shadow.

The soil temperature sensor should be buried in the ground. How deep it should be buried is depending from the goal which should be reached with the sensor. To have an impression of root growth and nitrogen mineralization in vines or apples in early spring it is best be mounted at 10 to 20 cm. It you want to assess the emergence possibilities of seeds it is depending on the sowing depth of the seed. Using it in corn (maize) would mean to mount it at 5 cm and using it for sugar beets would mean to mount it at 2 or 3 cm only.



Picture 18: Installing

The wet and dry bulb temperature sensor is mounted in the height of the lowest plant organ which should be protected from frost. Two clamps are packed with the unit to mount this sensor on the post. Make sure that the water bottle of the wet bulb temperature sensor is at least 80% full.

Water level sensors are equipped with 15 m cable to give the sensor into the water. It is combined with a barometric pressure sensor.

Picture 19: Wet and Dry Bulb Temperature Sensor

Installing PI-bus sensors
PI-bus sensors (Tensiometer, Water level, etc.) can be directly connected to RS485 on the main board and on PI-bus input on the Decagon interface.

The wiring to RS485 follows the labelled colors on the pcb, while on the Decagon interface is the following: **WH=brown, RD=green, BR= white**.

DIP switch for PI-bus is 111.

3.2 INSTALLING SOIL MOISTURE SENSORS

iMETOS weather and soil moisture stations support awide range of soil moisture sensors. This manual covers the most common of them.

In particular, iMETOS can be equipped with 4 different types of soil moisture sensors. Tensiometers are giving accurate readings in between 10 and 700 mbar of water tension. Tensiometers for this are widely used in horticulture because their measurement range fits very well with the most vegetables and soft fruits. Water-mark sensors are returning water tension too. The range of this sensor is between 10 and 2000 mbar. This sensor fits for all horticulture crops, soft fruits, for all tree fruits and for all agricultural crops. It is easy to use and allows applying a controlled deficit regime for crops that can accept this.

Then we have capacitive probes which give the amount of water what has been used by the crop but it tells nothing about the availability of the water. Sentek Drill&Drop or Aquacheck probes are giving a perfect way to monitor the water use in different soil depths.

On iMETOS we can combine tensiometers with watermark sensors, capacitive and profile probes with the use of nodes and interfaces. The combination of Tensiometer and Watermark will give accurate readings by the tensiometer in the area when water is easily available for the plant and readings for controlled water deficit when this is applied. Please note the tensiometers should be removed in the time of water deficit or refilled after this time. The combination of tensiometer with capacitive probes will give information about the availability of soil water and about the water needed to refill the soil.

Please note that before connecting a **NEW INTERFACE** to the motherboard, delete sensor configuration and unplug battery and solar panel. Once connected, plug them in again.

It is recommended to do always a SENSOR TEST before leaving the site to ensure the station reads properly the new sensor.

From tensiometric soil moisture measuring they support:
- Tensiometers with Pessl Instruments pressure transducer head
- Watermark sensors
- METER Group MPS

From volumetric water content measuring they support:
- Sentek Drill&Drop
- METER Group 10HS
- METER Group EC5
- METER Group 5TE
- METER Group 5TM
- METER Group GS1
- METER Group GS3
- METER Group MPS1

The soil moisture sensors are supported by nodes for PI sensor bus. These nodes connect PI sensor bus to RS485 input on the PCB. iMETOS 3.3 has one native RS485 input and can be expanded by 2 more on the extension connector. The PI sensor nodes come with a shielded 4-wire cable.

The cable has the following color code:
- Bare, Gray or Blue: Shield
- White: Ground
- Yellow: Data A
- Green: Data B
- Brown: VVC

The RS485 connectors on the PCB are labelled with SH(D) (Shield), WH(T) (Ground), YE(L) (Data A), GR(N) (Data cool and BR(N) (VVC). With a little interface PCB in the cable all the sensor bus nodes can be connected to the inputs 1 to 4 too.

To install fork-like sensors, excavate a trench to the depth required and insert the entire sensing portion of the sensor horizontally into the undisturbed soil face. Let the cable go down first and then take it up to the top. This prevents water from following the cable in the ground and wetting the sensor.

Picture 20: Installing Meter 10HS sensor.

3.3 INSTALLING TENSIOMETERS

Tensiometers are returning water tension in cBar, kPas or mBar. The pressure would be a negative value because it indicates tension, but for simplification FieldClimate handles them as positive.

Tensiometer sensors are supported by the PI-bus. Every pressure transducer comes with a shielded 3 wire cable. The wires and the labels on the PCB are: Bare: SH, WH: white, GR: green, BR: brown. The connection is the following: Brown wire on WH, Green on RD, White on BR.

The tensiometers are having an outside diameter of 20mm. Use a soil auger to make a narrow hole and moisture the hole with water before you enter the tensiometer. The tensiometer has to have close contact on the side and at the base of the hole. Water tension measurement is very sensible to air gaps below the sensor.

Tensiometers are returning water tension in cBar, kPas or mBar. The pressure would be a negative value because it indicates tension, but for simplification FieldClimate handles them as positive.

Tensiometer sensors are supported by the PI sensor nodes. There is a sensor node supporting 4 tensiometer pressure transducers and having a reference pressure sensor on the PCB. The inputs are enumerated from 1 to 4. On FieldClimate the data is displayed following this enumeration with the atmospheric pressure from the reference sensor as the leading value.

Every pressure transducer comes with a shielded 3 wire cable. The wires and th labels on the PCB are: Bare: SH, WH: white, GR: green, BR: brown.

3.3.1 FILLING AND RE-FILLING THE TENSIOMETER

To re-fill the tensiometer please emerge the sensor totally overnight in water filled bucket. The next morning please connect a syringe to the tensiometer and pull it up. Use the syringe to degas the tensiometer. When the syringe fills with water remove it and plug the tube again.

3.4 INSTALLING WATERMARK SENSORS

Watermark sensors measure water tension. These sensors measuring range is between 100 and 2000 mBar (10 to 250 kPa or cB). This sensor fits many horticultural crops, berries, stone fruits, vines and potatoes. Watermark sensors are easy to use and frost-proof.

Basically it is a gypsum block. The gypsum is embedded in a matrix material and gives a defined response in resistance on different water tension levels. We can measure the water tension on 3 to 5 cBar accuracy.

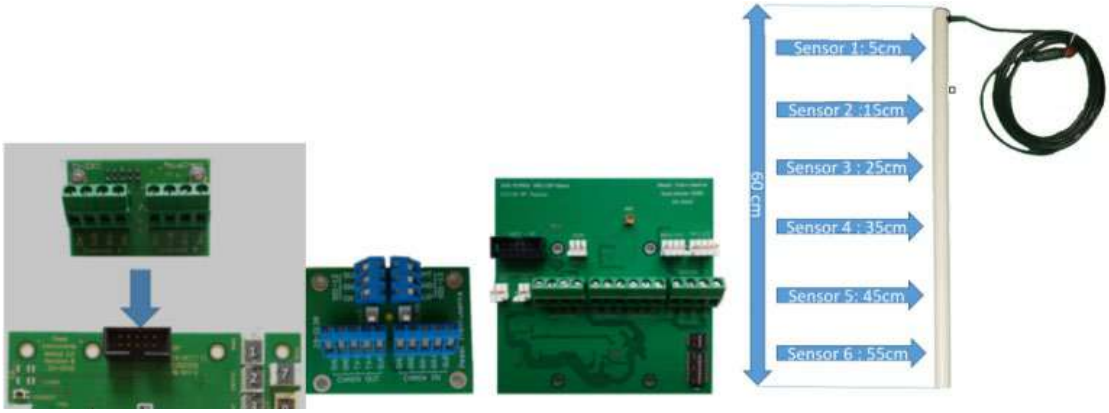
It showed that it works faster if it is wetted for 24 hours before installation. If you install it in the ground you will need a hole with the correct depth. Lay it horizontally on the ground and let the cable go horizontally first to before you take it up to the top. This avoids water following the cable in the ground, thus reaching and wetting the sensor.

The watermark PCB can be equipped with an own soil temperature sensor. This sensor is used to do the temperature compensation of the water tension measurement. It allows you to to measure the soil temperature in specific blocks where you measure water tension. The irrigation might influence the soil temperature what can be important in asparagus for example.

