



- ▶ Network of indoor sensors communicating via radio
- ▶ Measurement quality to the highest market standards
- ▶ A whole family of innovatively designed multi-parameter sensors for the best fit in the environment
- ▶ Integration of different variables within a single small body
- ▶ LoRa radio technology on EU868 frequency. LoRaWAN protocol
- ▶ Installation flexibility thanks to a wide variety of supports
- ▶ Measured data sent to LSI LASTEM INDOOR CUBE cloud software or server
- ▶ Local diagnostics via multicolored LED corona
- ▶ High battery runtime. Additional power supply via standard USB-C socket
- ▶ Additional inputs available for connection to external sensors
- ▶ Automatic calculation of derived quantities on LSI LASTEM cloud software

LSI LASTEM has designed a new type of indoor monitoring sensor. Sphensor™ are spherical multi-parameter radio sensors that can be arranged to form an indoor network and are integrated with LSI LASTEM's cloud platform. The Sphensors™ are designed with a pleasing visual impact, to blend harmoniously into their surroundings. The sensors are white spheres that measure various physical and chemical quantities, sending data via a robust LoRaWAN radio network to a LoRa Gateway to be ultimately transferred to the LSI LASTEM INDOOR CUBE cloud platform.

MODELLI SPHENSOR™ LORA							
Model	PRMPL0401	PRMPL0404	PRMPL0407	PRMPL0402—2.1	PRMPL0403—3.1	PRMPL0422 PRMPL0423	
							
Temperature	1	1	1	1	1		
RH%	1	1	1	1	1		
Illuminance				5 directions (402) 1 direction (402.1)	5 directions (403) 1 direction (403.1)		
UVA					1		
Dig. Temp. Ext.		2 inputs					
Motion			1			1	1
VOC						1	1
CO ₂						1	1
PM (1, 2.5, 4, 10)							1
CH ₂ O							1
Battery	Not Rec.	Not Rec.	Not Rec.	Not Rec.	Not Rec.	Rec.+USB-C	

LoRaWAN Gateway



- ▶ Radio modulation technology: LoRa on frequency EU868. Protocol: LoRaWAN.
- ▶ Two models: with Ethernet connection (TXRGC3101) or with additional LTE connectivity (TXRGC3201)
- ▶ Power supply via 1A barrel jack
- ▶ Programming functions via PC software

The primary function of the LoRaWAN Gateway is to decode and route incoming radio messages from sensors via the LoRa-WAN protocol to the MQTT broker that can be reached via Ethernet connection or Wi-Fi or LTE connectivity and, vice versa, to send messages from the same MQTT broker to the sensors in the network they belong to.

LoRaWAN protocol

The LoRaWAN protocol is a Low Power Wide Area Networking (LPWAN) communication protocol that runs over LoRa, which has been recognized as the international standard for LPWAN. The LoRaWAN specification is open so that anyone can configure and manage a LoRa network.

