



smartsense

Connect With Your Environment.

SENSEES

Environment Quality Monitoring System

System
Datasheet

Highlights

Modular air quality monitoring solution consisting of sensor unit(s), cloud and web & mobile applications

Monitors all important air quality parameters, from humidity, temperature and atmospheric pressure to presence of a number of gases and particles

Expandable with many sensors to monitor all important environmental parameters

Supports NB-IoT, LoRaWAN, 3G, 4G, 5G, WiFi, RS485 and Ethernet connection

Data accuracy validated through collaboration with [Andrija Štampar Teaching Institute of Public Health](#), dedicated to environmental protection and health ecology



Mechanical & Electrical Info



Unit Casing

Operating Environment

Outdoors

Dimensions [mm]

369 x 297 x 140

Weight

5 kg

Standard Operating Temperature [°C]

-20 - +65

Extended Operating Temperature* [°C]

-40 - +80

Power Requirements

100 – 240 VAC 50/60 Hz,
optional 12 VDC, 5W

Compliance

ETSI EN 301 489-1:V1.9.2
ETSI EN 301 489-17V2.2.1
EN 61000-6-1:2007 (IEC 61000-6-1:2005)
EN 61000-6-3:2007+A1:2011 (IEC 61000-6-3:2006+A1:2010)
EN 61000-3-2:2014
EN 61000-3-3:2013
EN60950-1:2006+A1:2010+A11:2009+A12:2011+A2:2013 (IEC 60950
1:2005+A1:2009+A2:2013 (mod.))
EN 62311:2008 (IEC 62311:2007, mod.)

*- with conditioning unit



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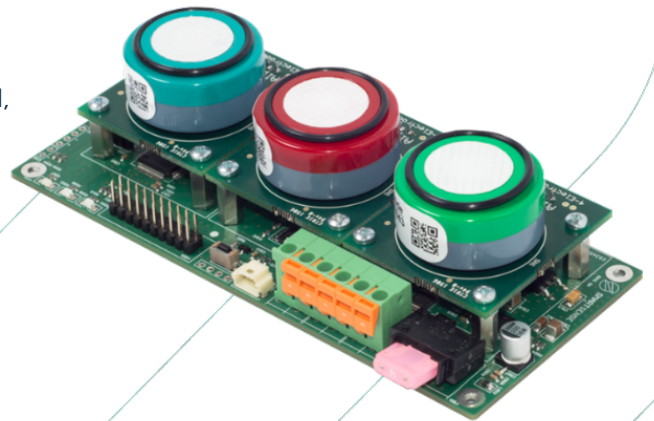
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Gas Sensors

Sensees.Environment monitoring station is equipped with high sensitivity 4 electrode electrochemical gas sensors. Each sensor element is factory stabilized and, thanks to our collaboration with Andrija Stampar Teaching Institute of Public Health, individually calibrated for sensitivity and zero offset. These correction constants are programmed into Smart Sense gas sensor module (GSMD) for every sensor.

One GSMD module contains up to 3 sensor elements for different gasses.

Sensees.Environment station can be equipped with wide array of gasses depending on customer requirements.



Sensor	CO	SO2	NO	NO2	O3
Range [ppb]	10 000	12 000	6 800	16 000	19 000
Type	electrochemical				
Lower Detectable Limit	1 ppb				
Resolution	0.1 ppb				
Precision [ppb]	3	3	5	5	5
Calibration	factory pre-calibrated + proprietary algorithm				
Non-linearity	0.007 %	0.002 %	0.02 %	0.01 %	0.03 %
Zero Drift [ppb/year]	<± 100	<± 20	<50	<20	<20
Operating Life [months]	> 36	> 36	> 24	> 24	> 24
Temperature Range* [°C]	-30 - +50	-30 - +50	-30 - +40	-30 - +40	-30 - +40
Humidity Range** [% RH]	15 - 90	15 - 90	15 - 85	15 - 85	15 - 85

*- refers to the operating temperature of the sensor elements, not the monitoring station

**- is extended with optional conditioning unit

In addition to standard gas sensors, Sensees.Environment monitoring station can be equipped with wide array of gasses depending on customer requirements. Optional gas sensors are presented in the following table.