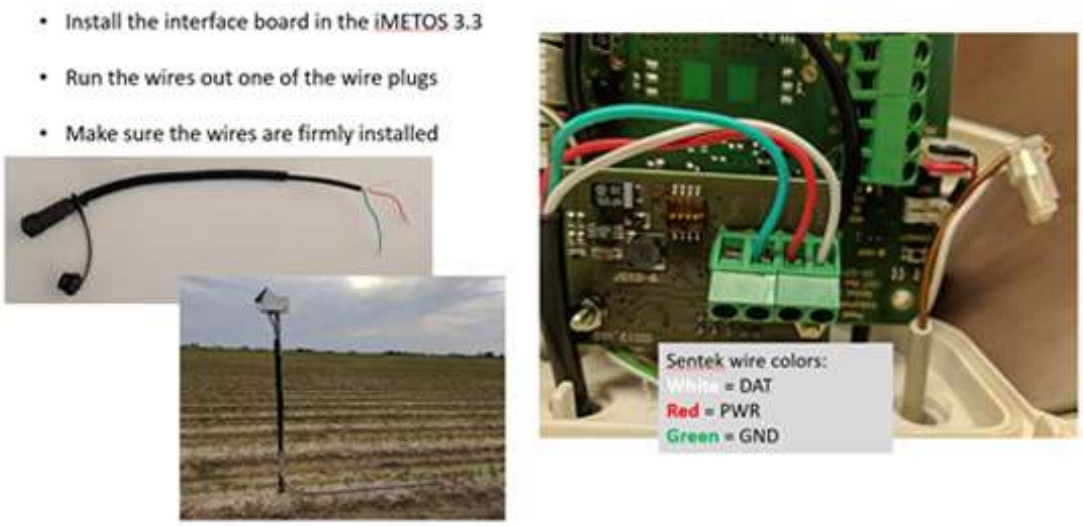
3.5 INSTALLING DRILL&DROP PROBES

Up to two Sentek “Drill And Drop” volumetric water content in the profile probes can be connected via extension board directly connected to the main PCB.

Further number od this probes can be connected via PI bus input or via radio node links. Refer to D&D manual for more details.



Picture 21: Sentek Drill&Drop with connectors

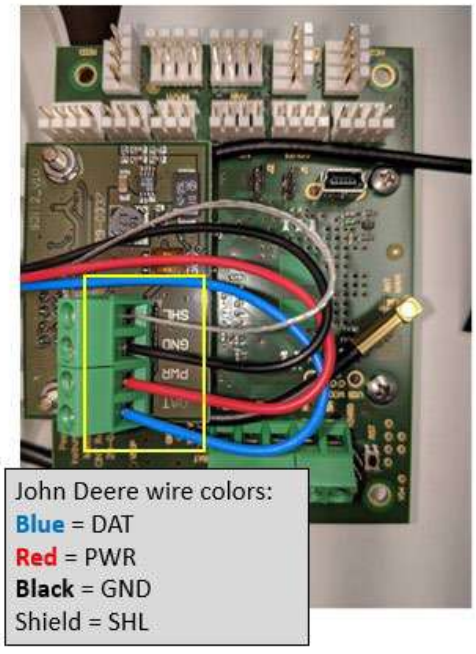


Picture 22: Wiring the Sentek probe to the iMETOS 3.3.

Picture 23: Installation of Drill&Drop probes.

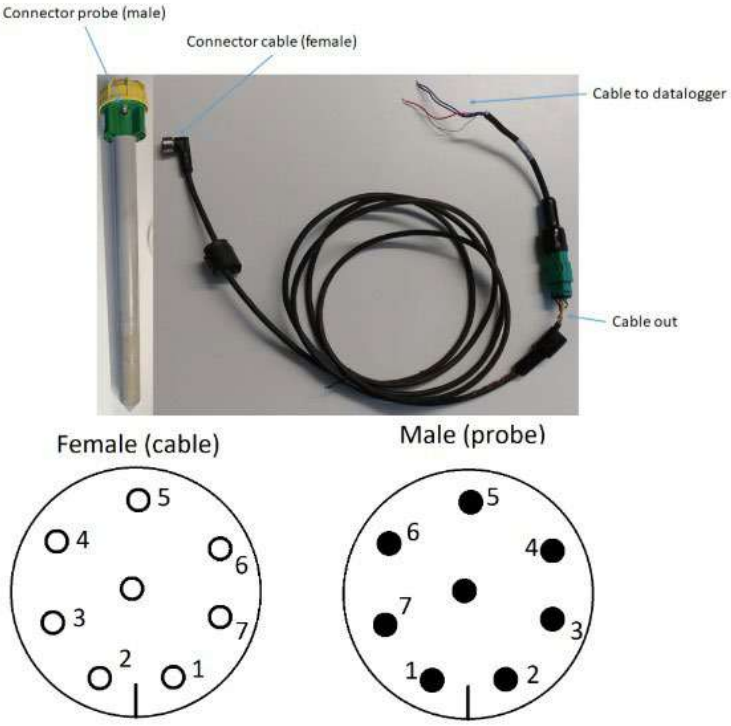
3.6 WIRING A JOHN DEERE PROBE

- Install the interface board SDI-12 in the IMT/ECO D3
- Run the wires out one of the wire plugs
- Make sure the wires are firmly installed



Picture 24: John Deere wire colors.

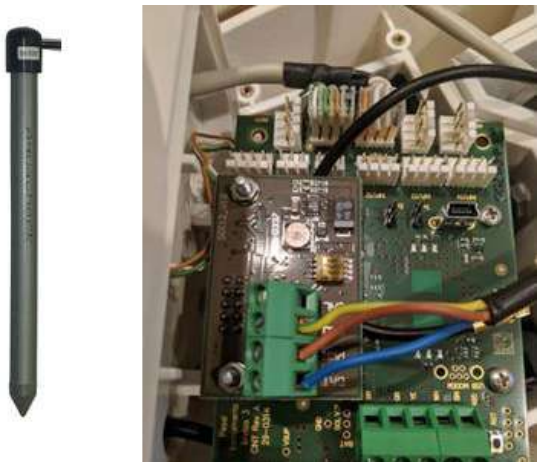
Cable to datalogger	Cable out	Connector pin#	Extension SDI12 PCB at iMetos	Description
Blue	Green	3	DAT or DT	SDI12 data
Red	Gray	6	PWR or PW or SUP	12V power
Black	Yellow	5	GND or GD	Ground
Shield	Transparent/Shield	4	SHL or SH	Shield



Picture 25: Connection scheme for John Deere soil moisture probes to iMETOS 3.3 or iMETOS ECO D3 stations

3.7 WIRING AN AQUACHECK PROBE

- Instruction for wiring the Aquacheck soil moisture probe to METOS SDI 12 interface
- Install the interface board
- Run the wires out one of the wire plugs
- Make sure the wires are firmly installed
- Connect the Blue wire from the Aquacheck probe to the terminal marked DAT.
- Connect the Yellow/Green stripe wire from the Aquacheck probe to the terminal marked GND.
- Connect the Brown wire from the Aquacheck probe to the terminal marked PWR.

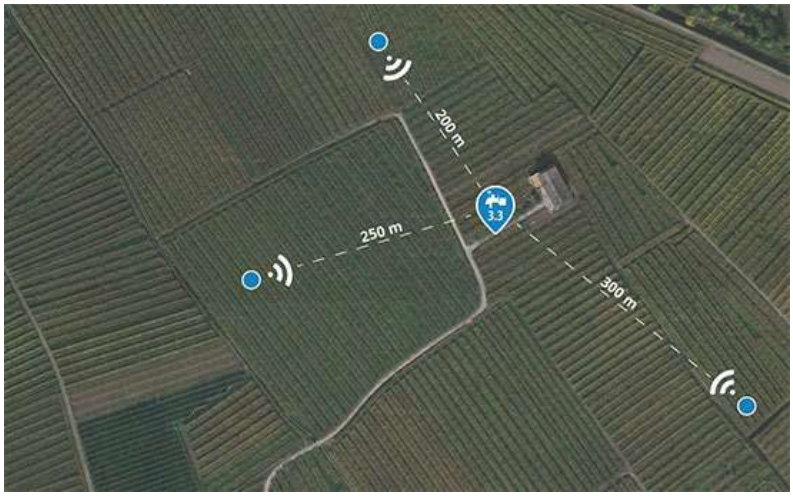


Picture 26: Aquacheck wire colors.

Picture 27: After pouring the slurry mixture into the bored hole you can insert the probe. Probe should be inserted until only the top cap is visible above the surface.

3.8 iMETOS 3.3 RADIO ACCESS POINT

iMETOS 3.3 includes the chipset for radio linking remote radio-nodes of sensors and actuators. The radio-node net has a star topology (iMETOS controls the net, RadioNodes are peer to it). 16 remote radio-nodes can be connected to the iMETOS 3.3. Radio-nodes should be places in a line of sight at a maximum distance of 500m from the iMETOS.



Picture 28: Radio Node star configuration.