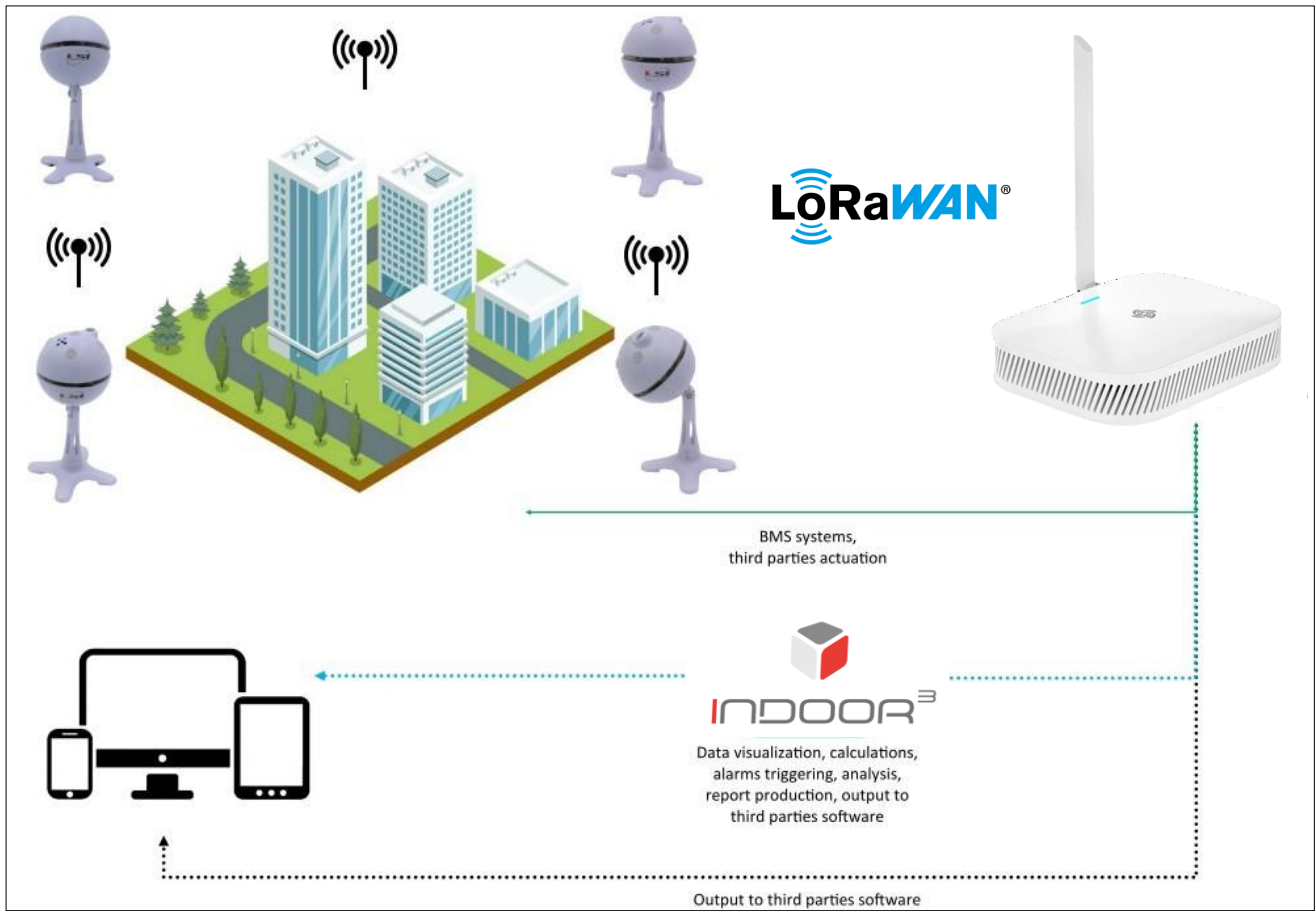
LoRa is a wireless audio frequency technology that operates in an unlicensed radio frequency spectrum. It is a physical layer protocol that uses spread spectrum modulation and supports long-range communication at the cost of reduced bandwidth. It uses a narrowband waveform with a center frequency to send data to be robust to interference.

LoRa uses free sub-gigahertz radio frequency bands such as 433 MHz, 868 MHz (Europe) and 915 MHz (North America) enabling long range transmissions (over 10 km in rural areas, 3-5 km in heavily urbanized areas) at low power consumption.

Features:

- Long-range communication up to 10 km in line-of-sight
- Unlicensed radio spectrum but region-specific regulations apply
- Low power but limited payload size

Sphensor™ Network architecture



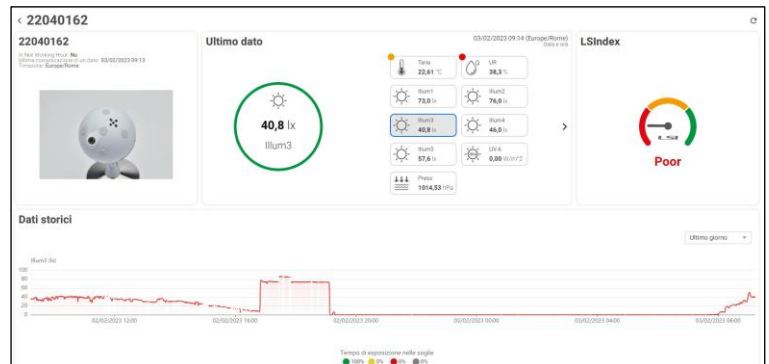
▶ The Sphensor™ sensors form a network of indoor sensors and communicate with each other and with the LoRa Gateway via LoRa radio, LoRaWAN protocol. The data is sent from Gateway via an internet network to the LSI LASTEM INDOOR CUBE cloud software for data management and storage. Data can also be automatically exported directly from the Sphensor Gateway or via cloud software to specialized third-party software.

INDOOR CUBE cloud platform

Sphensor™ sensors are equipped with the INDOOR CUBE Cloud Platform, with both desktop and mobile versions. Through the platform it is possible to:

- Display dynamic dashboards summarizing the latest data
- Display the LSIndex indoor environment quality summary index
- Configure calculated quantities
- View and download historical data and make comparisons
- Set alarms
- Download reports
- Create Monitoring Projects

(see catalogue *MW9006-ENG-15-LSI-INDOOR-CUBE*)



Sphensor™ applications

Sphensor™ sensors are designed for long-term monitoring of physical and chemical quantities in indoor environments.

