



SoilNet

Wireless Sensor Network for Measuring Soil Moisture

Manual

ADDENDUM

ICOS Version of End-Device



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Subject to technical modifications.

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1 Introduction

This addon manual is an extension of our manual V3.12, focusing the ICOS Version of the SoilNet End-Device.

For basic instructions on SoilNet, please refer to the following manuals:

- Manual V3.12
- Installation Guide V3.1
- SoilNet CPA V3.14 for the Data acquiring software tool
- SoilNet BoxCon V1.17 for the installation and configuration software tool

These manuals can be found under [www.SoilNet.de / Downloads](http://www.SoilNet.de/Downloads)

1.1 The ICOS End-Device



This version of our SoilNet End-Device is developed for the special requirements of **ICOS** (Integrated Carbon Observation System, see <http://www.icos-infrastruktur.de>).

It supports mainly accompanying measurement of soil moisture, temperature, radiation, waterlevel and heat flux.

For specific informations about the use of sensors within the ICOS project, please refer to the publications of ICOS.

1.2 Connections

While the standard version of the SoilNet End-Device allows only to connect nine SDI-12 sensors, the ICOS version allows the connection of

- up to 8 SDI-12 compatible sensors
(e.g. Truebner SMT-100 soil moisture, Decagon CTD water level)
- two HukseFlux heat flux plates (HFP01SC) with integrated calibration heating (analog)
- two Licor 190 radiation sensors (analog)
- one or two auxiliary inputs (analog), one can be used to connect an external power supply alternatively.

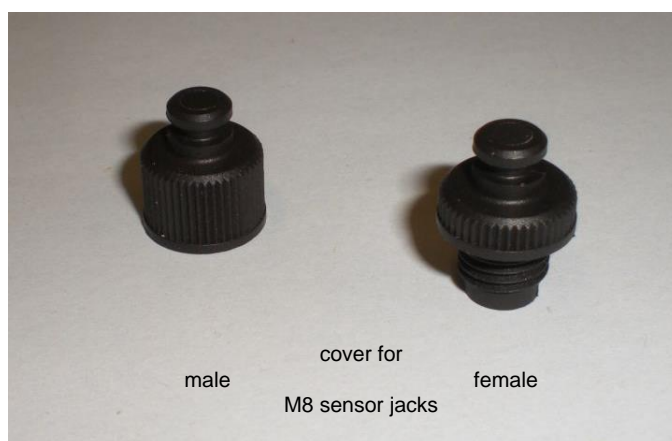


All connections of sensors are done by M8-type plugs.

→ See appendix for further information.

Attention!

It is strongly recommended to use covers for unused connectors. There are two types of covers, one for male jacks, another for female jacks.



Always keep jacks and plugs clean!

1.3 Battery

The device is constructed to include a 12V battery (lead gel or lead silicone), with a capacity of 15 Ah.

This will ensure stable voltage for the sensors and the heater of the flux plates at least for two months (surely depends on the amount of sensors and measuring frequency).

