IoP-MI8-N
Quick Start & connection
Configuration 001B:
2x SF-HP (N3D1_15mm), 2x Dendrometer,
1x FloraPulse, 1x Air T/RH, 1x soil T/VWC

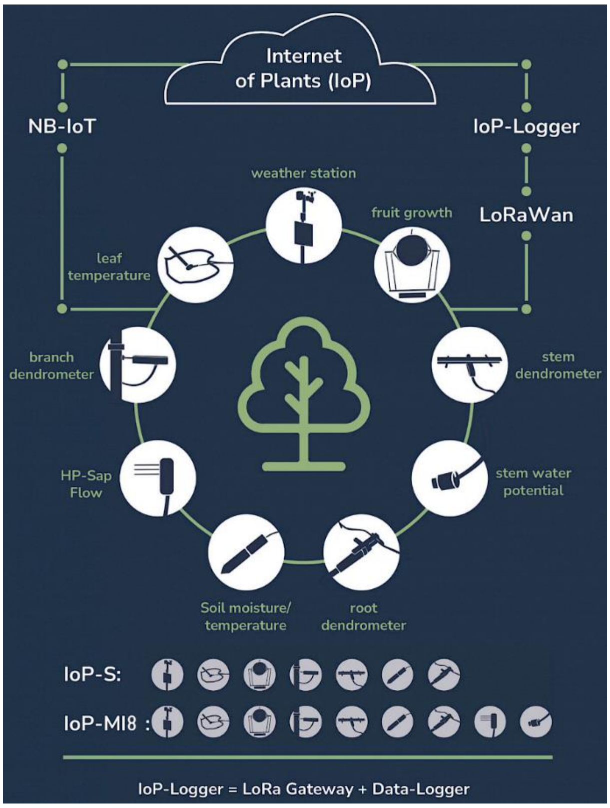
ECOMATIK GmbH
Muenchner Str. 23
D-85221 Dachau/Germany
Tel.: +49 8131 260 738
Fax: +49 8131 260 736
e-mail: info@ecomatik.de
website: www.ecomatik.de

Ecomatik MultiNode IoP-MI8 – Intelligent Plant Data Acquisition with Modern Wireless Technology

Thank you for choosing the Ecomatik MultiNode IoP-MI8!

The IoP-MI8 from Ecomatik is a powerful, flexible, energy-efficient, battery powered measurement solution for the continuous acquisition of plant physiological and environmental data. The system combines precise sensor technology with modern wireless communication for cable-free data transmission – ideal for research, agriculture, and environmental monitoring.

The IoP-MI8 is available in two versions:
- IoP-MI8-**L** – with LoRaWAN module (Low Power, Long Range) for independent LoRa infrastructures
- IoP-MI8-**N** – with NB-IoT module (Narrowband IoT) for direct communication via mobile networks



Both versions are based on the versatile Ecomatik Multi-Interface (MI), which offers the following connection options:
- 8x analog inputs (8x single-ended or 4x differential)
- 1x SDI-12 port
- 1x I²C interface

This variety allows for the simultaneous operation of multiple sensors with a single device, such as e.g.:
- 1× Heat-Pulse Sap Flow Sensor (e.g., N3D1)
- 2× Dendrometers (fruit, branch, stem or root)
- 1× Leaf & Air Temperature Sensor (LAT-B3)
- 1× Stem Water Potential Sensor (FloraPulse)
- 1× Soil Sensor (soil moisture & temperature)
- 1× Air Sensor (air humidity & temperature)

Each IoP-MI8 is fully pre-configured and tailored to the customer's specific requirements.

Getting started is done in just a few simple steps, as described in this quick-start guide for your customized configuration.

Please read this manual carefully before installing and commissioning the device. It also serves as a reference in case of questions during setup or operation.

Note: To operate the LoRa version IoP-MI8-**L**, a LoRa gateway and a LoRa stack server are additionally required to receive and process the transmitted data. The best option here is our IoP-Logger, a LoRa gateway with integrated stack server and logging function.

