IoP-MI8-L
Quick Start & connection
Configuration 003:
1x SF-HP (N3D2), 1x Dendrometer,
1x LAT-B3, 4x SDI-12

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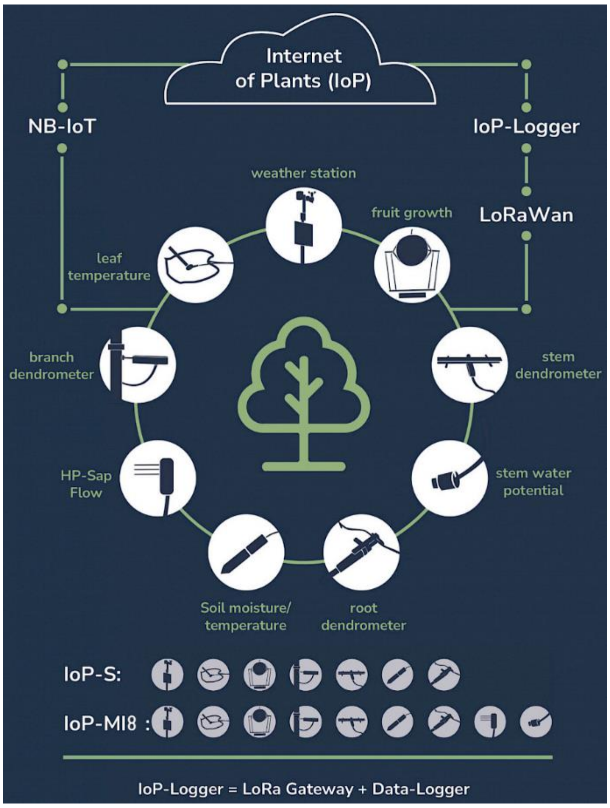
Ecomatik MultiNode IoP-MI8 – Intelligent Plant Data Acquisition with Modern Wireless Technology

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).

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 properly and wired !)

- 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 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

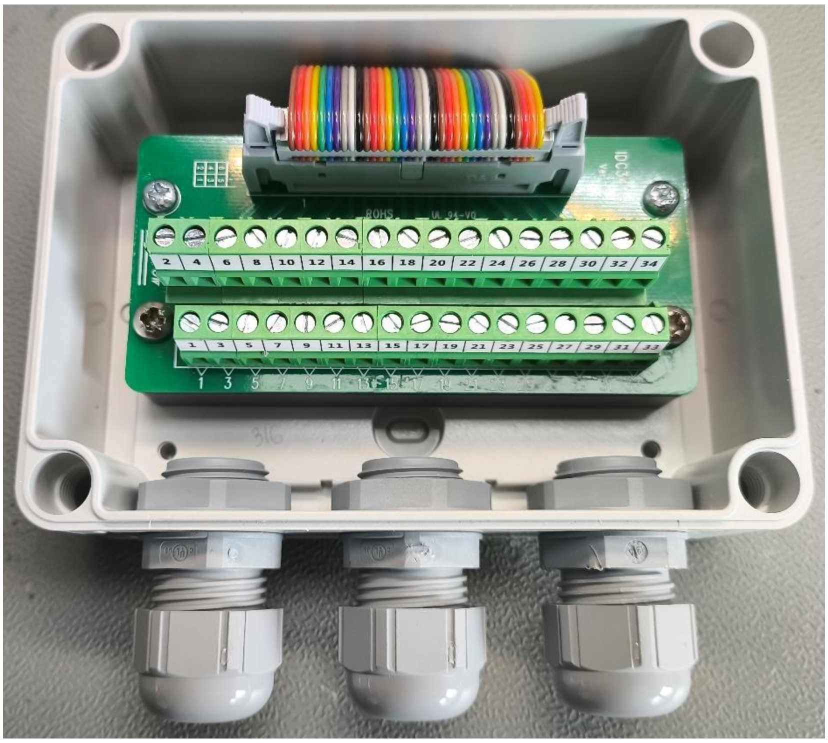
- 1x IoP-MI8 MutliNode
- 1x Antenna
- 1x tension strap
- 2x wood screws

IoP-MI8 with IoP-BAT

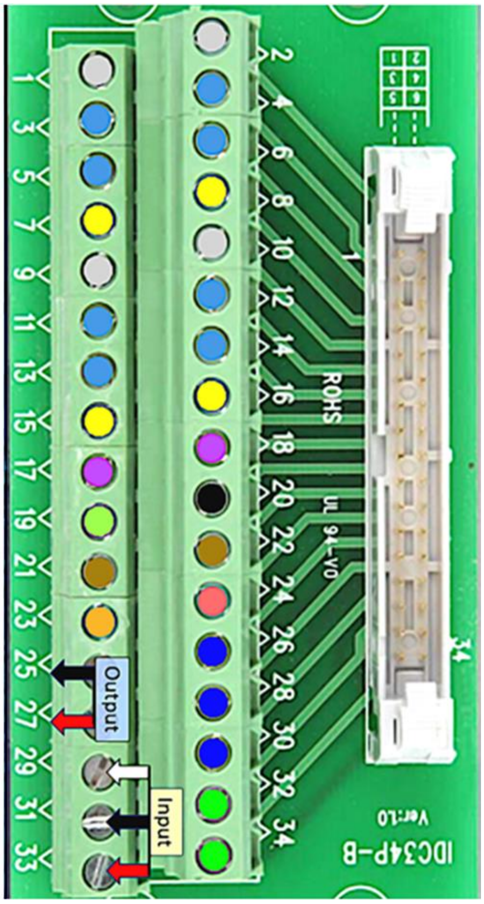
- 1x Box with
  - 3.3V power module
  - 12.8 LiFePO4 30 Ah battery
  - Mounting parts for box