The battery type is

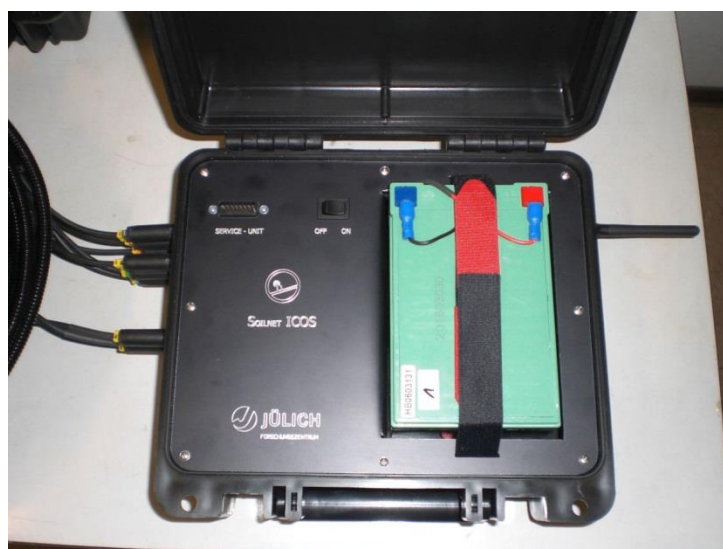
GREENSAVER SP15-12



It is available at

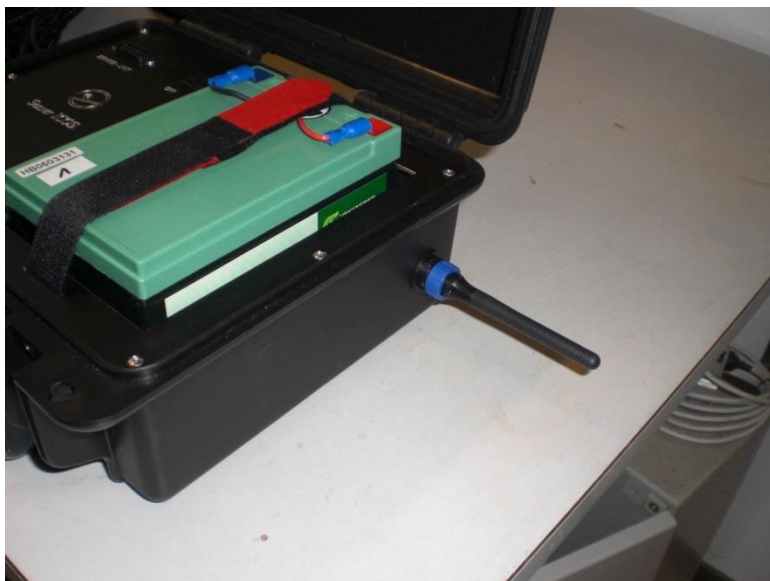
<http://www.pollin.de> , Nr.271067

Two Velcro fasteners make sure the battery is held down in the case.



1.4 Antenna

The antenna is not integrated in the case, it has to be mounted outside before launching the device.



Important!

**Do not remove or mount the antenna while the device is running!
This can damage the radio module.**

As an option, another antenna can be mounted, if the line signal of the radio transmission is too low:



Here you see the rod antenna connected to a standard End-Device.

The rod itself is heavy flexible, so the farmer can work the field without restriction.

1.5 Baseplate for soil moisture sensors 5 & 6

Usually, six soil moisture sensors (e.g. Truebner SMT-100) are used with the Icos device.

While the first four sensors mounted near the surface of the soil (2 cm, 5 cm, 10 cm and 20 cm), they have to be removed if the farmer is working the field.

Therefore, the two remaining sensors (one in 50 cm depth, one in 100 cm) can left behind in the soil for the whole measuring period.

We constructed a base plate from aluminium with a distribution box for two sensors.



Because the SMT sensors have the SDI-12 bus, they can be wired together in parallel, so only one cable has to be connected with the End-Device above the surface and has to be buried under the baseplate to be protected from the farmers tools.

The distribution box is fitted with a very strong magnet and filled with cast resin to make it fully waterproof.

The magnet ensures to find again the plate when it is buried under ground in a depth of 50cm. (with the help of a magnetic detection tool and an additional GPS system).

This baseplate is optional available.

2 Installation

2.1 Sensor installation

We installed six soil moisture sensors (calibrated Truebner SMT-100) and one Heat Flux sensor (HukseFlux HFP01SC).



The case is left on the ground while measuring period. The four sensors near the surface as well as the heat flux plate have to be removed while field working.

The two sensors in the depth of 50 cm and 100 cm are left in the soil. While field working, its cable to the End-Device is buried underneath the alu plate to be protected.



Soil moisture sensors number 1 to 4 are inserted

- near the surface (2-3 cm)
- in 5cm depth
- in 10cm depth and
- in 20cm depth

Also the HukseFlux thermal sensor is mounted near the surface (about 5 cm) of the soil.



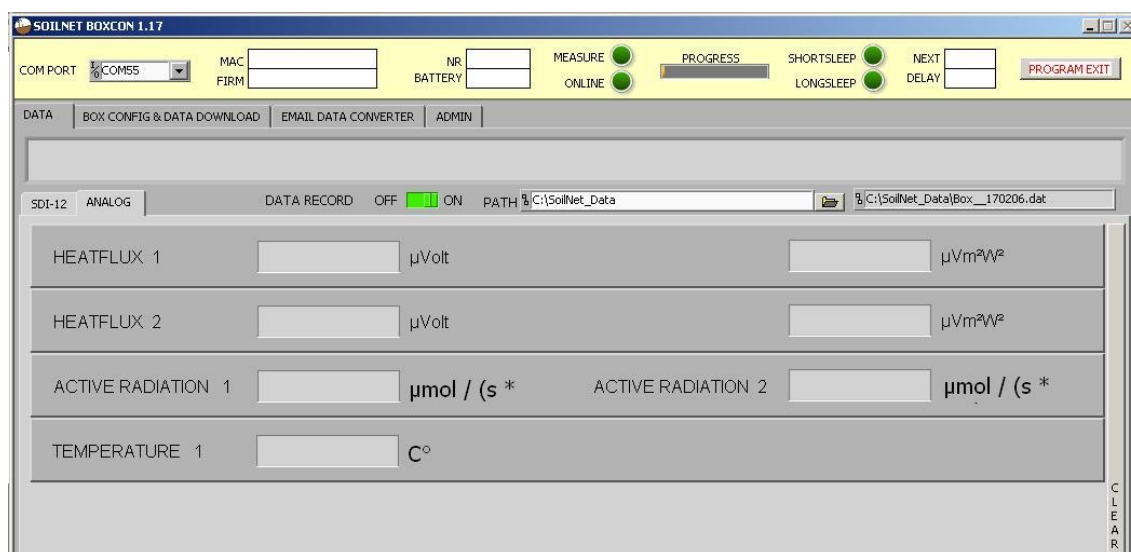
2.2 Configuration

To prepare the system before installation, make sure the SoilNet Coordinator and required Routers are running. Please refer to the manual **SoilNet CPA V3.14** also.