Sensor	CO2	H2S
Range	5 000 ppm	20 000 ppb
Type	NDIR	electrochemical
Resolution	1 ppm	0.1 ppb
Precision	50 ppm	1 ppb
Calibration	factory pre-calibrated + proprietary algorithm	factory pre-calibrated*
Non-linearity	< 1 %	
Zero Drift [per year]		<± 20 ppb
Sensitivity drift (per year)		< 15 %
Operating Life [months]		> 24
Temperature Range** [°C]	-25 - +50	-30 - +50
Humidity Range*** [% RH]	0 - 95	15 - 90

*- for maximum accuracy, calibration in the field is recommended

**- refers to the operating temperature of the sensor elements, not the monitoring station

***- is extended with optional conditioning unit



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Suspended Particles Sensors

Sensees. Environment monitoring station is equipped with optical particle monitor for detecting particulate matter of following diameters:

- PM1 (1 μm)
- PM2.5 (2.5 μm)
- PM10 (10 μm)



Sensor	PM1	PM2.5	PM10
Range [$\mu\text{g}/\text{m}^3$]	500	2 000	5 000
Lower Detectable Limit		1 $\mu\text{g}/\text{m}^3$	
Resolution		0.1 $\mu\text{g}/\text{m}^3$	
Correlation Coefficient		> 0.9	
Particle Range		0.38 – 17	
Size Categorization		16 SW bins	
Sampling Interval [sec]		1.4 - 10	
Total Flow Rate (typical)		1.2 L/min	
Sample Flow Rate (typical)		220 mL/min	
Max Particle Count Rate		10 000 particles/second	
Max Coincidence Probability		0.84 % @ 10^6 particles/L	
Temperature Range		-10 - +50 $^{\circ}\text{C}$	
Humidity Range		0 – 90 %RH (non-condensing)	

Basic Atmosphere Sensor

Sensees. Environment monitoring station is equipped with basic atmosphere sensor for measurement of atmospheric temperature, relative humidity and barometric pressure. It is mounted inside waterproof casing which serves as rain and solar radiation shield.

Sensor characteristics are high sensitivity, excellent stability, fast response time, and, due to low consumption, long service life.



Sensor	Temperature	Humidity	Pressure
Range	-40 - +60 °C	0 – 100 %RH	100 – 1100 hPa
Resolution	0.1 °C	0.5 %RH	0.1 hPa
Accuracy	±0.5 °C	±3 %RH	±1 hPa
Supply	5 VDC, 12 – 24 VDC		
Current Consumption	< 20 mA		
Operating Temperature Range	-40 - +80 °C		
Dimension [mm]	Ø150 x 220		



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Additional Meteo Sensors

Optionally, Sensees.Environment monitoring station can be equipped with additional sensors for:

- wind speed and direction
- noise
- precipitation
- solar radiation
- UV radiation
- lighting intensity



Sensor	Wind Speed	Wind Direction	Noise	Precipitation
Range	0 – 40 m/s	0 – 100 %RH	30 – 130 dB	0 – 1 000 mm/hr
Resolution	0.1 m/s	0.5 %RH	0.1 dB	0.2 mm
Accuracy	±3 %	±3 %RH	class 2 class 1	0.2 mm
Other	ultrasonic sensor with no moving parts in waterproof casing		IEC 61672-1:2002	

Sensor	Solar Radiation	UV Radiation	Lighting Intensity	Illuminance
Range	50 – 1800 W/m ²	0 – 200 W/m ² 0 – 15 UV index	40 km	0 – 20 000 lux
Resolution	1 W/m ²		14 steps	1 lux
Accuracy	±5 %FS	±5 %		±5 %FS
Other		200 – 400 nm	33 kHz @ 500 kHz	380 – 780 nm

Electromagnetic Field Sensor

Designed in collaboration with partner
Končar – Electrical Engineering Institute Inc.