The objective of these multi-parametric radio sensors is to monitor the Healthiness of environments, i.e. IEQ (Indoor Environmental Quality) and IAQ (Indoor Air Quality)

Among the system's strengths is the ability to monitor the state of the environment in real time, continuously monitoring all key health-related variables. Another key feature is the accuracy of the measurements to the highest market standards, combined with the modern design, which allows the introduction of the monitoring network in a central position with respect to the area to be monitored.

The possibility of transmitting data to customers' servers, to those of system integrators or to the LSI LASTEM cloud platform enables a remote control of the quantities of interest, even in the case of complex monitoring projects.

All these features make Sphensor™ the most suitable solution for monitoring

- Museums
- Buildings (residential and public)
- Offices and workplaces
- Schools/Universities
- Hospitals
- Shopping Centers
- Laboratories and Production Close Control



Technical features

Temperature	Principle	CMOS digital
	Measure range	-40...90 °C
	Accuracy	- Typ ± 0.1 °C @ 5...60 °C - Typ ± 0.2 °C @ -20...5 °C e 60...90 °C - Max 0.3 °C @ -40...90 °C
	Resolution	0.01 °C
	Response time (T63)	< 10 s
	Long term stability	<0.03 °C / year
Relative Humidity	Principle	Capacitive
	Measure range	0...100%
	Accuracy	- Typ $\pm 1\%$ @ 20...70% RH - Typ $\pm 1.5\%$ @ 0...20% RH e 70...90% RH - Typ $\pm 1.8\%$ @ 90...100% RH - Max $\pm 2\%$ @ 0...90% RH - Max $\pm 3\%$ @ 90...100% RH
	Resolution	0.01%
	Response time (T63)	< 8 s
	Long term stability	<0.2 %RH / year
Illuminance (PRMPL0402— PRMPL0402.1— PRMPL0403— PRMPL0403.1)	Principle	Ambient Light Photodiode Sensor
	Measure direction	0°, 90°, 180°, 270°. elevation 45° respect to sensor plane 1 measurement on the normal plane (402.1)
	Measure range	0.01...90 klx
	Accuracy	$\pm 5\%$ MV
	Resolution	0.01 lx
	Sensitivity	1 lx
	Cosine response	2% (for angle of incidence < 50°)
UV-A (PRMPL0403— PRMPL0403.1)	Principle	Indium Gallium Nitride Photodiode
	Measure direction	On the normal of the sensor plane
	Measure range	0...200 $\mu\text{W}/\text{cm}^2$
	Accuracy	$\pm 2\%$ MV
	Resolution	0.05 $\mu\text{W}/\text{cm}^2$
Motion (PRMPL0407— PRLMPL022— PRLMPL023)	Optical range	5...7 m
	Sensitivity	($T_{\text{body}} - T_{\text{surround}}$): Min. 4 °C
	Acquired data	- Current presence status (instantaneous) - Calculated number of presence detections compared to previous transmission - Incremental number of detections with self-clearing compared to a defined threshold - Percentage of time presence versus non-presence in the time unit determined by the transmission rate

VOC (PRMPL0422—23)	Principle	Nano metal oxide material with multi-pixel gas measurement
	Measure range (TVOC)	0...65000 ppb
	Accuracy	Typ < 12% MV (@ T=25 °C, RH=50%)
	Resolution	1 ppb
PM (1, 2.5, 4, 10) (PRMPL0422—23)	Measure range	0...1000 µg/m ³
	Precision	PM1 and PM2.5: 0...100 µg/m³ ±10 µg/m³ 100...1000 µg/m³ ±10 % of measured value PM4 and PM10: 0...100 µg/m³ ±25 µg/m³ 100...1000 µg/m³ ±25 % of measured value
	Thermal drift	0...100 µg/m³ ±1,25 µg/m³/year 100...1000 µg/m³ ±1,25 % of measured value/year
	Lifetime	> 10 years
	Noise emission level	25 dB—Drift: +0.5 dB
	Operative temperature	-10...60 °C
CO₂ (PRMPL0422—PRMPL0423)	Principle	Photoacoustic NDIR
	Measure range	0...5000 ppm
	Accuracy	±(50 ppm + 2,5% ave) @ 400...1000 ppm ±(50 ppm + 3% ave) @ 1000...2000 ppm ±(50 ppm + 5% ave) @ 2000...5000 ppm
	Response time (T63)	60 s
	Lifetime	10 years, after 5 years additional error of ±(5 ppm + 0,5% ave)
Formaldehyde (CH₂O) (PRMPL0423)	Measure range	0...1000 ppb
	Accuracy	±20 ppb or ±20% ave
	Resolution	1 ppb
	Lifetime	6 years
	Environmental operating	0...40 °C, 10...90% RH
General Information	Protection grade	IP30
	Operative temperature	-30...60 °C
	Sampling rate	Programmable from 10 s to 1 h
	Power supply	- Lithium battery: non-rechargeable 2/3 A, 2.1 Ah, replaceable (PRMPL0401-402-402.1-404-405-407) - Rechargeable lithium battery, 2Ah (PRMPL0422-423) - USB-C socket for additional external power supply