While installing the sensors it is required to have a laptop connected to the End-Device to verify the values of the sensors immediately.

Please use the **Service Unit** and the **“BoxCon”** Software as described in the **SoilNet Installation Guide V3.1**.

The actual version of the **“BoxCon”** software as well as the data acquiring software **“SoilNet CPA”** contain special tabs for the ICOS values.



N	DATE	TIME	BAT	M1	T1	M2	T2	M3	T3	M4	T4	M5	T5	M6	T6	µVolt	E sen	µVolt	E sen	Radi	Radi	T_109	depth	T	EC	Count	Delay	LQI	Router
1	06.02.2017	15:12:00	1179	0.00	17.99	0.00	18.12	0.00	18.18	0.00	18.05	0.00	18.05	0.00	18.12	-64.9754	68.9136	9820.2942	69.6654	894.0408	886.7684	18.12			4424	0	238	329	
2	06.02.2017	15:12:00	12174	0.00	18.77	0.00	18.85	0.00	18.91	0.00	18.84	0.00	18.93	0.00	18.79	111.1464	68.1848	9029.5921	37.4468	883.3465	841.6183	17.51			17364	0	174	329	
3	06.02.2017	15:12:00	12214	0.00	18.95	0.00	18.82	0.00	18.80	0.00	18.92	0.00	18.80	0.00	18.89	139.1775	63.9589	9622.7527	05.0399	908.2992	889.1446	18.75			17201	0	186	330	
4	06.02.2017	15:12:00	12104	0.00	19.14	0.00	19.00	0.00	18.99	0.00	19.03	0.00	18.98	0.00	19.09	87.1305	64.4800	9148.2873	54.6059	851.2613	855.8770	18.59			15125	0	204	329	
5	06.02.2017	15:12:00	12232	0.00	18.60	0.00	18.56	0.00	18.51	0.00	18.55	0.00	18.48	0.00	18.58	223.2175	30.9129	9361.8597	0.0000	906.0987	1166.1922	18.12			4448	0	150	330	

When the SoilNet System is delivered to the customer, all configuration data of the End-Devices should be set already.

These are the parameters of the device itself (box number, MAC address, date and time settings etc.), also the MAC addresses of all End-Devices should be set in the CPA software.

2.2.1 Additional SoilNet BoxCon Settings

When connecting a heat flux plate to the device, some parameters have to be set. These are

- The resistance of the plate (Rself) and
- The sensitivity of the plate (E sen.),