1. Quick start instructions

a. 📦 Delivery State

- IoP-MI8 is deactivated upon delivery. If MI8 is ordered without IoP-BAT, jumper inside of tranmission node OPEN. If ordered together with IoP-BAT, jumper inside of tranmission node CLOSED and ready, but large 12.8 LiFePO4 battery in IoP-BAT is not connected.

b. 🔗 Mounting

- Use the included tension strap to attach the device to a sturdy tree, stake, or mast.

c. 🌿 Sensor Setup

- Install all sensors on the plant or measurement site.

d. 🔌 Wiring

- Connect sensor cables to the Multi-Interface following the wiring diagram below.

e. ⚙️ Activation (! Only after all sensors are installed and wired properly !)

- If IoP-MI8 was ordered **without** IoP-BAT: Activate device (Jumper inside of tranmission node CLOSED, see photos below)
- If IoP-MI8 was ordered **with** IoP-BAT: connect 12.8 V LiFePO4 battery inside of the IoP-BAT box: red wire => battery(+) and black wire => battery (-)

f. ✅ Verification

- Look for the LED signal after activation.
- Check data reception on the server to confirm proper transmission.

⚠️ **IMPORTANT NOTE:**

!!! **For power-intensive sensors**—such as heat-pulse sap flow sensors or when connecting multiple SDI-12 sensors—an external battery box **(IoP-BATT) is required**.

!!! **Always install and wire all sensors before activation connecting the battery box.**

!!! **Never power heat-pulse sensors unless they are properly installed in a stem or embedded in a heat-absorbing material.** Firing a heat pulse into the air will immediately burn the heater element and irreparably damage the sensor.

!!! Please refer to the **IoP-BATT Manual** for detailed installation and safety instructions.

2. Scope of delivery

IoP-MI8 without IoP-BAT

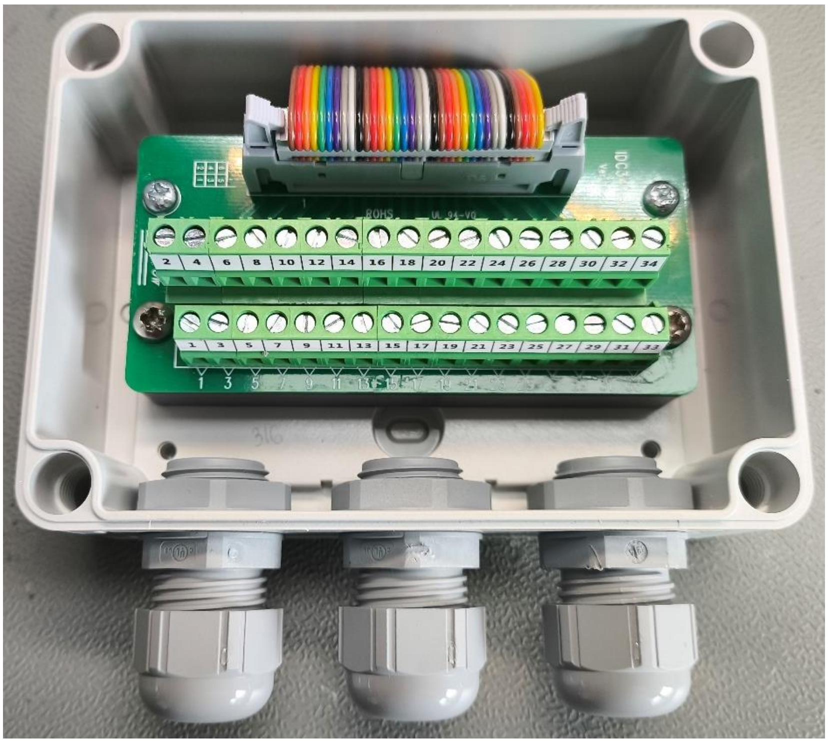
- 1x IoP-MI8 MutliNode
- 1x Antenna
- 1x tension strap
- 2x wood screws