3.9 SETUP YOUR iMETOS WiFi NETWORK

Before you can start using your iMETOS WiFi you need to correctly setup the connectivity settings, that your device will be able to connect to your local WiFi network. To do this, please follow the following steps:

1. Start the station with jumper on J1 position and connect it with your. When this is done please enter the terminal window program and plug in the battery.
2. In terminal window program, you will see basic menú, please select option nr. **3 – MODEM**.

```
================================================================================
USER: \ MAIN MENU
================================================================================

(1) SYSTEM
(2) SENSORS
(3) MODEM
```

3. Select (1) MODEM SETTINGS and please wait as station checks the modem.

```
29/03/2020 00:20:42 >> Chosen function: MODEM

================================================================================
USER: \ MAIN MENU \ MODEM
================================================================================

(1) MODEM SETTINGS
(3) SEND STATION DATA
(4) GET GPS
(5) GET CONF SMS
(6) Download FW
(7) Download APN list
(ESC) BACK

29/03/2020 00:20:45 >> Chosen function: MODEM SETTINGS
>
> Starting modem process
>
>
>> Turning modem on
>
Try saved baudrate: 38400
ATE1
[ERROR: INVALID INPUT]
ATE1
[OK]
Baudrate detected
>
>> Reading modem's info
>
AT+NMAC=?
```

00:08:dc:1c:9d:62
[OK]
ATI1
GS1011
[OK]
ATI0
WIZnet
[OK]
ATI2
WizFi210
1.1.1.0(W)
[OK]

Manufacturer of modem: WIZnet
Type of modem: GS1011
Modem firmware version: WizFi210__1.1.1.0(W)
MAC: 00:08:dc:1c:9d:62
Modem Baudrate: 38400

==========
USER: \ MAIN MENU \ MODEM \ MODEM SETTINGS
==========

(1) SEE AVAILABLE NETWORKS
(2) CONFIGURE NETWORK
(3) DISPLAY NETWORK CONFIGURATION
(4) ERASE NETWORK CONFIGURATION
(5) TEST CONNECTION
(ESC) BACK

4. In the menu, select option nr. 1 – **See available networks**. Please find suitable network on the list. Please take a look at RSSI number – the bigger the number is the better is signal on the location (note that it is a negative value – so in this case the best is -57).

29/03/2020 00:21:10 >> Chosen function: SEE AVAILABLE NETWORKS
==========
USER: \ MAIN MENU \ MODEM \ MODEM SETTINGS \ SEE AVAILABLE NETWORKS
==========

Scanning, please wait...
BSSID SSID Channel Type RSSI Security
46:d9:e7:cd:55:f3, Pessl WiFi, 01, INFRA , -57 , WPA2-PERSONAL
00:1f:33:fb:b5:26, Pessl_Dev, 06, INFRA , -86 , NONE
46:d9:e7:cd:53:30, Pessl WiFi, 06, INFRA , -80 , WPA2-PERSONAL
46:d9:e7:cd:55:11, Pessl WiFi , 11, INFRA , -76 , WPA2-PERSONAL
No.Of AP Found:4

5. Now navigate to menu nr. 2 – **Configure network**. Now please follow the on-screen instructions. Input the right network name, type of security and password. Usually Automatic IP and Automatic DNS is set to YES.

```
================================================================================
USER: \ MAIN MENU \ MODEM \ MODEM SETTINGS
================================================================================

(1) SEE AVAILABLE NETWORKS
(2) CONFIGURE NETWORK
(3) DISPLAY NETWORK CONFIGURATION
(4) ERASE NETWORK CONFIGURATION
(5) TEST CONNECTION
(ESC) BACK
29/03/2020 00:46:28 >> Chosen function: CONFIGURE NETWORK

================================================================================
USER: \ MAIN MENU \ MODEM \ MODEM SETTINGS \ CONFIGURE NETWORK
================================================================================

Please select the proper security option:

(1) WEP (KEY 1)
(2) WPA
(3) WPA2-PSK (Using Password)
(4) WPA2-PSK (Using PSK)
(5) NONE
(ESC) BACK
```

and now set your Network Parameters.

6. After successfully inputting new settings for WiFi network, you can check on menu nr. 3 – **Display network configuration**, if all is as you set it up.

7. As the last step you should run a test, so in the menu please choose nr. 5 – Test connection. You will see the full list of all available networks, and then the station will try to connect to the network of which you provided the settings. If at the end of this process there is a massage: INFO: Network properly configured, then everything is ok and you can start using your iMETOS station. If you get a massage ERROR: Network NOT properly configured, then the provided configuration is not working. In this case, please make sure that you have entered the right parameters.

```
29/03/2020 00:47:44 >> Chosen function: TEST CONNECTION

================================================================================
USER: \ MAIN MENU \ MODEM \ MODEM SETTINGS \ TEST CONNECTION
================================================================================

ATC0
```

[OK]
AT+WM=0
[OK]
AT+WS=iMetosWiFi
BSSID SSID Channel Type RSSI Security
46:d9:e7:cd:55:f3, Pessl WiFi,01, INFRA,-57,WPA2-PERSONAL
No.Of AP Found:1
[OK]
> Chosen network: BSSID d4:28:d5:5e:90:f3 with RSSI: -91
AT+WPAPSK=iMetosWiFi,wifi1234
Computing PSK from SSID and PassPhrase...

[OK]
AT+NDHCP=1
[OK]
AT+WA=iMetosWiFi,d4:28:d5:5e:90:f3
[ERROR]
AT+WD
[OK]

4. INSTALLING NEW SENSORS ON THE iMETOS

Each iMETOS can be expanded to the maximum possible number of sensors. It is equipped with specific inputs for rain, wind speed, leaf wetness, temperature and relative humidity and for watermarks, gypsum blocks or echo probes. Beside of this it has 3 digital inputs more which can be used for a range of different sensors and sensor chains.

iMETOS is able to distinguish in between the different sensors added to the 3 digital inputs. If we connect a global radiation, a photosynthetic active radiant sensor, a wind direction, a barometric pressure sensor or a temperature sensor – they can be detected by their frequency. When we connect digital sensors with a numerical output like chains of tensiometers, they can be detected by their identifier.

4.1 INSTALLING AIR, SOIL, WET OR DRY BULB TEMPERATURE

iMETOS is able to distinguish between different sensors. All the temperature sensors, that iMETOS is normally equipped with, are basing on the same IC and they are not distinguishable. Therefore iMETOS make assumptions on the most common temperature sensors for horticulture and agriculture.

If you connected the temperatures to these connectors and they are not one of the sensors which are preset, please rename them on the website FieldClimate -> Settings -Y Sensors and Nodes. If you are going to rename the sensors in the internet, every combination of temperature sensors is possible.

Picture 29: Sensors

4.2 INSTALLING A GLOBAL RADIATION SENSOR

The global radiation sensor identifies itself by its frequency. It can be connected to any input from 1 to 4. The design of the iMETOS makes it more comfortable to enter the box from the right side and to use the input 1.

To fix the global radiation sensor on the iMETOS holder unscrew the three screws right of the box and fix the global radiation holder with this screws.

4.3 INSTALLING A WIND SENSOR

4.3.1 PI ULTRASONIC WIND MONITOR

PI Ultrasonic Wind monitor measures accurately wind speed and direction.

The sensor is to be mounted at the top of the second pole of the iMetos and with the standard clamps. It is supplied with a 2-meter PIbus cable (optional is to include the longer cable when placing your order). It gives the following values:

- Average wind speed in the logging interval
- The maximum gust of wind in a running 3-seconds average
- Wind run direction

You will take the same installation care and placement considerations as for the traditional anemometer with the plus of a careful orientation to the north pole guided by the “north mark” indication in the sensor.

It measures 3 times per second and applies a median-filtering to save this value in its embedded logger. On request of the iMetos, it performs the averaging and the pertinent vectorial calculations to supply the 3 mentioned values.

It is powered with a small super-cap charged in milliseconds by the iMetos during every reading. The power uptake is negligible. It requires no maintenance and fulfills and improves all the measurement demands.

Scheme connection on iMETOS 3.3

Pancon connector: Input 1, input 2, input 3, input 4.

In case you need to connect it to PI-bus RS485, you have to cut and strip the cable before the black heat shrink tubing, which contains the RS485 converter.

Connection to RS485 on the main board with the following wiring color: BR=brown, GR=green, YE=yellow, WH=white.
Note: both iMETOS 3.3 and ECO D3 need FW version x.521 or newer.

To install the PI Ultrasonic wind sensor on the 2nd pole (42.4 mm) for iMetos 3.3 follow the next steps:

1. Bend the cable about 10 cm from the sensor.

2. Place the Ultrasonic sensor on the top of the second mounting pole. The PI Ultrasonic Wind is fitted with two clamps and one metal holder, allowing it to be fixed on the pole or post.

3. The PI Ultrasonic Wind must be oriented with the „North mark“ sticker below the sensor to true north. Check it with the usage of Compass mobile app.

4. Use a wrench to tighten the bolts and let the cable passing through the screw and the pole (see figure below).

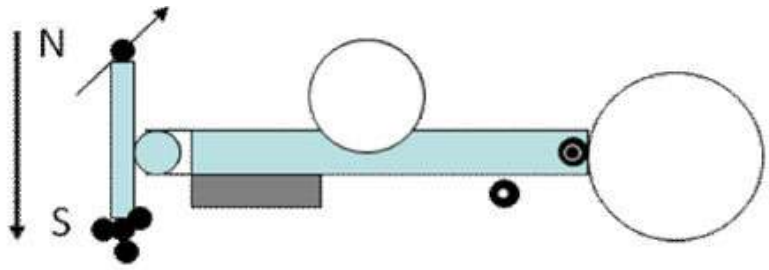
5. Fix the cable vertically along the pole with zip ties avoiding to wrap it around the pole.

4.3.2 WIND DIRECTION SENSOR

The wind direction sensor identifies itself by is frequency. It can be connected to any input from 1 to 4. The design of the iMETOS makes it more comfortable to enter the box from the downside and to connect the sensor to input 2 or to input 4.