3. Channel Description, Wiring & Activation:

3.1. Multi-Interface ports overview:



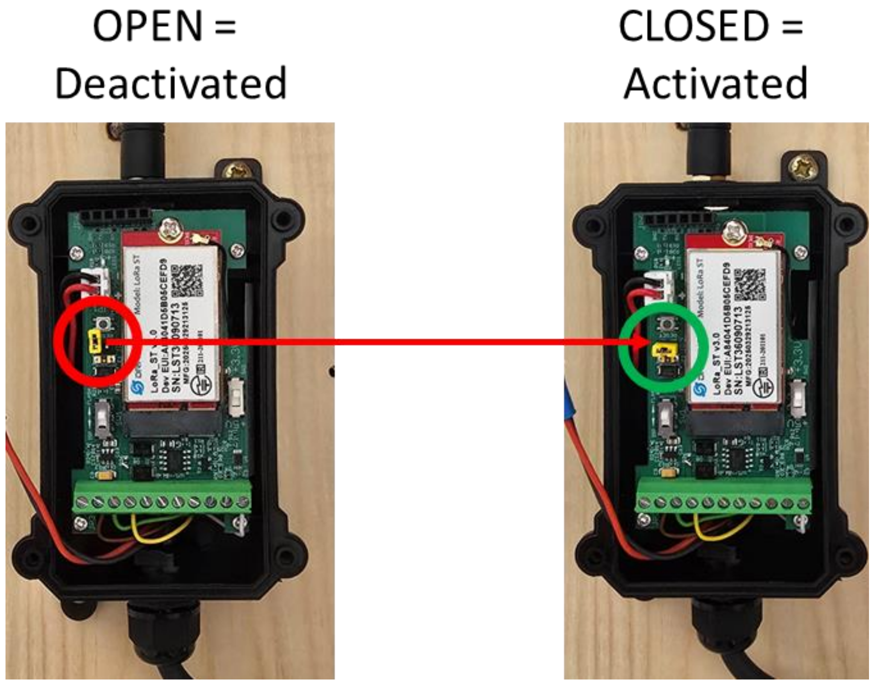
analog GND	1	2	analog GND
A0___#1	3	4	A1___#1
A2___#1	5	6	A3___#1
SW_3.3VREF	7	8	SW_3.3VREF
analog GND	9	10	analog GND
A0___#2	11	12	A1___#2
A2___#2	13	14	A3___#2
SW_3.3VREF	15	16	SW_3.3VREF
GPIO 4	17	18	MCU A0
3.3VREF	19	20	GND
I2C_SCL	21	22	I2C_SDA
SW_5.3V_OUT	23	24	SDI-12
Power GND	25	26	UART 3.3V: RX
SW_VIN_OUT	27	28	UART 3.3V: TX
Enable (2 – 15 V	29	30	
GND_source	31	32	RS485: A+
Vin (2.75 – 15 V)	33	34	RS485: B-



Sensor wiring (configuration 003, option 1 with 1x SF-HP (N3D2), 1x Dendrometer, 1x LAT-B3, 4x SDI-12 (sensor address '0': Teros 11 II '1': SMT100 II '2': Teros 21 II '3': EM02 Air_T/RH)

Default: Option 1					
Sensor-side			Multi-Interface MI8 side		
Sensor option 1 (default)	wire colour	Function of sensor wire	Multi-Interface (MI8) Channel Nr.	Channel description	Comment
SF-HP N3D2 (Ecomatik cable)	green	analog GND	1	analog GND	Heat-Pulse Command for SF-HP N3D2 has to be: 1MH682M! AT+COMMAND6=31 4d 48 36 38 32 4d 21,0 For 6 seconds heating duration
	grey	signal out (U1: upper, outer)	3	A0 #1	
	blue	signal out (U2: upper, inner)	4	A1 #1	
	pink	signal out (L1: lower, outer)	5	A2 #1	
	red	signal out (L2: lower, inner)	6	A3 #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	
Dendrometer	white	analog GND	9	analog GND	
	yellow	signal out	11	A0 #2	
	brown	excitation voltage input	15	SW_3.3Vref	
LAT-B3	grey	analog GND	10	analog GND	LAT-B3 always connect to channel pair: Tair odd channel N° Tleaf even channel N°
	yellow	signal out (Tair)	13	A2 #2	
	brown	excitation voltage input	16	SW_3.3Vref	
	green	signal out (Tleaf)	14	A3 #2	
	white	analog GND	10	analog GND	
SDI-12: 1x Teros 11	bare	GND	25	High Power Output GND	**Address of Teros 11 must be configured to 0**
	orange	signal out (SDI-12)	24	SDI-12 input	
	brown	5V sensor power supply +VCC	23	SW_5V_out	
SDI-12: 1x SMT100	white	GND	25	High Power Output GND	**Address of SMT100 must be configured to 1**
	green	signal out (SDI-12)	24	SDI-12 input	
	brown	5V sensor power supply +VCC	23	SW_5V_out	
SDI-12: 1x Teros 21	bare	GND	25	High Power Output GND	**Address of Teros 21 must be configured to 2**
	orange	signal out (SDI-12)	24	SDI-12 input	
	brown	5V sensor power supply +VCC	23	SW_5V_out	
SDI-12: 1x Air T/RH	white	GND	25	High Power Output GND	**Address of Air T/RH must be configured to 3**
	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):