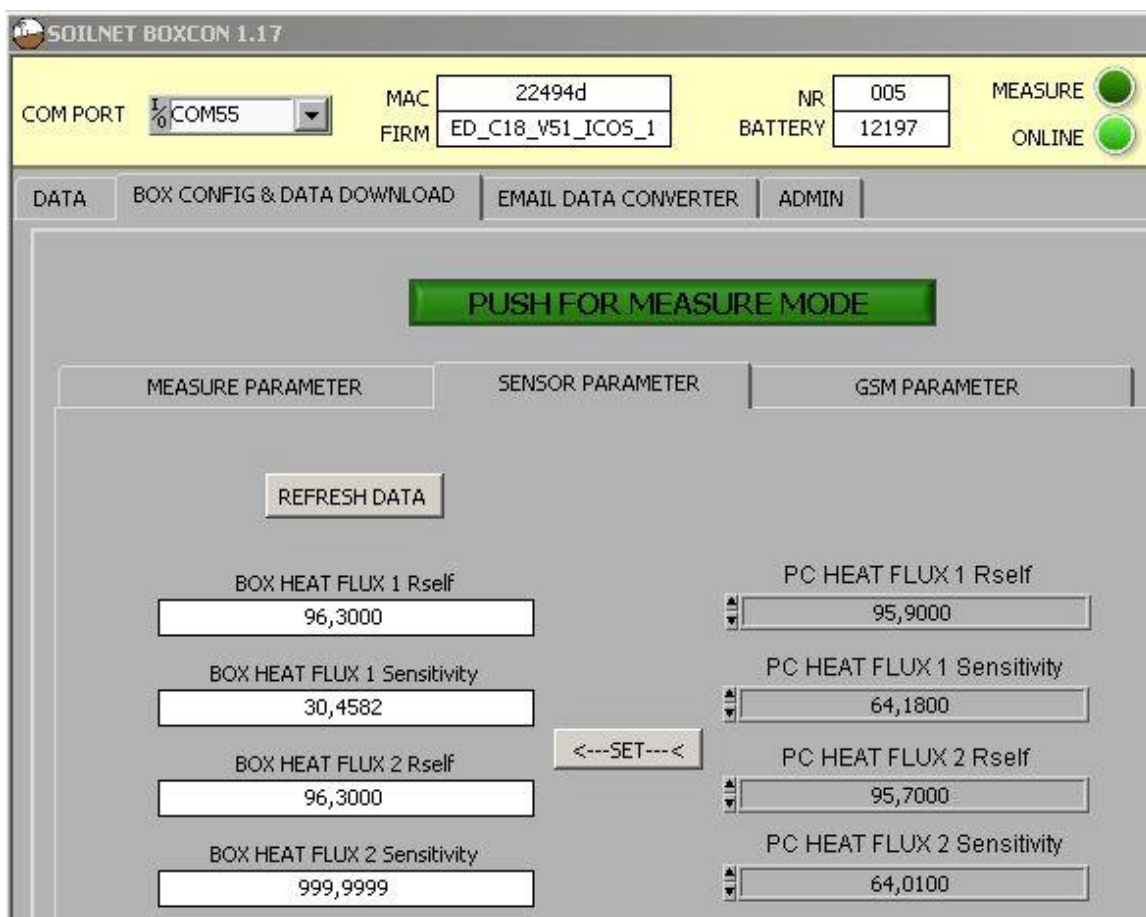
which are documented with the HukseFlux sensors when purchased.

To configure the End-Device, please connect the **Service Unit** to it and to a Laptop and run the **BoxCon** Software.

On the **“Box Config & Data Download”** – tab, press the button **“Push to activate Config Mode”** and switch on the End-Device (or reset it, if it is already running).

The screen of the **BoxCon** should change and you see another three tabs. Please choose the tab **“Sensor Parameter”**.

On the right side, the parameters Rself and Sensitivity (E sen.) can be set. After doing so, please press the **“←set”** button to transfer the data to the device..



After setting the data press the button **“Push for Measure Mode”** to return to normal operation. The Device will start measuring.

Note:

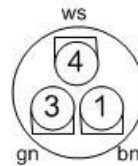
The HukseFlux sensor will be automatically calibrated every 12 hours. This is due to the specifications of ICOS.

3 Appendix

3.1 Sensor connections

3.1.1 Truebner SMT 100 Soil Moisture / Temperature sensor (SDI-12)

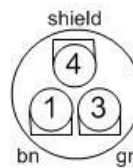
SENSOR		Signal	M8 - Plug
SDI-12 Decagon SMT-100			3pole male
Shield	White	Gnd	4
White	Brown	Vcc	1
Red	Green	Data	3



The drawings show the contact sides, view from the screws.

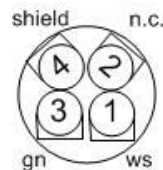
3.1.2 Hukseflux HFP01SC – HEATING –

SENSOR		Signal	M8 - Plug
Heat			3pole female
Shield		Gnd	4
Brown		+ Heater	1
Green		- Heater	3



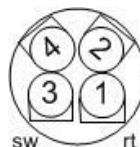
3.1.3 Hukseflux HFP01SC – DATA –

SENSOR		Signal	M8 - Plug
Flux			4 pole male
Shield		Gnd	4
White		+ signal	1
Green		- signal	3



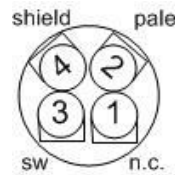
3.1.4 Licor 190 radiation sensor

SENSOR		Signal	M8 - Plug
Licor 190			4 pole male
Red		+ signal	1
Black		- signal	3



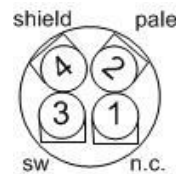
3.1.5 Probe 109 / temperature sensor

SENSOR	Signal	M8 - Plug
Probe 109		4 pole male
Black	Volt.exc.	3
Pale	Anal.Volt.	2
Shield	Shield	4



3.1.6 External Power Supply

SENSOR	Signal	M8 - Plug
Power Supply (alternate)		4 pole male
	+ 12 V	2
	Gnd	4



In addition to the internal battery, an external power supply can be used. Please keep in mind that both connections are simply wired in parallel.

3.2 Labeling the sensors

For clear assignment of the sensors to the End-Devices and the sensor numbers, they are fitted with little numbers at the plug.

The first number gives the device number, while the second one is the sensor number.