KONČAR
Electrical Engineering
INSTITUTE

Optionally, Sensees.Environment monitoring station can be equipped with the electromagnetic field sensor. It consists of external antenna mast and embedded spectrum analyzer.

System is configured to perform periodical 6-minute sweeps (averaging according to the norm) and to send the maximum measured values to the Cloud. Data is highly accurate and comparable to reference levels set in regulations.



Frequency Range

1 Hz – 4.4 GHz

Bandwidth Resolution

0.1 Hz to 250 KHz and 5 MHz

Amplitude

RBW \leq 100 KHz

Max Input Value

+10 dBm

Accuracy (Selected Referent Range \leq 0 dBm)

\pm 1.5 dB

Accuracy (0 dBm < Selected Referent Range \leq 10 dBm)

\pm 2 dB

Antenna Wide Field Dynamic Range

5 mV/m – 50 V/m

Antenna Noise Level

-0.3 mV/m (BW 3 KHz)

Antenna Linearity Deviation

\pm 1 dB



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Network

Sensees Environment monitoring station implements 2G/3G/LTE, NB-IoT and Wi-Fi for wireless communication options. It also supports RS485 wired interface.

SMS is used as additional channel for alarming and configuration.

Advanced network manager monitors network status and selects the best connection method.

Network Interfaces

LTE

Five-Band LTE-FDD B1/B3/B7/B8/B20
Quad-Band LTE-TDD B38/B39/B40/B41
Tri-Band UMTS/HSDPA/HSPA+ B1/B5/B8
Dual-Band TD-SCDMA B34/B39
EVDO/CDMA BC0
Quad-Band GSM/GPRS/EDGE B2/B3/B5/B8
GPRS multi-slot class 33
EDGE multi-slot class 33

5G

Sub-6G:
n1, n2, n3, n5, n7, n8, n12, n20, n28, n38, n40, n41, n48, n66, n71, n77, n78, n79

NB-IoT

LTE Cat NB1, Multi Region, LTE bands: 1, 2, 3, 4, 5, 8, 12, 13, 18, 20, 26, 28, Class 3 (23 dBm), 62.5 kb/s UL, 27.2 kb/s DL

LTE Cat M1

LTE Cat M1, Multi Region, LTE bands: 1, 2, 3, 4, 5, 8, 12, 13, 18, 20, 26, 28, Class 3 (23 dBm), 375 kb/s UL, 300 kb/s DL

LoRaWAN

433/868 MHz, Class A

GPS / Location

CELL assistant Location (No GPS)
A-GPS: MS-Based, MS-Assisted
Stand-alone GPS
QUALCOMM XTRA GPS mode

Wi-Fi

IEEE 802.11 b/g/n
Frequency: 2.4 GHz – 2.484 GHz

Platform

Software platform on monitoring station ensures reliable operation of the air quality application and high availability of the system. Sitting on top of dedicated hardware it implements redundant and secure operation. The platform establishes communication to the Smart Sense Cloud (Sensees Cloud) for measurement data acquisition and for Operation and maintenance (O&M) which includes remote monitoring, alarming, configuration and SW upgrades. Platform also supports all standard Internet protocol stacks making it easy to integrate to third party IoT frameworks.

Platform Features

OS	Linux
Bootloader	U-Boot, dual OS partition boot (active, passive), reset counter
Security	Full file system encryption supported by U-Boot
OTA SW Upgrade	Yes, to passive partition, automatic fallback to reliable partition
System Supervision	Smart watchdog supervision of critical processes, memory, network
Alarming	MQTT, SMS, customizable
Remote Configuration	SSH
Local Configuration	Wi-Fi AP / Telnet
Logging	Configurable log levels, log rotation
Network Manager	Connectivity monitoring, automatic fallbacks and reconnects
Communication	HTTP, LWM2M, MQTT, SSH, expandable