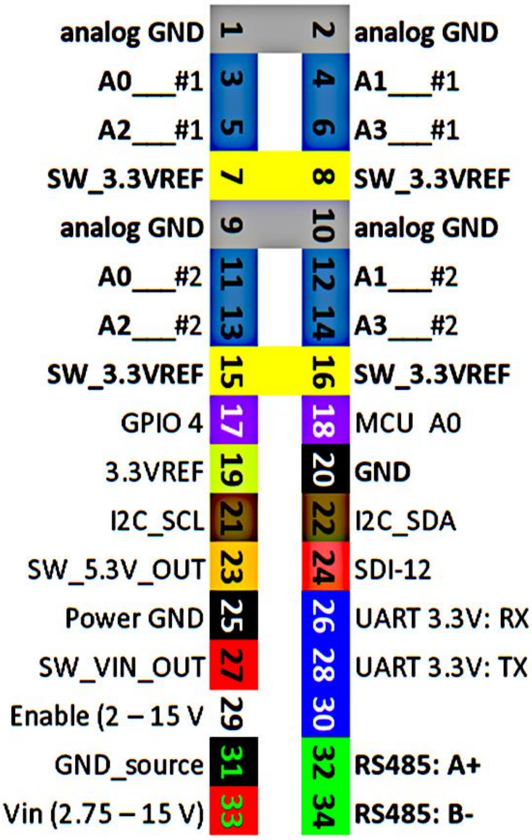
IoP-MI8 with IoP-BAT

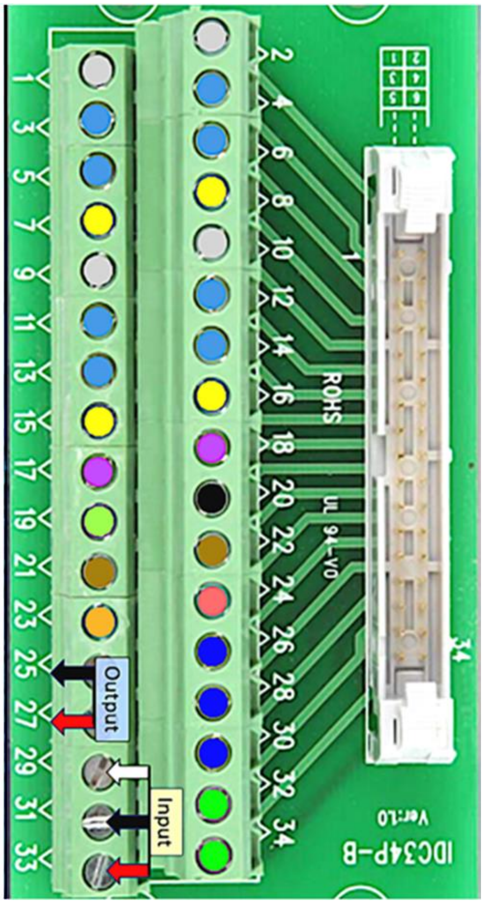
- 1x Box equipped with
  - 3.3V power module
  - 12.8 LiFePO4 30 Ah battery
  - Mounting parts for box

3. **<u>Channel Description, Wiring & Activation:</u>**

3.1. Multi-Interface (MI8) ports overview:







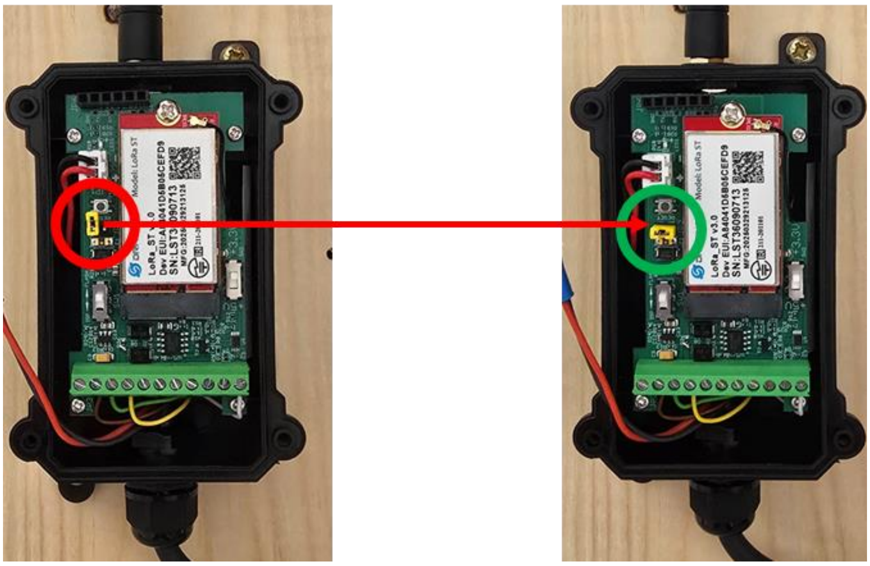
Sensor wiring, configuration 001B (Sensor option B):
2x SF-HP (N3D1_15mm), 2x Dendro, 1x FloraPulse, 1x Air T/RH, 1x soil T/VWC):

