Operating manual
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ELSYS.se

LoRaWAN Wireless sensor

Operating manual
ECO series

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Important safety information

Read this manual before attempting to install the device!

Failure to observe recommendations included in this manual may be dangerous or cause a violation of the law. The manufacturer, ElektronikSystem i Umeå AB will not be held responsible for any loss or damage resulting from not following the instructions of this operating manual.

- The device must not be dismantled or modified in any way.
- The device is only intended for indoor use. Do not expose it to moisture.
- The device is not intended to be used as a reference sensor, and ElektronikSystem i Umeå AB will not be held liable for any damage which may result from inaccurate readings.
- The device must never be subjected to shocks or impacts.
- To clean the device, wipe with a soft moistened cloth. Use another soft, dry cloth to wipe dry. Do not use any detergent or alcohol to clean the device.

Disposal note in accordance with Waste from Electrical and Electronic Equipment (WEEE) Directive 2012/19/EU

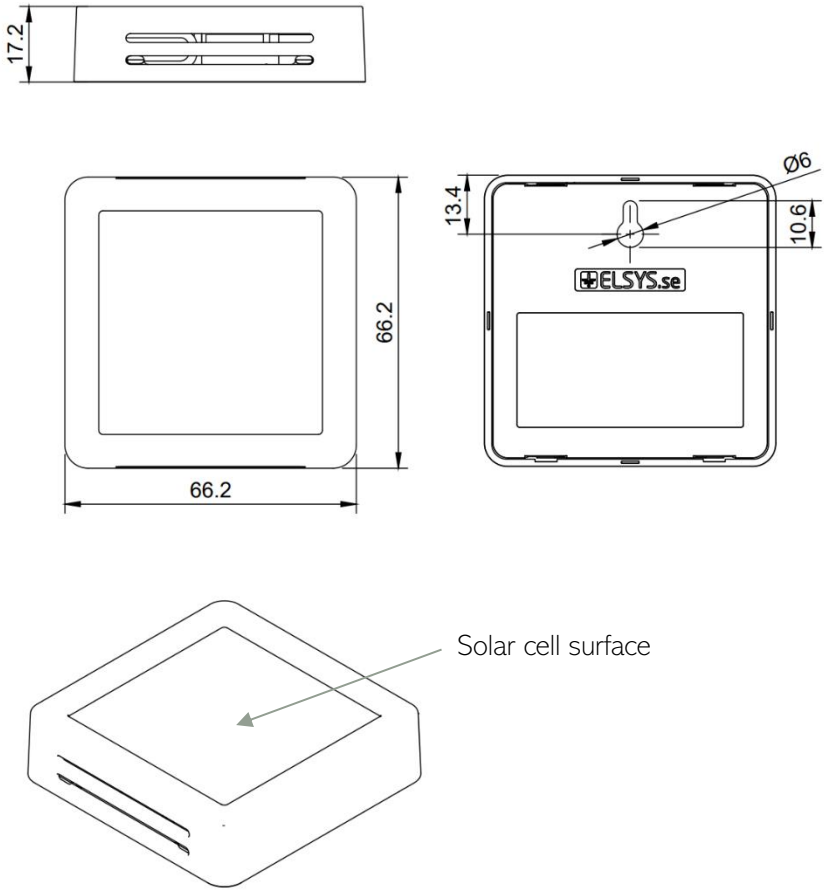
The device, as well as all the individual parts, must not be disposed of with household waste or industrial waste. You are obliged to dispose of the device at the end of its service life in accordance with the requirements of Directive 2012/19/EU to protect the environment and to reduce waste through recycling. For additional information and how to carry out disposal, please contact the certified disposal service providers.

Contents

1. Description

The ECO series of sensors are batteryless LoRaWAN® indoor climate sensors powered by indoor light. The sensor measures, depending on model, temperature, humidity, light intensity, and CO2 level. It is equipped with NFC (Near Field Communication) for easy configuration with an NFC-enabled

1.1 Dimensions (mm)



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1.2 Label

At the back of your device there is a label with an Aztec barcode containing DevEUI and sensor type.

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1.3 Main features of the ECO series

- Batteryless
- Powered by a printed, organic solar cell optimized for indoor light
- Energy storage that lasts up to 50 days in the dark*
- Maintenance free and low total cost of ownership
- Enclosure made from biodegradable material
- Compatible with LoRaWAN® specification 1.0.4
- Measures ambient temperature
- Measures ambient humidity
- Measures light intensity
- Measures CO2 level**
- Easy installation
- Easy configuration
- May be installed on a wall or any (non-metallic) surface
- Long-range communication
- Configurable over NFC
- Configurable over the air
- Supported channel plans: EU868, IN865, US915, AU915, AS923, HK923, KR923**
- CE Approved and RoHS compliant

** Depending on settings and environmental factors*

*** Depending on model*

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2. Mounting guidelines

Before installation, the light conditions in the intended installation location should be known. As a guideline, with default settings and at Spreading Factor 7 an average illuminance of at least 60 lux is needed for the solar cell to be able to harvest enough energy and keep the sensor running. During a whole week this corresponds to 250 lux for eight hours followed by 16 hours of darkness and darkness during the weekend.