4. IoP-MI8 Payload structure:

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

1. General System Section
   This part is generated by the Dragino transmitter module (e.g., NB-IoT or LoRaWAN) and includes general system information such as device identification, firmware version, battery voltage, signal quality, and timestamp.
2. Sensor Data Section (from the Multi-Interface)
   This part is provided by the connected Multi-Interface (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	10	11	...
Battery		Payload Version	Value 1 from MI			Value 2 from MI			Value 3 from MI			Value n from MI

Important Note for LoRa version:
In the pre-configured IoP-MI8-L, the payload length is at 51 bytes. In the EU868 region, this ensures unrestricted use of all available transmission data rates starting from DR0.

By default, an uplink interval of 15 minutes is configured (corresponding to the command AT+TDC=900000), which is recommendable for dendrometer measurements.

Please be aware of any applicable Fair Use Policy (e.g., in the case of TTN), which may still limit the air-time of LoRa end devices.

4.1. Payload Decoding for IoP-MI8-L with configuration 003:

Payload structure

Byte #	MI Index	Description / Signal	Decoding Method
0 – 1	Dragino	Supply voltage of Dragino transmission node (between 2.8 and 3.6 V if operated on small internal battery, stable at 3.0 V if operated via IoP-BAT)	BATmV = (bytes[0] << 8) | bytes[1]) & 0x7FFF
2 - 2	Dragino	Payload version	
3 – 5	0	Fault current (1234 = OK; 222 = short on 3.3VREF, 333 = short on SW_3.3VREF, 444 = short on SW_5V)	1 & 2
6 – 8	1	Vin MI8 [V]	1 & 2
9 – 11	7	A0_#2: analog SE [ratio in % of SW_3.3Vref]	1 & 2
12 – 14	9	A2_#2: analog SE [ratio in % of SW_3.3Vref]	1 & 2
15 – 17	10	A3_#2: analog SE [ratio in % of SW_3.3Vref]	1 & 2
18 – 20	35	SDI12: Teros 11 VWC [raw counts]	**1 & 3**
21 – 23	36	SDI12: Teros 11 Temperature [°C]	**1 & 3**
24 – 26	37	SDI12: SMT100 Volumetric Water Content [%]	1 & 2
27 – 29	35	SDI12: Teros 21 Matric Potential [kPa]	**1 & 3**
30 – 32	36	SDI12: Teros 21 Temperature [°C]	**1 & 3**
33 – 35	35	SDI12: AIR RH [%]	1 & 2
36 – 38	36	SDI12: AIR T [°C]	1 & 2
39 – 41	11	V_hrm_outer [m/h]	1 & 2
42 – 44	12	V_hrm_inner [m/h]	1 & 2
45 – 47	15	V_MHR_outer [m/h]	1 & 2
48 – 50	16	V_MHR_inner [m/h]	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 each byte triplet 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:

0c 00 01 60 8d cb 9a 08 10 3e 63 0f f2 67 0f 91 78 0f 2c 5a 9b 34 a1 98 40 42 0f 32 dc 82 98 a1 98 08 ce 15 cc 66 13 f0 ef 10 00 17 11 30 8c 11 40 b3 11

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

RS485-BL: Vsup [mV]	3.072
RS485-BL: PAYVER	
Fault current	1234.00000
Vin [V]	5.07780
A0_#2 [ratio Vin/Ref in%]	0.84460
A2_#2 [ratio Vin/Ref in%]	0.96500
A3_#2 [ratio Vin/Ref in%]	1.39050
SDI12_02: Teros11 Raw VWC	1811.64
SDI12_03: Teros11 Temp [°C]	27.40
SDI12_04: SMT100 VWC [%]	0.00000
SDI12_02: Teros 21 Potential [kPa]	-14239.50
SDI12_03: Teros 21 Temperature [°C]	28.40
SDI12_02: Air RH [%]	42.90000
SDI12_03: Air Temp [°C]	27.15000
V_hrm_outer [m/h]	11.00000
V_hrm_inner [m/h]	12.00000
V_MHR_outer [m/h]	15.00000
V_MHR_inner [m/h]	16.00000