Option B					
Sensor-side			Multi-Interface MI8 side		
Sensor option 1	**wire colour**	**Function of sensor wire**	**Multi-Interface**	**Channel description**	**Comment**
#1 SF-HP N3D1_15mm (Ecomatik cable)	green	analog GND	1	analog GND	Heat-Pulse Command for SF-HP N3D1 has to be: 1MH282M! AT+COMMAND6=31 4d 48 32 38 32 4d 21,0 **For 2 seconds heating duration**
	grey	signal out (U1: upper, outer)	3	A0 #1	
	pink	signal out (L1: lower, outer)	4	A2 #1	
	yellow	excitation voltage input	7	SW_3.3Vref	
	white	heater power GND (-)	25	High Power Output GND	
	braun	heater power input (+)	26	Heater Power Output SW-Vin-out	
#1 SF-HP N3D1_15mm (Ecomatik cable)	green	analog GND	2	analog GND	
	grey	signal out (U1: upper, outer)	5	A1 #1	
	pink	signal out (L1: lower, outer)	6	A3 #1	
	yellow	excitation voltage input	8	SW_3.3Vref	
	white	heater power GND (-)	25	High Power Output GND	
	braun	heater power input (+)	26	Heater Power Output SW-Vin-out	
LAT-B3	grey	analog GND	9	analog GND	
	yellow	signal out (Tair)	11	A0 #2	
	brown	excitation voltage input	15	SW_3.3Vref	
	green	signal out (Tleaf)	12	A1 #2	
	white	analog GND	9	analog GND	
FloraPulse	red (! Correct !)	analog GND	10	analog GND	
	green	Vsense +	13	A2 #2 (Differential High, +)	
	yellow	Vsense -	14	A3 #2 (Differential Low, -)	
	black (! Correct !)	excitation voltage input	16	SW_3.3Vref	
I2C T/RH Air Sensor	black	GND	20	GND	
	yellow	SCL (I2C)	21	SCL (I2C)	
	green	SDA (I2C)	22	SDA (I2C)	
	red	3.3V sensor power supply +VCC	19	3.3V sensor power supply +VCC	
SDI-12: 1x SMT100	white	GND	25	High Power Output GND	Other configs for SDI-12 sensors are possible
	green	signal out (SDI-12)	24	SDI-12 input	
	brown	5V sensor power supply +VCC	23	SW_5V_out	

3.2. Activation of the device (not required if ordered together with IoP-BAT):

OPEN = Deactivated

CLOSED = Activated



4. IoP-MI8-N Payload structure:

The general payload of the IoP-MI8 consists of two main parts:

1. General System Section
   This section is generated by the Dragino transmitter module (designated as "-N" for cellular NB-IoT/LTEM or "-L" for LoRaWAN) and contains general system information such as device identification, firmware version, battery voltage, signal quality, and a timestamp. For LoRaWAN, the payload is encoded as compressed HEX data, in order to minimize payload size.
   For cellular NB-IoT/LTEM, the data is formatted as a JSON object, with properties representing both the transmission node's metadata and the sensor data collected by the Multi-Interface (MI).


```
{    "IMEI":"861562073844166",
     "IMSI":"901405118011228",
     "Model":"RS485-NB",
     "Payload":"01608dcb404511d0a110b05310c07a10f0ef10001711103e11206511308c1140b31150da11600112702
812804f12907612a09d12b0c412c0eb12d01213e03913f0601300881310af1320d61330fd13402414504b1490e714a00e1
5a07f17b0a61731c40f",
     "battery":3.309,
     "signal":19,
     "time":"2025/06/26 14:05:33"}
```


2. Sensor Data Section (from the MI)
   This part is provided by the connected MI and contains the actual measurement data. In order to make the MI8 data transmission is as efficient as possible, each measurement value is encoded as a 3-byte triplet. The number and order of these values are variable and depend on the specific configuration of the MI.