Gateway LoRaWAN (TXRGC3101, TXRGC3201) technical features

Power Supply	Connector	Barrel jack
	Power supply	DC 12 V - 1 A
	Consumption	12 W (max)
Diagnostics	Led Power supply	Presence of power supply
	Led Breathing	Indicates Gateway status, programmable
	Led ETH	Indicates Ethernet communication status
	Led LoRa	Indicates the status of the LoRa radio
	Led WLAN	Indicates LAN connectivity status
	Led LTE (TXRGC3201)	Indicates LTE connectivity status
LoRa Radio	Module	8 Channel communication
	Frequency	EU868
	Receiving sensitivity	-148 dBm @ 10.4 kHz, spreading factor 12
	Transmission power	14 dBm (25 mW)
	Antenna	LoRa: RP-SMA female connector
Network Connection	Connection 1	Ethernet RJ45
	Connection 2	Wi-Fi 2.4 GHz
	Connection 3	Cellular connection LTE (only TXRGC3201)
General information	Protection grade	IP30
	Operative temperature	-10...55 °C
	Weight—Dimensions	0.3 kg— 166 x 127 x 36 mm

Fixing systems



► Fixing system via **BASE**

System suitable for positioning sensors on a flat surface with easy position shifting. The system also allows the sensor to be tilted horizontally up to a maximum inclination of 45°.



► Fixing system using **PRIGIONEER**

This system is very practical and allows the ball to be rotated in any direction by acting on the joint that connects it to the ball in the case of fixing on a pre-drilled rod or indoor support.



► **WALL** mounting system

Directly derived from the previous method, the sensor can be easily attached to a wall using a dowel.



► Fixing by **PLATE**

A similar method to wall mounting by means of a dowel, but with greater control over the position, axis and direction of the sensor is fixed by means of a plate.



► Fixing system for **SUSPENSION**

In case the Sphensor needs to be suspended from a ceiling, the stem can be replaced by a hook. Fixing to the ball is done in the same way as for the stem, but the presence of a hole allows the wire to pass through (see Accessories).

Fixing systems



▶ **MINI TRIPOD** fastening system

Possibility of anchoring the stem with nut to a mini tripod for quick and stable positioning of the sensor on a flat, sloping or uneven surface.

▶ **CLAMPING** system

▶ Fixing system by means of an **ADJUSTABLE ARM**

Accessories

	MAOFA0002	Metal base for shelf mounting
	MC8114.R	Replacement stem compatible with steel base supplied with Sphensor sensors with M4 hole
	MC8113.R	Stem containing nut for 1/4" thread compatible with tripods or photographic supports
	MAGFA2006	Wire suspension accessory
	PRTHB0701.R	Thermo-hygrometric cell for PRMPL04xx, spare part
	PRTEA0922	Contact temperature sensor for PRMPL0404, ribbon cable L=5 m • Range: -40...105 °C • Resolution: 0.01 °C • Accuracy: ±0.1 °C @ -20...50 °C
	PRTEA4922.1	Globe temperature sensor for PRMPL0404, cable L=2 m • Range: -20...80 °C • Resolution: 0.01 °C • Accuracy: ±0.1 °C @ -20...50 °C
	EDPSA4201	UPS unit for Gateway TXRGC3101-02. Input: 12 V DC Output: 12 V DC @ 1 A max Capacity: 14.8 Wh.

	SVICA0003	Calibration report according to ISO 9001 (Temperature)
	SVICA1003	Calibration report according to ISO 9001 (RH%)
	SVICA4301.1	Calibration report according to ISO 9001 (UV-A)
	SVICA6001	Calibration report according to ISO 9001 (Illuminance)
	SVICA7002	Calibration report according to ISO 9001 (CO2)