The wind direction sensor is different from the other sensors in its mode of measurement. It uses its own intelligence to measure every second. It transmits the average of its readings on every request from the main unit. To be able to measure during the periods, the main unit sleeps, this sensor has its own small battery. This battery should last for 10 years. If this sensor fails to work after several years, please note that it might be the battery which is empty.

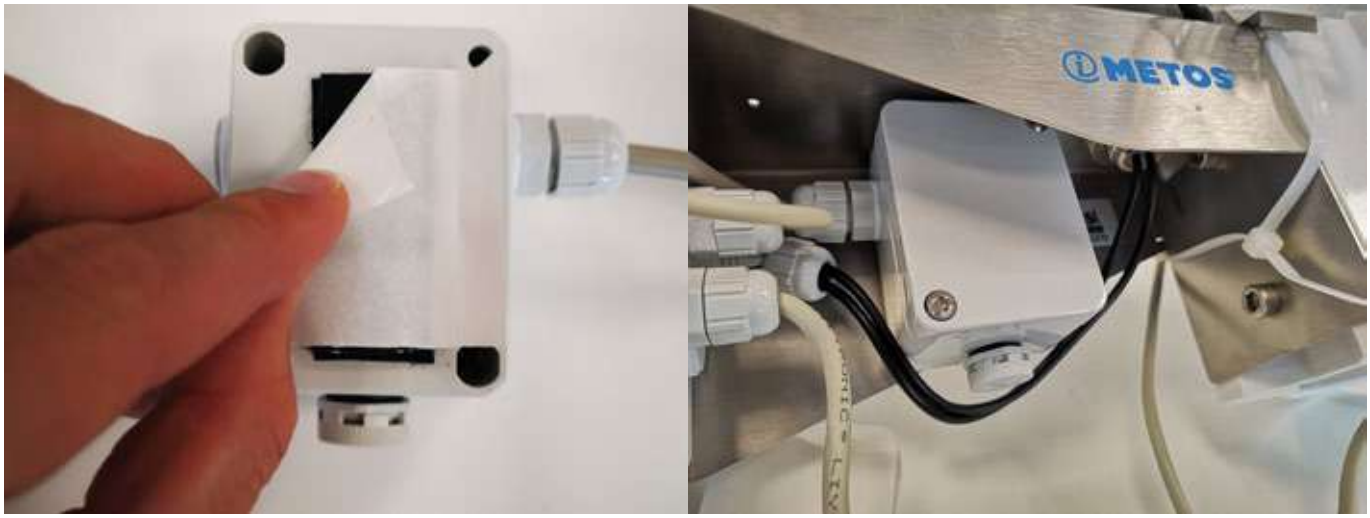
On northern hemisphere the wind direction sensor should point towards north and the wind speed sensor should point towards south again.



Picture 30: Wind direction

4.4 INSTALLING BAROMETRIC PRESSURE SENSOR

The barometric pressure sensor can be connected to one of the digital Inputs 1-4 on the PCB inside the box. To install it, attach it with the tape (it is included) on the metal holder for the iMetos next to the box containing the pcb. The following pictures show the steps for the installation of the sensor.



Picture 31: Installation of barometric pressure sensor

5. MAINTAINING THE iMETOS

When the solar panel of the iMETOS is exposed to the sun and it gets enough sunlight it should recharge the lead acid battery of the system constantly. With this the system should have enough power for years. The lifespan of the lead acid battery can be expected to be 5 to 6 years with sufficient reloading from the solar panel. Insufficient reloading will shorten the lifetime of the battery. In case of insufficient reloading of the battery the system will reduce the frequency of data upload to the amount which is needed to make sure that no data will be missed on the server. With this, power use will be reduced, and battery power will last longer.

The maintenance needed for the sensors depends on the different sensors. Temperature sensors will not need any maintenance for their lifetime whereas the rain gauge will only work properly when it is cleaned periodically.

5.1 MAINTAINING THE RAIN GAUGE

New rain-gauge sensor funnel includes a plastic filter intended to reduce maintenance needs. It is possible that birds or insects construct nests inside the mechanism; so, if it rains and the data does not look consistent, check your Rain Gauge internally. To open it, just press the lateral walls and pull the metallic lid (see pictures below).

Picture 32: Three steps to open the rain gauge.

In case of recurrent bird or insect infestation, a good practice is to spray some Diesel or similar oil inside the Rain Gauge; this will keep them away. If necessary, the Rain Gauge can be recalibrated – the spoons must tip with 4 ml. This can be adjusted using the white screws underneath the mechanism.

Picture 33: Rain gauge

5.2 MAINTAINING THE LEAF WETNESS SENSOR

The filter paper which is used as a sensing element for the leaf wetness sensor is destroyed after to many wettings and dryings. It has to be changed in dependence of rain frequency.

5.3 MAINTAINING THE TEMPERATURE AND RELATIVE HUMIDITY SENSOR

The temperature sensors of iMETOS are free of any maintenance as long as they are used in a proper way and the cables are not damaged. The relative humidity sensor is affected by pollution in dependence of the severity of the pollution. In clean air this sensor will give accurate readings for 3 and more years but in pollut-

ed air it may give inaccurate high readings after some years of use. In this case the sensor has to be changed for a new calibrated one.

5.4 MAINTAINING THE SOIL TEMPERATURE SENSOR

The soil temperature sensor does not need any maintenance. If it fails it is nearly always due to damaged wires.

5.5 MAINTAINING THE GLOBAL RADIATION SENSOR

The global radiation sensor should be cleaned every month. After 2 or 3 years the sensor has to be calibrated in our factory.

5.6 MAINTAINING THE WIND SPEED SENSOR

The wind sensor should be examined whether the windwheel is low-friction. If that is not the case sent the sensor for sevice to us. If the windwheel is damaged please order a new one.

6. FIRMWARE

6.1 UPDATE OVER THE AIR

The firmware is the application that runs on the processor of the iMETOS. Every time the iMETOS 3.3 connects to FieldClimate, it checks for the latest firmware version. If it finds a newer version the iMETOS 3.3 automatically downloads it and updates its self.

In addition firmware can also be uploaded manually via the USB connection. A detailed description is given on pages about USB communication.

6.2 STATION WORKING MODES

The iMETOS 3.3 can operate in three different working modes:

1. Logging and transmitting (normal mode)

2. Logging, not transmitting (gathering mode)

3. No logging, no transmitting (sleeping mode)

The standard working mode is the **normal mode** in which the station measures and communicates regularly.

When battery voltage drops below a threshold (**6.3V**), the fixed transfer interval is ignored.

If the battery voltage drops below a threshold (**6.1V**), the station changes to **gathering mode**. The station measures regularly, but modem communication is deactivated.

If the battery voltage falls below yet another threshold (**5.4V**), the station changes to **sleeping mode**. Both measurements and communication are deactivated.

A station in gathering mode automatically changes back to normal mode if the voltage is high enough again.

If the station is in sleeping mode, also the measurement of the battery voltage is deactivated. Therefore the station has to be activated manually by pressing the **connect button** (see Picture 29) on the board in order to change back to normal mode. First the SMS are checked, then the communication with the server is started.

Picture 34: Connect button

6.3 EVENTS

Along with the weather data, the iMETOS 3.3 also sends relevant info concerning previous communication, SMS readings, internal parameters and many other things.

User can see this events at FieldClimate (Fieldclimate.com / Settings / Station info / Events details) or locally via USB connection.

Please refer to appendix 2 for the complete list, here as an example:

Code description	Code description
1 Hard fault of the system	38 APN not found in XML APN FILE
2 Operation system error	39 NET is not registered => no signal
10 Power on reset	40 NET is not registered => network is not available
11 Brown-out reset	41 NET registration - BTS info is not available

Picture 35: Example of code description

7. WEB SERVER COMMUNICATION

7.1 STATION TO WEB-SERVER COMUNICATION

Data from station to the server is sent in XML format.

The XML file contains:

- station info (e.g. firmware version, serial number,...)
- the station settings (e.g. rain monitoring settings, measurement intervals,..),
- modem info and GSM settings (SIM ID, APN settings,...),
- the events since the last communication,
- the measured data ("weather bin", encoded in Base64 format).

7.2 WEB-SERVER RESPONSE

After receiving the station data, the web-server parses the data, stores it in the database and sends a response (also in XML format). In this response the newest versions of firmware, APN table and sensor table are transferred, the settings are updated and the success of the database upload is confirmed. In detail this includes:

1. IM-RTC-TIME: date and time for synchronization

2. IM-STATION-NAME: user-defined station name

3. IM-UOTA: available firmware version to download

4. IM-FWCRC: firmware correction value

5. IM-FWFILE: name of firmware binary file

6. IM-APNTABLE: available APN table version

7. IM-SENSTABLE: available sensor table version

8. IM-MODE: station mode

9. IM-WL-MON: user-defined water level monitoring settings

10. IM-RAIN-ENABLED: rain monitoring enabled flag

11. IM-MEAS-INT: user-defined measurement and logging intervals

12. IM-FIXED-TRANSF-INT: user-defined fixed transfer interval

13. IM-RAIN-INT: user-defined rain monitoring interval

14. IM-WL-INT: user-defined water level monitoring interval

15. IM-EMG-SMS: user-defined emergency phone number

16. IM-DATA-SCHED: user-defined data transfer schedule

17. IM-SMS-WARN-GSM: user-defined SMS warning phone number

18. IM-SMS-WARN-VAL: user-defined SMS warning sensor settings

19. IM-DB-DATE: begin and end date of data stored at server side

20. IM-DB-UPLOAD: Database upload success flag (if 1 successful, if 0 not successful)

* this settings can change in future

7.3 USER DEFINED SETTINGS

In this section the user-defined settings are given. They can be configured for each station in FieldClimate.