Payload from Dragino	In MI data each value is packed in 3 HEX-bytes									...
0	1	2	3	4	5	6	7	8	9	...
Payload Version	Value 1 from MI			Value 2 from MI			Value 3 from MI			Value n from MI

4.1. Payload Decoder for IoP-MI8-N with configuration 001B:

Byte #	MI Index	Description / Signal	Decoding Method
0	Dragino	Payload version	
1 – 3	0	Fault current (1234 = OK; 222 = short on 3.3VREF, 333 = short on SW_3.3VREF, 444 = short on SW_5V)	(1) & (2)
4 – 6	1	Vin [V]	(1) & (2)
7 – 9	9	A2_#2: analog DIFF A2-to-A3 in ratio [mV/V]	(1) & (2)
10 – 12	7	A0_#2: analog SE [ratio in % of SW_3.3Vref]	(1) & (2)
13 – 15	8	A1_#2: analog SE [ratio in % of SW_3.3Vref]	(1) & (2)
16 – 18	11	V_hrm_SFHP_N3D1_#1 [m/h]	(1) & (2)
19 – 21	12	V_hrm_SFHP_N3D1_#2 [m/h]	(1) & (2)
22 – 24	13	V_Tmax_SFHP_N3D1_#1 [m/h]	(1) & (2)
25 – 27	14	V_Tmax_SFHP_N3D1_#2 [m/h]	(1) & (2)
28 – 30	15	V_MHR_SFHP_N3D1_#1 [m/h]	(1) & (2)
31 – 33	16	V_MHR_SFHP_N3D1_#2 [m/h]	(1) & (2)
34 – 36	17	Tini_upper_SFHP_N3D1_#1 [°C]	(1) & (2)
37 – 39	18	Tini_upper_SFHP_N3D1_#2 [°C]	(1) & (2)
40 – 42	19	Tini_lower_SFHP_N3D1_#1 [°C]	(1) & (2)
43 – 45	20	Tini_lower_SFHP_N3D1_#2 [°C]	(1) & (2)
46 – 48	21	Thrm_upper_SFHP_N3D1_#1 [°C]	(1) & (2)
49 – 51	22	Thrm_upper_SFHP_N3D1_#2 [°C]	(1) & (2)
52 – 54	23	Thrm_lower_SFHP_N3D1_#1 [°C]	(1) & (2)
55 – 57	24	Thrm_lower_SFHP_N3D1_#2 [°C]	(1) & (2)
58 – 60	25	Tmax_upper_SFHP_N3D1_#1 [°C]	(1) & (2)
61 – 63	26	Tmax_upper_SFHP_N3D1_#2 [°C]	(1) & (2)
64 – 66	27	Tmax_lower_SFHP_N3D1_#1 [°C]	(1) & (2)
67 – 69	28	Tmax_lower_SFHP_N3D1_#2 [°C]	(1) & (2)
70 – 72	29	t_Tmax_upper_SFHP_N3D1_#1 [sec]	(1) & (2)
73 – 75	30	t_Tmax_upper_SFHP_N3D1_#2 [sec]	(1) & (2)
76 – 78	31	t_Tmax_lower_SFHP_N3D1_#1 [sec]	(1) & (2)
79 – 81	32	t_Tmax_lower_SFHP_N3D1_#2 [sec]	(1) & (2)
82 – 84	33	Applied_HP_Duration [sec]	(1) & (2)
85 – 87	37	SDI12_04 -> e.g. SMT100 Vol Water Content [%]	(1) & (2)
88 – 90	38	SDI12_05 -> e.g. SMT100 Temperature [°C]	(1) & (2)
91 – 93	54	I2C_01 -> e.g. SHT 31 Temp [°C]	(1) & (2)
94 – 96	55	I2C_02 -> e.g. SHT 31 RH [%]	(1) & (2)
97 – 99	59	SW_3v3_Vref [V]	(1) & (2)

Each Value of the MI is coded in a Byte Triplet which can be decoded into an unsigned integer value:

(1) Integer Value = Byte1 + (Byte2 × 2^8) + (Byte3 × 2^16)

JavaScript code snippet:

```
// Combine three bytes to form a 24-bit integer.
// Order: least significant byte first (bytes[index]), then next byte, then highest byte.
// This forms a raw integer value representing the sensor measurement.
const raw_integer = (bytes[index + 2] << 16) | (bytes[index + 1] << 8) | bytes[index];
```

The MI8 is pre-configured to accommodate the value ranges of the connected sensors.