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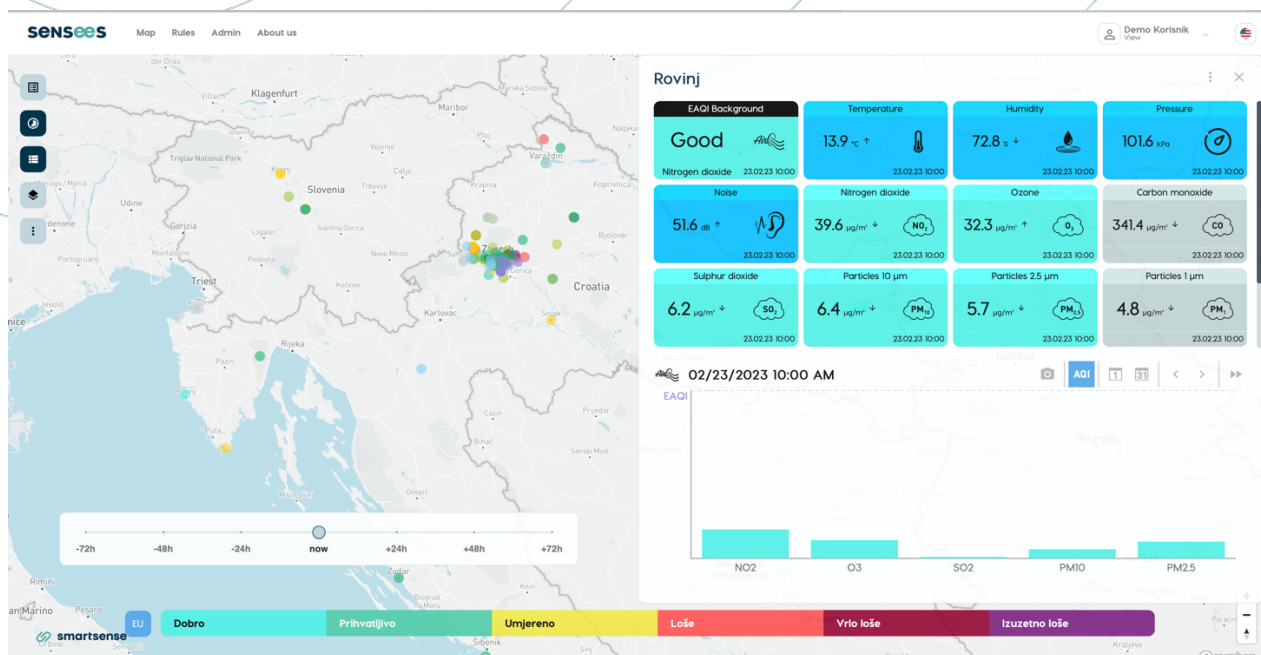
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Sensees Application

Sensees application is a cloud-based web application that enables the communication between the SW platform and the user. It sits on top of the SW platform, but also features northbound and southbound API for the integration with the third-party systems.

Web application implements multi-tenant architecture and allows authentication and authorization for different tenants. Tenants are administered via dedicated frontend administration interface, where the admin user can grant permissions to and configure the sensors. Besides the tenant classification, platform supports free access mode that allows access to all the sensors that are marked as free to access by their respective tenants.

The frontend part of the SW platform is developed with HTML/CSS/JavaScript technologies and is accessible by any modern browser (Chrome, Mozilla Firefox, Edge, IE11+, mobile browsers). It implements the principles of the responsive design, scaling well on different screen sizes. Central component of the dashboard is the interactive geographic map of currently active stations.



All sensor data of the stations can be inspected in detail through tables and interactive graphs, both in real-time and history form. History data analysis also allows the client to view the data in predefined, as well as custom time ranges and provides him with the option of exporting the sensor data to CSV format.

Different air quality index calculation methods are implemented and used, all according to the local regulations of the country or the city where the station is physically placed. E-mail alarm triggers are dispatched when the air quality index reaches a critical level.



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