7.3.1 RAIN MONITORING

The user can define a rain monitoring interval. If rain monitoring is enabled, the iMETOS 3.3 measures, logs and transfers data in the specified interval while it is raining. By default rain monitoring is off.

This option is available only at the stations, which have rain sensor.

If the measurement and logging interval are smaller than the specified rain monitoring interval, they are kept.

Note:
iMETOS 3.3 supports rain-gauges with different resolutions, (i.e.: 0.1mm, 0.2mm, 0.5mm) user sets the corresponding resolution in the FieldClimate portal settings. User can also enable pulse filtering when it is neces-

sary to ignore fast pulsing due to vibrations or wind.

For SMS rain alarms a second rain counter accumulates the rain when it is in the same rain event independently of the timestamps.

7.3.2 WATER LEVEL MONITORING

The user can define a water level monitoring interval and a water level threshold. When the threshold is exceeded, the iMETOS 3.3 measures, logs and transfers data in the specified interval.

If the measurement and logging interval are smaller than the specified water level monitoring interval, they are kept.

7.3.3 MEASUREMENT AND LOGGING INTERVAL

The **measurement interval** defines, when a sensor does measurements. The default measurement interval is 5 minutes.

The **logging interval** defines when the measured data is logged (meaning: measured data is combined into one block and the minimum, maximum, average,... values of each sensor within this logging interval are calculated). The default logging interval is 60 minutes.

Before each transfer, an additional logging event is triggered.

Each sensor chain (i.e. each input on the iMETOS 3.3 board) may have distinct measurement and logging intervals.

7.3.4 FIXED TRANSFER INTERVAL AND TRANSFER SCHEDULE

The times when an iMETOS 3.3 attempts to communicate with the webserver and transfer the logged data can be defined in three ways:

1. A user-defined data transfer schedule: the user can define transfer times at full hours on a weekly basis,
2. A user-defined fixed transfer interval,
3. A user-defined forced transfer interval, which is the same as the fixed transfer interval but limited to a certain timespan.

Default is a fixed transfer interval of 60 minutes. Web-server communication and data transfer are also started due to the following reasons:

1. If rain monitoring is enabled, the iMETOS 3.3 sends data to the server every specified interval during precipitation events,

2. If water level monitoring is enabled, the iMETOS 3.3 sends data to the server every specified interval when the water level is higher than the threshold,
3. If the Connect button on the board is pressed.

7.3.5 EMERGENCY SMS

The user can define one phone number, to which the iMETOS 3.3 sends out an emergency SMS if the battery voltage falls below a certain threshold.

7.3.6 SMS WARNING SYSTEM

The user can define an upper and lower threshold SMS alarm values for each sensor. If a measured value exceeds (or goes below) the establish threshold, the iMETOS 3.3 will send the SMS with a warning text (name of sensor, actual value, threshold value) to up to 10 different mobile phone numbers.

Alarm thresholds are checked every 5 minutes within each measurement. When the iMETOS receives the sent acknowledgment from the mobile network the iMETOS 3.3 will disable SMS sending for 4 hours.

But if a measured value drops below the threshold in 3 consequent measurement cycles, the iMETOS will again enable the sending of SMS and send the corresponding alarm.

Example:
Temperature sensor threshold for SMS warning is set to 30°C

Measurement 1: 9:00 value = 28°C

Measurement 2: 9:05 value = 30°C -> a warning SMS is send

Measurement 3: 9:10 value = 31°C -> within a 4hour block interval -> warning SMS is not send

Measurement 4: 9:15 value = 28°C

Measurement 5: 9:20 value = 29.5°C

Measurement 6: 9.25 value = 29°C -> the blocking interval is cleared

Measurement 7: 9:30 value = 31°C -> warning SMS is send and block interval is started again

After each SMS is sent the iMETOS 3.3 will maintain the modem “on” and establish a communication with FieldClimate to upload the complete set of stored data since the previous communication and to receive new settings (if there are any) from the user.

8. SETTING COMMUNICATION PARAMETERS AND RESETTING iMETOS VIA SMS

A user-defined APN can be set via SMS when the required information is not yet in the APN table of the iMETOS. Also a station reset via SMS is possible.

Notes:

- You need the phone number associated to the SIM card in the iMETOS 3.3
- Alternatively, to send the SMS to the SIM card at the iMETOS 3.3 you can use a SIM card which already has the configuration SMS locally stored.
- After sending the SMS described below in this section press the connect button in the iMETOS so it checks for received SMS!

The following commands can be send via SMS to the iMETOS 3.3:

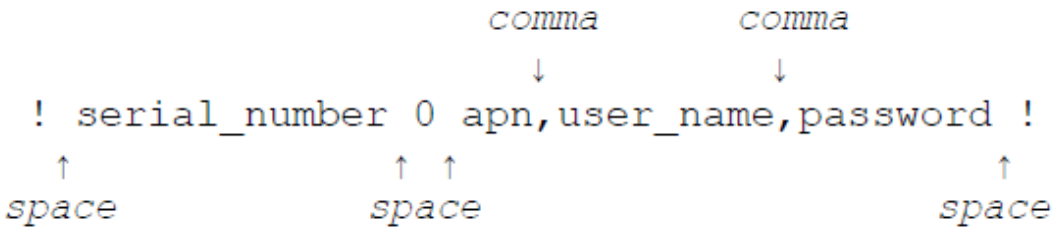
1. Set user-defined APN:

Code:! serial_number 0 apn,user_name,password !

serial_number	is the serial number of the station,
apn	is the APN server address,
user_name	is the user name of APN server,
password	is the password of APN server.

Example: ! 00200003 0 a1.net,gprs,a1!

Note: there is no space between the APN parameters but there is one space between exclamation mark, serial number, SMS parameter, APN string and exclamation mark.



Picture 36: SMS APN

When sending this command, the MCC and MNC numbers are taken from the SIM card. Therefore an APN set this way only works for SIM cards with the same MCC and MNC as the in SIM receiving this command (usually this is true for SIM cards of the same provider).

An APN send via SMS is stored in the internal APN XML file, and if correct, is set as default.

If the APN does not work, the system will try to find another APN access from the APN table and the user-de-

fined APN will not be used anymore with the SIM. In order to force the system to retry using a user-defined APN, change the SIM card (as this forces the system to again find a correct APN in the whole APN XML file) or send a new SMS.

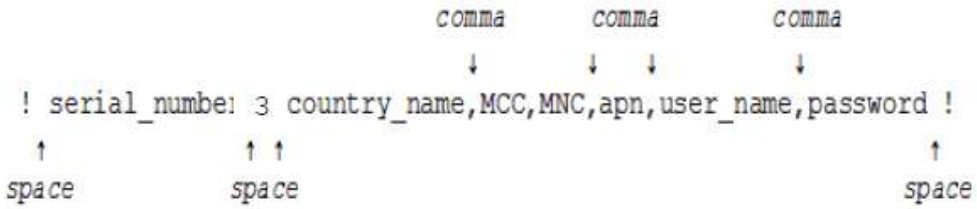
To reset the user-defined APN send an SMS without parameters: ! serial_number 0 ,, !

2. Set user-defined APN full definition:
Code: ! serial_number 3 country_name,MCC,MNC,apn,user_name,password !

serial_number	is the serial number of the station
country_name	is the country of the provider
MCC	is the MCC of the provider
MNC	is the MNC of the provider
apn	is the APN server
user_name	is the user name of APN server
password	is the password of APN server

Examples: 00202233 3 austria,232,1,a1.net,gprs,a1 !
argonaut 3 spain, 214,07,movistar.es,movistar,movistar !

Note: there is no space between the APN parameters but that there is one space between exclamation mark, serial number, SMS parameter, APN string and exclamation mark.



Picture 37: SMS APN 2

This command is equivalent to the command Set user-defined APN, except that the MCC and MNC are set manually.

3. Reset station:
Code: ! serial_number 2 UID_station !

serial_number	is the serial number of the station
UID_station	is the Unique identification number of the station

You can get the UID_number by connecting the iMETOS to the PC via USB cable and asking for a quick report (see pages abour USB communication).

This command does a factory reset (exception: the APN table is kept).

9. USB COMMUNICATION (PI FIRMWARE UPLOADER)

Direct communication with the iMETOS 3.3 is possible via a standard mini USB cable that is connected to the USB connector. The standard interface for communication is the “iMETOS Firmware Uploader”.

Requirements:

- NET 3.5 or higher
- EFM32-cdc USB drivers have to be installed
- PI Firmware Uploader has to be installed

The iMETOS Firmware Uploader and the appropriate drivers can be downloaded at: /redmine/projects/pi-firmware-uploader/files

Alternatively contact our support team at support@metos.at.