When the sensor is exposed to light it will wake up and start running the LoRaWAN® join procedure. It is therefore recommended to commission the sensor to the server before removing it from its packaging.

Avoid placing the sensor where it is constantly exposed to direct sunlight as this may degrade the performance of the solar cell over time. Occasional exposure to high light intensities such as a few hours of sunlight each day is of no issue.

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3. Installation

1. Place double sided adhesive tape on the back side of the sensor or mount a screw in the intended sensor location.
2. Place the sensor in its intended location by gently applying pressure to it for the tape to adhere to the surface. Or, in the case of using a screw, hang the sensor onto the screw using the back side mounting hole.

Caution: When using a screw for mounting, please make sure that the total length protruding from the wall does NOT exceed 6 mm. Not adhering to this advice might result in physical contact between the screw and internal parts of the sensor causing a loss in range or malfunctioning of the sensor.

4. Service and maintenance

No serviceable parts inside. If service is needed, please contact your distributor.

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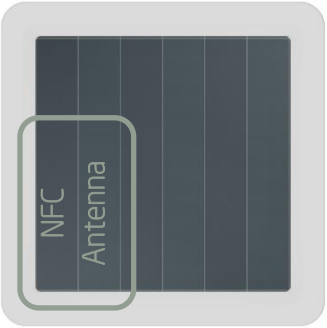
5. Sensor configuration

All sensor settings can be configured via a smartphone application with NFC (Near Field Communication) or over the air via the network server and downlink data to the sensor. The sampling rate, spreading factor, encryption keys, port, and modes can be changed. All sensor settings can be locked from the server or NFC to make end-users unable to read or change settings on the sensor.

5.1 NFC configuration

1. Download ELSYS "Sensor Settings" application from Google Play or App Store and install it on a smartphone or tablet. The device must support NFC.
2. Enable NFC on the device and start the application.
3. Place your device on top of the NFC antenna on the sensor. Keep the two devices close to each other and don't move them to get as good connectivity as possible.
4. Remove the device. Current settings will be displayed in the application.



5. Use the application to change any settings if needed.
6. Quickly tap the device on top of the NFC antenna to transfer the new settings to the sensor. Make sure that the application confirms your new settings.
7. Wait for the sensor to reboot (1 sec), indicated by the LED flashing. Sensor settings have been updated. Always validate your settings by reading the NFC data after the sensor has restarted.

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5.2 Over the air configuration

All settings may be configured over the air via your LoRaWAN® infrastructure. Please visit the support section on our webpage for more information regarding downlink protocol.

5.3 Application parameters

All parameters for the "Sensor Settings" application can be found in our settings document. Please visit the support section on our webpage for more information.

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6. Sensor behavior

6.1 Sensor startup

When delivered, the ECO is in a low power sleep mode. It will periodically sample the ambient light conditions and won't start its join procedure until it determines that there is sufficient incoming light. The recommended deployment procedure is to keep the sensor in the dark until it has been commissioned to the server and is ready to be deployed. When exposed to light the sensor will start running the LoRaWAN® join procedure at a 0.1% duty cycle, starting at Spreading Factor 7.

6.2 Energy storage

If the internal energy storage for some reason is depleted, for example from being started without any network server to connect to, the sensor needs to recharge. Place the sensor in a well-lit area (not direct sunlight) and it will harvest the energy from the light source to replenish its energy storage. Depending on light conditions this may take from a few hours up to a couple of days. In a fairly well-lit office with 1000 lux, it will take ~12 hours.

If the sensor is to be stored for a prolonged period of time, the energy storage will also eventually discharge. Approximate run-time in low power sleep mode is two months after production date. In the case that the sensor is stored longer than this, the above-mentioned recharging procedure must be done to wake up the sensor.

6.3 Sampling mode / Periodic measurement

The sensor makes periodic measurements according to the user configuration.

6.4 Scheduled transmission

The sensor transmits data according to the user configuration. However, the configured sending interval can be overridden by network limitations. Due to this, the spreading factor and sending interval settings might result in longer intervals than intended.

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6.5 LED indication

The LED in the center of the sensor indicates different actions when the sensor is active.

LED indication	Action
Red/green sequence	Sensor is starting up
Short orange blink	LoRa join request transmission
Short green blink	LoRa uplink transmission
Short red blink	Sensor failed to send an uplink Common cause is duty cycle limits

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7. Internal sensors

The populated internal sensors in the ECO series differ between models according to the list below.