The default range of -100 to +1577.7216 applies to most sensor values (except e.g. Teros 11 or Teros 21). To convert an integer value to a floating-point value, use the following formula:

(2) Decoded Floating-Point Value = (Integer Value / 10 000) – 100

JavaScript code snippet:

```
// Convert default range value (-100 to +1577.7216) from raw integer to floating point:
// Formula: (raw / 10000) - 100
// Apply a rounding to ensure numerical stability and fixed decimals.
const fp_value = Math.round((((raw / 10000) - 100) * 100000 + Number.EPSILON)) / 100000;
```

For large values, the MI8 is pre-configured to encode respective byte triplets differently for a range from -100,000 to +67,772.16 (e.g., in the case of Teros 11 or Teros 21). To convert these large integer values to floating-point values, use the following formula:

(3) Decoded Floating-Point Value = (Integer Value / 100) – 100 000

JavaScript code snippet:

```
// Convert large range value (-100000 to +67772.16) from raw integer to floating point:
// Formula: (raw / 10000) - 100
// Apply a rounding to ensure numerical stability and fixed decimals.
const fp_value = Math.round((((raw / 100) - 100000) * 100 + Number.EPSILON)) / 100;
```

Test Payload for decoder debugging:

01608dcb404511d0a110b05310c07a10f0ef10001711103e11206511308c1140b31150da11600112702812804f1 2907612a09d12b0c412c0eb12d01213e03913f0601300881310af1320d61330fd13402414504b1490e714a00e15 a07f17b0a61731c40f

The correctly decoded result of this test payload has to be:

Description / Signal	Decoded Value
Payload version	01
Fault current	1234.0000
Vin [V]	13.1840
A2_#2: analog DIFF A2-to-A3 in ratio [mV/V]	9.0000
A0_#2: analog SE in ratio Vin/Ref [%]	7.0000
A1_#2: analog SE in ratio Vin/Ref [%]	8.0000
V_hrm_SFHP_N3D1_#1 [m/h]	11.0000
V_hrm_SFHP_N3D1_#2 [m/h]	12.0000
V_Tmax_SFHP_N3D1_#1 [m/h]	13.0000
V_Tmax_SFHP_N3D1_#2 [m/h]	14.0000
V_MHR_SFHP_N3D1_#1 [m/h]	15.0000
V_MHR_SFHP_N3D1_#2 [m/h]	16.0000
Tini_upper_SFHP_N3D1_#1 [°C]	17.0000
Tini_upper_SFHP_N3D1_#2 [°C]	18.0000
Tini_lower_SFHP_N3D1_#1 [°C]	19.0000
Tini_lower_SFHP_N3D1_#2 [°C]	20.0000
Thrm_upper_SFHP_N3D1_#1 [°C]	21.0000
Thrm_upper_SFHP_N3D1_#2 [°C]	22.0000
Thrm_lower_SFHP_N3D1_#1 [°C]	23.0000
Thrm_lower_SFHP_N3D1_#2 [°C]	24.0000
Tmax_upper_SFHP_N3D1_#1 [°C]	25.0000
Tmax_upper_SFHP_N3D1_#2 [°C]	26.0000
Tmax_lower_SFHP_N3D1_#1 [°C]	27.0000
Tmax_lower_SFHP_N3D1_#2 [°C]	28.0000
t_Tmax_upper_SFHP_N3D1_#1 [sec]	29.0000
t_Tmax_upper_SFHP_N3D1_#2 [sec]	30.0000
t_Tmax_lower_SFHP_N3D1_#1 [sec]	31.0000
t_Tmax_lower_SFHP_N3D1_#2 [sec]	32.0000
Applied_HP_Duration [sec]	33.0000
SDI12_04 -> SMT100 Vol Water Content [%]	37.0000
SDI12_05 -> SMT100 Temperature [°C]	38.0000
I2C_01 -> SHT 31 Temp [°C]	54.0000
I2C_02 -> e.g. SHT 31 RH [%]	55.0000
SW_3v3_Vref [V]	3.3265