9.1 USB COMMUNICATIONS MODES

Depending on the jumper configuration on the iMETOS 3.3 board one of the following USB communication modes is active:

- **Terminal mode (Jumper 1 set – G in the picture below):**

In terminal mode active communication with the iMETOS 3.3 is possible.

- **Modem direct communication mode (Jumper 2 set – F in the Picture):**

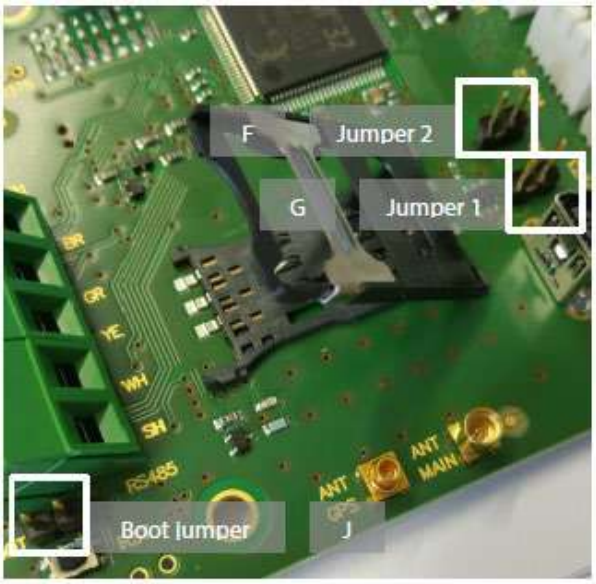
Direct active communication with the modem is possible.

- **Boot mode (Boot jumper set – J in the Picture):**

In boot mode new firmware versions can be uploaded manually.

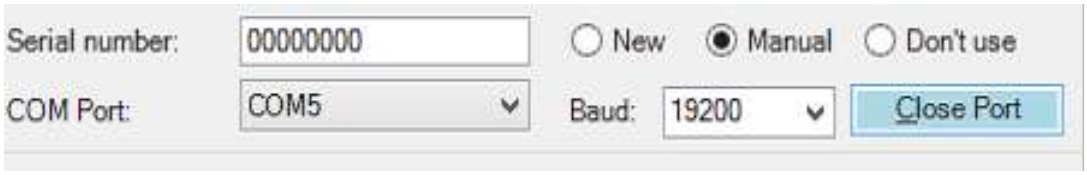
- **Spy mode (no jumper set but USB cable is connected):**

In spy mode the iMETOS 3.3 carries out the normal processes like measuring and communicating with the web server. Real-time information on the processes is printed to the screen and can be used for monitoring, testing and error tracing.



Picture 38: Jumpers

Switching between normal mode, terminal mode and modem direct communication mode can be done simply by changing the jumper position. Boot mode is only started or exited upon resetting the board. To do this disconnect the power supply or press the Reset button. Before resetting the station always close the serial port (picture 39).



Picture 39: Close port

The basic communication procedure for normal, terminal and modem direct communication mode is:

1. Place the appropriate jumper and plug in the USB.

2. If the battery is unplugged: Plug in the battery.

3. If station is in boot mode: Press the Reset button on the iMETOS 3.3 board to exit boot mode. Check if the jumper is not set on boot pins.

4. In PI Firmware Uploader: Click “Open Port” button.

5. Communicate with station.

6. Optional: Switch between normal, terminal and modem direct communication mode by changing the jumper position.

7. Click button “Close Port” when you want to end the communication.

8. Unplug USB.

The most common application of the **boot mode** is to manually upload a new firmware version.

Possible reasons for the error message “COM port unavailable” or similar:

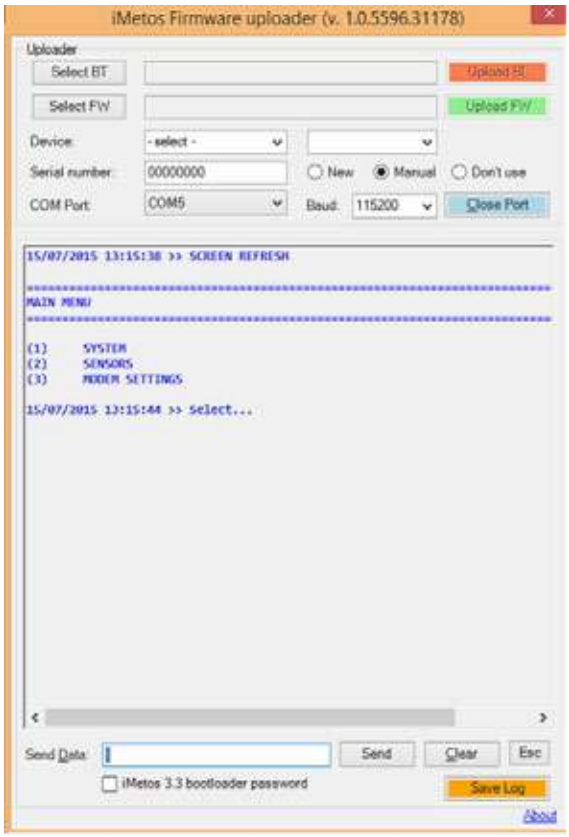
- The board is not connected to the power supply.
- The board was reset while the port was open.

Solution: Close Port and reset the board again by pressing the Reset button. If needed, try to unplug and plug back again the USB cable.

9.2 USING THE TERMINAL MODE

With the battery connected to the iMETOS 3.3 proceed as follows:

1. Plug USB cable to the iMETOS 3.3
2. Plug the USB cable to the PC
3. Place Jumper 1
4. Run the application PI_uploader
5. Click on “Open Port” button You will get the main menu. If not press space bar in your keyboard



Picture 40: Firmware uploader

Navigation through the menus is done by pressing keys, which are specified on the screen and given below in brackets. To navigate back to the parent menu press “ESC” on your keyboard or click over the “Esc” button. The terminal window can be cleared by clicking “Clear” or saved to a RTF file by clicking “Save Log”.

=======
MAIN MENU
=======
(1) SYSTEM
(2) SENSORS
(3) MODEM SETTINGS
6. Press 1 to go to the system menu and get:
=======
MAIN MENU > SYSTEM
=======
(1) QUICK VIEW
(2) FULL REPORT
(3) FACTORY RESET
The following options are available:
(1) in the menu SYSTEM:

(1) QUICK VIEW: gives some basic station, modem and server information.
(2) FULL REPORT: gives a detailed report on the station including the station settings and events.
(3) FACTORY RESET: discards the station settings, measured data and APN table.
7. press Esc to return to main menu
8. press 2 to get sensors menu

```
=======
MAIN MENU > SENSORS
=======
(T)     DO SENSOR TEST
(W)     WIRELESS TEST
(P)     PRINT LAST MEASURED DATA
(S)     PRINT LIST OF SUPPORTED SENSORS
(I)     STORE MEASURED DATA
(R)     PRINT ENCODED RECORDS
(D)     DISCARD SENSOR DATABASE
(ESC)   BACK
```

(2) in the menu SENSORS:
(T) TEST OF SENSORS: opens the sensor test menu (see below).
(M) DO MEASUREMENT ONLY: prompts the iMETOS 3.3 to start a measurement. A submenu is opened in which you can select a chain by pressing (1) – (7) or all sensors by pressing (A).
(P) PRINT LAST MEASURED DATA
(S) PRINT LIST OF SUPPORTED SENSORS
(I) STORE DATA IN MEM: prompts a logging event.
(R) PRINT ENCODED RECORDS: shows all stored data encoded as weather bin (data transfer format)
(D) SET DATABASE TO DEFAULT: discards the station settings and measured data (the APN table is kept).
9. press Esc to return to main menu
10. press 3 to get the modem settings menu

```
=======
MAIN MENU > MODEM SETTINGS
=======
(1)     GET MODEM INFO
(2)     UNLOCK SIM CARD (PIN CODE)
(3)     SIGNAL QUALITY GRAPH
(4)     APN OF CUSTOMER
(5)     SERVER REDIRECTION
```

(3) in the menu MODEM SETTINGS:
(1) GET MODEM INFO: shows IMEI, SIM card number, type of modem...

```
=======
MAIN MENU > MODEM SETTINGS > GET MODEM INFO
=======
Modem Brand: Sierra Wireless
Modem Type: SL6087 Product
Modem FwVersion: R7.46
Modem IMEI: 354293068370835
Modem bearer type: GPRS
Modem Baudrate: 115200
```

SIM status: Inserted (SIM ID: 8943015614107200408)
SIM locking: UNBLOCKED
(2) UNLOCK SIM CARD: check whether the PIN number request is enable and also provides means to disable it.
(3) SIGNAL QUALITY GRAPH: gives a representation of the carrier signal quality
=======
MAIN MENU > MODEM SETTINGS > SIGNAL QUALITY GRAPH
=======
—
(Esc) <- exit from this menu item – Signal: >| | | | | | | | ...< (RSSI: 29 / BER: 0)
(4) APN OF CUSTOMER : it let you directly configure the Access Point Name for the specific provider
=======
MAIN MENU > MODEM SETTINGS > APN OF CUSTOMER
=======
CURRENT APN ACCESS DEFINED BY USER:
-There is not defined APN by user
CHOOSE THE ACTION:
– –
(I) INSERT NEW APN ACCESS
(D) DELETE DEFINED USER APN
(5) SERVER REDIRECTION: It allows you to change the ULR address of the server
=======
MAIN MENU > MODEM SETTINGS > SERVER REDIRECTION
=======
CURRENT SERVER SETTINGS:
Domain name: metos.at
URL address: /pikernel_dev/metos_upload_xml33.php
Port: 80
CHOOSE THE ACTION:
– –
(R) REDIRECT SERVER
(D) RESET SERVER REDIRECTION

Clue: If there is no menu visible, press Space on your keyboard and the actual menu will be shown. With ESC parent menu will be shown.