	ECO	ECO CO2
Temperature	✓	✓
Humidity	✓	✓
Light	✓	✓
CO2		✓
NFC	✓	✓

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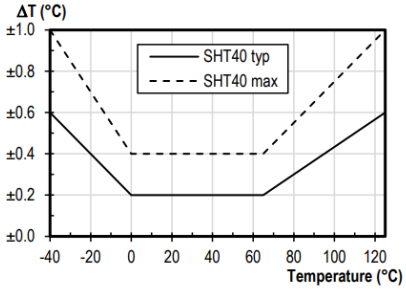
7.1 Temperature

Resolution: 0.1 °C

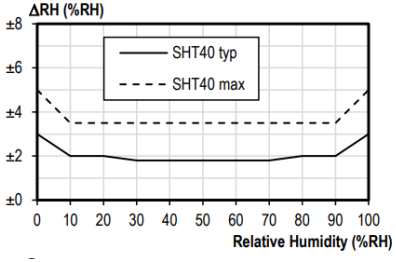
Accuracy: ±0.2 °C typical, see figure



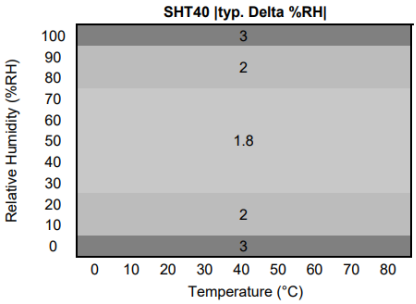
7.2 Humidity

Resolution: 1 % RH

Accuracy at 25 °C: ±2 % RH, see figure



Accuracy of RH over temp.: See figure



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7.3 Light

The sensor uses the solar cell to measure light intensity. For correct reading, make sure it isn't obstructed. The electrical characteristics of the solar cell as a function of light angle of incidence roughly equates to a cosine corrected measurement.

Range: 0 – 4000 lux
Resolution: 1 lux
Accuracy: ±10 lux ±2% of reading

7.4 CO2

The CO2 sensor normally runs an automatic baseline correction algorithm (ABC), with a period of 8 days. For a fully corrected measurement, the ABC needs 3 consecutive 8-day periods where the sensor sees fresh air sometime during each ABC period. It can also be calibrated manually, and the ABC can be turned off. In this case it is recommended to do a manual calibration in fresh air once/year.

Range: 400-10000 ppm

Accuracy:
400-5000 ppm: ±30 ppm, ±3 % of reading (15-35 °C, 0-80 % RH)
5001-10000 ppm: ±10 % of reading (15-35 °C, 0-80 % RH)

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8. Device specifications

Mechanical specifications	
Dimensions	66.2 x 66.2 x 17.2 mm
Weight	ECO: 33 g ECO CO2: 38 g
Enclosure	Biodegradable material, Biodolomer®
IP rating	IP20
Mounting	Screw/Adhesive tape
Recommended installation height	1.6 m
Operating conditions	
Usage environment	Indoor
Temperature	0 to 50 °C
Humidity	0 to 85 % RH (non-condensing)
Power supply	
Operating voltage	2.8-3.6V DC
Power source	Epishine Light Energy Harvesting Module
Energy storage type	Lithium-ion capacitor (LIC)
Expected run-time	Up to 50 days in the dark (Depending on configuration and environment)
Radio / wireless	
Wireless technology	LoRaWAN® 1.0.4, Regional Parameters RP2 - 1.0.3
Wireless security	LoRaWAN® End-to-End encryption (AES-CTR), Data Integrity Protection (AES-CMAC)
LoRaWAN® Device Type	Class A End-device
Supported LoRaWAN® features	OTAA, ABP, ADR, Adaptive Channel Setup
Supported LoRaWAN® regions	EU868, IN865, US915, AU915, AS923, KR923, HK923
Link budget	137dB (SF7) to 151 dB (SF12)
RF Transmit Power	Max 14 dBm EIRP
EU directives compliance	RED 2014/53/EU RoHS 2011/65/EU WEEE 2012/19/EU

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9. Sensor payload format

The device uses the standard ELSYS payload format. Please see the specified document on our webpage.

10. Regulations

10.1 Legal notices

All information, including, but not limited to, information regarding the features, functionality, and/or other product specification, are subject to change without notice. ELSYS reserves all rights to revise or update its products, software, or documentation without any obligation to notify any individual or entity. ELSYS and ELSYS logo are trademarks of ElektronikSystem i Umeå AB. All other brands and product names referred to herein are trademarks of their respective holders.

10.2 Declaration of conformity

Hereby, ElektronikSystem i Umeå AB declares that the radio equipment type Radio communication devices for low-speed data R&TTE Class 1 is in compliance with Directive 2014/53/EU, Directive 2011/65/EU and Directive 2012/19/EU.

The full text of the EU declaration of conformity is available at:
https://www.elsys.se/link/eu-doc

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11. Revision History

Revision	Description	Date
1.0	ECO series operating manual created	2023-01-30

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