Note: Options in the Terminal Menu can be changed with new Firmware.

9.3 TESTING SENSORS

To test the sensors start terminal mode and navigate to the Test of sensors menu as described above. There you can select the chain to test by pressing (1) – (8) or you can test all sensors at once by pressing “A” on your keyboard. While the test measurement is in progress, the yellow LED is turned on. This may take several minutes. The output then printed on the screen has the format:

Sensor Name
Sensor Code
CH[chain nr.]/[channel nr.]
Measured Value

Picture 41: Sensors table

You can repeat the measurement by pressing “r” or quit the test by pressing “q”.

9.4 UPLOADING FIRMWARE

Eventually it can be necessary to manually upload firmware. To do this follow the given steps:

1. Plug the USB and set the Boot jumper. If not done yet, insert the SIM card and connect the antenna.
2. If the battery is unplugged: Plug battery.
3. Check whether the station is in boot mode and the Pessl bootloader is installed: Yellow LED in the lower row is on.
4. If the station is not in boot mode: Press Reset button on the board.
5. In Firmware Up-loader:

- Click “Select FW” and select the correct firmware binary file.
- Check that Device “iMETOS 3.3” is selected.
- Select the correct COM Port.
- Click “Upload firmware”.
- After successful upload, the board automatically restarts, starts communication with the web-server and enters the boot menu. The boot menu is a simple version of the terminal menu, offering only limited options.
- To leave the boot menu/boot mode click “Close Port”, remove the Boot jumper, remove the USB cable and press reset on the board.

9.5 CHANGING THE SERIAL NUMBER

In order to change the serial number of a station, an *.ini file containing the new serial number is needed. *.ini files are issued by mail upon request (support@metos.at).

Picture 42: Icon

If you received your *.ini file, copy it to the path where the firmware uploader application is installed and start the firmware uploader. The new serial number is recognized automatically. Follow the instructions to upload firmware given above. After the upload, the *.ini file is deleted automatically!

Important note:
Complete monitoring of the communication process should be done after every installation by connecting the PC to the iMETOS. Installer never should leave the site without performing sensor test and communication process log.

10. APENDIX I.

10.1 SENSOR CODES

Up to the date of this edition, a total of 182 codes for different types of connectible sensors has been defined for the iMETOS 3.3. Continuous development further increases it.

Code	Name	Unit	FullName	Code	Name	Unit	FullName
0	AIRTM	C	Air temperature	25345	@WTMT	L	Water meter
1	RELHM	%	Relative humidity	25346	@WMBT	mV	Water met battery
2	SOLAR	W/mm	Solar radiation	25602	@CHRG	0/1	Aqua battery charging
3	BRIGH	Min	Brightness	25603	@AQBT	mV	Aqua battery
4	LEAFW	Min	Leaf Wetness	25857	@SMST	%	Aqua Soil Moisture
5	WNDSP	m/s	Wind speed	26370	@MPS1	kPa	MPS-1
6	PRECP	mm	Precipitation	26626	@AQCH	0/1	Aqua battery charging
7	BATTR	mV	Battery	26627	@AQBT	mV	Aqua battery
16	SOILT	C	Soil temperature	26881	@AQSM	%	Aqua Soil Moisture
21	DEWPT	C	Dew Point	28673	@Nois	sec	Noise
25	VPD	kPa	Vapor press deficit	28929	@IRMV	-	IR movement
30	SOLPN	mV	Solar Panel	28931	@IREM	-	During entir meas. time
123	WMARK	CBar	Water mark	28932	@IRDM	-	During time of movement
143	WNDDR	Deg	Wind direction	28933	@IRMM	-	MAX peak value of movement
300	PREC2	mm	Precipitation2	28934	@IRTM	sec	Movement seconds
500	LEAFT	C	Leaf temperature	29185	@TENS	mBar	Tensiometer Dgt
501	WETBT	C	Wetbulb temperature	29441	@PRSW	-	Pressure switch
502	DRYBT	C	Drybulb temperature	29698	@ASAD	-	Aquaspy Address
503	WTRTM	C	Water temperature	29699	@ASID	-	Aquaspy Serial Number

506	AIRTM	C	HC Air temperature	30210	@PYRU	w/m2	Pyrradiometer UP
507	RELHM	%	HC Relative humidity	30211	@PYRL	w/m2	Pyrradiometer LOW
508	HC_SN	-	HC Serial Number	30212	@PYRT	C	Pyrradiometer Temp
600	SOLAR	W/mm	Solar radiation	30737	@PERM	-	5TE EI permittivity
Code	Name	Unit	FullName	Code	Name	Unit	FullName
601	LUXMT	Lx	Lux meter	30738	@COND	mS/m	5TE EL conductivity
602	QUANT	W/mm	Quantum	30739	@WVCT	%	5TE Water content
657	WNDDF	m/s	Wind diff	30740	@SOIT	C	5TE Soil temperature
658	@WTRD	mm	Water depth	30741	@BATT	mV	5TE Battery voltage
720	ET0	mm	Evaptranspiration	32002	@UVI	UVI	Ultraviolet Index
16385	@AIRT	C	Air temperature	32003	@UVPW	w/m2	Ultraviolet Power
16386	@ERR	-	Error code	32513	@WTDP	mm	Water depth
16387	@SOIM	-	Soil media	32769	@PH	-	PH
16388	@POSI	-	Input number	32770	@COND	ms/m	Conductivity
16391	@WNDS	m/s	Wind speed	32771	@PHBT	mV	PHC battery
16392	@WNDD	Deg	Wind direction	33025	@Diam	mm	Diameter
16641	@TENS	mBar	Tensiometer	33296	@S1	-	Yara S1
16895	@AIRP	mBar	Air pressure	33297	@R1	-	Yara R1
16897	@WETB	C	Wetbulb temperature	33298	@R2	-	Yara R2
17153	@SOIT	C	Soil temperature	33299	@HTMP	C	Yara Head Temp
17409	@CHD	@Chain node		33300	@PLT1	C	Yara PLD1 T1
17665	@SOIT	C	Soil temperature	33301	@PLT2	C	Yara PLD2 T2
17921	@WMRK	CBar	Water mark	33302	@R1D	-	Yara R1D
18160	@WMRS	Ohm	Water mark res	33303	@R1S	-	Yara R1S
18177	@DRYB	C	Drybulb temperature	33304	@R2D	-	Yara R2D
18433	@AIRP	mBar	Air pressure	33305	@R2S	-	Yara R2S
18449	@AIRP	mBar	Air pressure	33306	@D1	-	Yara D1

18689	@WTRP	mBar	Water pressure	33307	@L1	-	Yara L1
18945	@CHD	-	Soil Chain node	33308	@D2	-	Yara D2
19201	@SMST	%	Soil Moisture	33309	@L2	-	Yara L2
19457	@WSS	kg	Weight scale sensor	33312	@YSER	-	Yara serial
19713	@CHD	-	EAG Chain node	33313	@YFWV	-	Yara FW version
19953	@ERRM	-	EAG interface soil moisture	33314	@YGAI	-	Yara gain
19954	@ERRS	-	EAG interface soil salinity	33538	@CRDE	-	CC Red-edge
19957	@BATT	mV	EAG battery	33539	@CNIR	-	CC NIR reflectance
19958	@CHRG	0/1	EAG battery charging	33540	@CRED	-	CC RED reflectance
19969	@SMST	%	EAG Soil moisture	33541	@CNDR	-	CC Normalized diff red-edge
20225	@SSST	VIC	EAG Soil salinity	33542	@CNDV	-	CC Normalized diff veg. index
20226	@RHST	%	EAG Relative Humidity	33793	@LPCB	MAC	Leading PCB
20227	@SMDD	%	EAG Soil moisture	33796	@LPM1	MAC1	Leading packet MAC 1
20228	@SSDD	VIC	EAG Soil salinity	33797	@LPM2	MAC2	Leading packet MAC 2
20482	@CNT		Chain counter	33798	@LPBT	mV	Leading packet battery
20483	@TAVR	C	Air temperature avg	33799	@LPSL	mV	Leading packet solar
20484	@TMIN	C	Air temperature min	34049	@ECO2	ppm	ppm of Carbon dioxide (CO2)
20485	@TMAX	C	Air temperature max	34306	@SDTM	C	Snow depth temperature
20486	@AIRT	C	Air temperature Dgt	34562	@ECSM	%	EC-5 Soil moisture
21009	YTIME	sec	Wind speed time	34625	@MPS2	kPa	MPS-2
21010	+YWSM	m/s	Wind speed max	34626	@MPST	C	MPS-2 water temperature
21011	+YWSA	m/s	Wind speed aver	34674	@4S3T	C	GS3 Temperature

21012	YWDS	m/s	Wind speed	34689	@4S1M	%	GS1 Soil moisture
21013	YWDR	Deg	Wind direction	34705	@NDVA	-	SRS NDVI Alpha index
21249	@K&Z	W/m2	KZ Solar radiation	34706	@NDV6	W/m2nm	SRS NDVI downward radiance 630
21505	@EVAP	mm	Pan Water Depth	34707	@NDV8	W/m2nm	SRS NDVI downward radiance 800
21777	@AIRT	C	HC Air temperature	34721	@PRIA	-	SRS PRI Alpha index
21778	@RH	%	HC Relative humidity	34722	@PR53	W/m2nm	SRS PRI downward radiance 532
21779	@DEWP	C	Dew Point	34723	@PR57	W/m2nm	SRS PRI downward radiance 570
22273	@LWet	Min	Leaf Wetness	34835	@ACCS	-	AquaCheck Serial Number
22785	@FLUX	W/m2	Heat flux	35073	@RGPR	mm	RG Precipitation
23041	@snow	mm	Snow Depth	35074	@LPBT	mV	RG battery
23297	@NETR	W/m2	Net Radiometer	35329	@IRLT	C	Leaf temperature (IR)
23553	@EVAP	mm	Pan Water Depth	35586	@GDTA	-	Gps DTAF
23809	@AQUA	uMol/m2/s	Active Radiation	35587	@GTS	sec	Gps timestamp
24066	@EC5	%	Echo probe 5 cm	35588	@GSP	km/h	Gps speed
24067	@EC10	%	Echo probe 10 cm	35589	@GCO	Deg	Gps course
24068	@EC20	%	Echo probe 20 cm	35590	@GERR	-	Gps error
24069	@DLWS	Min	Leaf Wetness	35602	@GLAT	Deg	Gps Latitude
24070	@BATT	mV	Echo battery	35603	@GLON	Deg	Gps Longitude
24071	@VLWS	-	Leaf wetness	35604	@GALT	m	Gps Altitude
24321	@10HS	%	10HS soil moisture	36097	@SM10	-	SMT-100 Soil moisture (VWC)
24322	@BATT	mV	10HS battery	36098	@SM1A	-	Address
24577	@WTMT	L	Water meter	36100	@SM1V	%	SMT-100 VWC Value
24593	@WTMD	L	Water meter 0.1L	36101	@SM1P	-	SMT-100 Perm. P
25089	@WTDT	mm	WATER Depth	36102	@SM1T	C	SMT-100 Temperature

11. APENDIX II.

Up to this date there are a total of 182 codes of this edition that are defined for the iMETOS 3.3. These codes include 182 for different types of connectible sensors. Continuous developing from our side increases this list constantly.

11.1 LIST OF EVENTS

Code	Description
1	Hard fault of the system
2	Operation system error
10	Power on reset
11	Brown-out reset
12	External reset
13	Watchdog reset
14	System reset
15	Other reset
16	Factory reset -> station settings discarded, measured data discarded, APN list discarded
17	Set to default -> station settings discarded, measured data discarded, APN list kept
20	Date and time synchronized
21	Connect button pressed
22	USB was connected
23	Extremely low-level of battery detected => station switch to sleep
24	Low battery level detected => station communication stopped
30	Turning on of modem was fault
31	Soft reset of modem
32	Hard reset of modem
33	SIM card is not inserted
34	SIM card hard fault
35	SIM card code is locked
36	SIM card code has hard fault
37	SIM card IMSI has hard fault
38	APN not found in XML APN file
39	NET is not registered => no signal
40	NET is not registered => network is not available
41	NET registration - BTS info is not available
42	SMS transmit failure
43	SMS receive failure
44	WIP stack - initialisation failure
45	WIP stack - bearer setup failure
46	WIP stack - HTTP start service failure
47	WIP stack - HTTP data transfer failure
48	Update: -- STATION SETTINGS -- [SUCCESSFUL]
49	Update: -- STATION SETTINGS -- [FAILED]
50	Update: -- APN XML file -- [SUCCESSFUL]
51	Update: -- APN XML file -- [FAILED]
52	Update: -- FIRMWARE Update Over The Air -- [SUCCESSFUL]
53	Update: -- FIRMWARE Update Over The Air -- [FAILED]
60	Measurement failure - local storage overload
61	Sensor settings was updated
62	Unknown sensor detected => missing in sensor list
63	Sensor was disconnected
64	Sensor sent invalid data
65	- sensor general error (default) + CHAIN_CHANNEL INPUT
66	sensor special error + CHAIN_CHANNEL INPUT

67	Unknown event of the storage
68	read of chain failed (broken chain) + info = chain_input
69	chain is removed + info = chain_input
1000	Modem turning-on process fault
1001	Modem device configuration fault
1002	Modem soft reset fault
1003	Modem hard reset fault
1020	Modem - SIM card configuration fault
1021	Modem - SIM card is not inserted
1022	Modem - SIM card hard fault
1023	Modem - SIM card is locked
1024	Modem - SIM card - code hard fault
1025	Modem - SIM card - IMSI has hard fault
1040	Modem - APN settings not found in system
1041	Modem - Network - general fault during registration
1042	Modem - Network - any signal is not detected
1043	Modem - Network - network of carrier is not accessible
1044	Modem - Network - Information about BTS is not available
1045	Modem - Network - successful activation of CDMA modem
1046	Modem - Network - fault activation of CDMA modem
1060	Modem - SMS - transmit fault
1061	Modem - SMS - receive fault
1062	Modem - SMS - warning SMS was sent successfully
1063	Modem - SMS - received settings via SMS
1064	Modem - SMS - executed settings via SMS
1065	Modem - SMS - settings via SMS was fault
1080	Modem - Internet - internat stack initialization fault
1081	Modem - Internet - internet bearer setup fault
1082	Modem - Internet - PPP access set by system
1083	Modem - Internet - PPP access set by customer
1090	Modem - Internet - fault start of TCP service
1091	Modem - Internet - fault data transfer by TCP service
1092	Modem - Internet - fault start of HTTP service
1093	Modem - Internet - fault data transfer by HTTP service
1100	Update: -- STATION SETTINGS -- [SUCCESSFUL]
1101	Update: -- STATION SETTINGS -- [FAILED]
1102	Update: -- APN XML file -- [SUCCESSFUL]
1103	Update: -- APN XML file -- [FAILED]
1104	Update: -- FIRMWARE Update Over The Air -- [SUCCESSFUL]
1105	Update: -- FIRMWARE Update Over The Air -- [FAILED]
2000	Measurement - system force-close
2001	Measurement - sensor settings was updated
2002	Measurement - Sensor - detected unknown sensor
2003	Measurement - Sensor - sensor was unconnected
2004	Measurement - Sensor - sensor returns invalid data
2005	Measurement - Sensor - sensor has general error
2006	Measurement - Sensor - sensor has special error
2007	Measurement - Storage - unknown error of local storage
2008	Sensor Database Indexing Fault
2009	Sensor not stored with defined code (in pair with code 2010)

2010	Sensor not stored at channel (in pair with code 2009)
2011	Measurement - sensor storage overflow
2020	Measurement - Chain - fault reading of chain input
2021	Measurement - Chain - chain was removed
2030	connected new board with MAC address (added new sensors related to MAC)
2031	board with MAC address was unconnected (removed old sensors related to MAC)
2032	board with MAC address was removed from database (discarded old sensors related to MAC)
2035	sensor with serial number was connected (added new sensors related to SN)
2036	sensor with serial number was unconnected (removed old sensors related to SN)
2037	sensor with serial number was removed from database (discarded old sensors related to SN)
2040	Measurement - Wireless system - startup fault
2041	Measurement - Wireless system - waiting time for data is to long (out of synchronization)
2042	Measurement - Wireless system - RF system has different serial number
2043	Measurement - Wireless system - fault start of measurement process by RF system
2044	Measurement - Wireless system - data not available from RF system
2060	Measurement - Sensors - Extension board was removed
2061	Measurement - Sensors - sensor was detected at input A of extension board
2062	Measurement - Sensors - sensor was removed at input A of extension board
2063	Measurement - Sensors - sensor was changed at input A of extension board
2064	Measurement - Sensors - sensor was detected at input B of extension board
2065	Measurement - Sensors - sensor was removed at input B of extension board
2066	Measurement - Sensors - sensor was changed at input B of extension board
2100	Measurement - Sensors - duty sensor was unplugged
2101	Measurement - Sensors - plugged unknown duty sensor
2120	Hygroclip2 detected at Input HC1
2121	Hygroclip2 removed from input HC1
2122	Hygroclip2 at input HC1 has data parser error
2123	Hygroclip2 detected at Input HC2
2124	Hygroclip2 removed from input HC2
2125	Hygroclip2 at input HC2 has data parser error
2160	Measurement - Sensors - Build-in GPS - captured GPS position
2161	Measurement - Sensors - Build-in GPS - captured GPS position fault