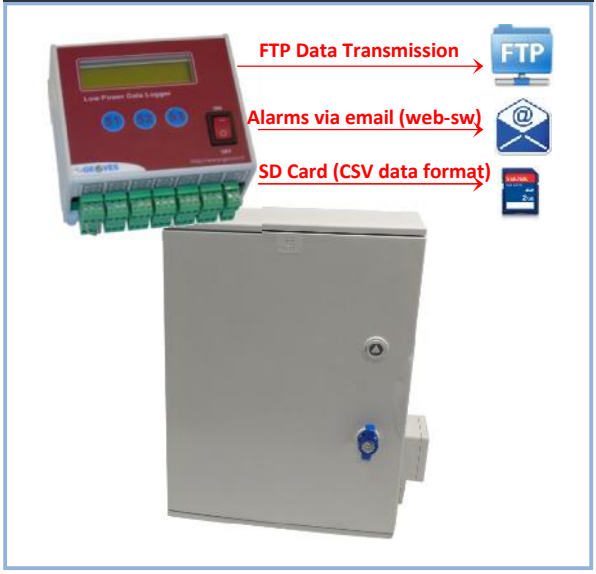
LPDL-SMART-CITY – MONITORING SYSTEM OF AIR POLLUTANTS (Rev.2 01022024)



LPDL Smart City is a monitoring system consisting of a Geoves datalogger and several sensors for measuring atmospheric pollutants and meteorological and environmental parameters; it is completely configurable both by type and by number of sensors, thus obtaining a customized system based on the specific needs of the application.

LPDL Smart City allows both the monitoring of data with **GPRS transmission on the FTP area** and the sending of alarms **via email** (with the MeteoGraph web application) when programmable thresholds are exceeded.

Thanks to the construction with cutting-edge technologies, LPDL has a very low consumption that allows it to work even with small batteries; besides it's a very compact and low environmental impact device.

The wireless technology combined with an autonomous power supply allow LPDL to be installed at any point of interest, effectively constituting a remote measurement network.

LPDL has a high versatility of connecting numerous transducers for environmental and industrial monitoring, making it extremely adaptable to any meteorological, micro-climatic, geotechnical application or for any other remote monitoring application.
LPDL is housed in a watertight box for outdoor use therefore it can be used in any indoor or outdoor environment; it is extremely easy to install thanks to the universal bracket on the back that allows you to mount the device on poles or elements with a circular section of any diameter or on the wall.

SAirHR sensors assembled in the LPDL Smart City box for measuring air quality

SAirHR sensors are measurement sensors consisting of a miniaturized system that uses an intelligent cpu with high reliability solid polymer electrochemical gas detection technology and intelligent algorithm calculation. Each electrochemical sensor consists of three electrodes: the working electrode (anode), the counter electrode (cathode) and the reference electrode. The gas to be analyzed is diffused through a membrane on the sensitive electrode; depending on the gas to be monitored, oxidation occurs on the anode or cathode and therefore the concentration will be proportional to the electrical signal generated between the two electrodes.
The reliability of the measurement is obtained by limiting the effect of humidity variations by means of special construction measures before sampling that isolate the sensitive part of the transducers from the electrical and electronic part of the management and treatment of the measurement.

The miniaturization of our sensors and their low energy consumption allow the use and installation of multiple measurement stations that can be directly connected to a wireless GPRS network in order to allow the monitoring of large areas.

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Datalogger specifications

Base model	LPDL
I/O channels	**8 analog inputs** (+ 8 optionnals on Expa8 interface) for meteorological sensors such as pyranometers, hydrometers, thermometers, barometers or chemical sensors **2 insulated digital inputs (pulse counter)** for sensors with "high" frequency up to 50KHz (anemometers, flow gauges, ecc…) and with "low" frequency output (rain gauges), sensors that requires the time counting (sunshine duration, leaf wetness,…), on/off signal (free-contacts) **1 diagnostic input** for battery voltage **1 serial input** for smart sensors connection (**n.1 multiparametric probe** mod. SMx for water analysis)
Data elaborations	Min, max (gust), arithmetic average, standard deviation, turbulence; trigonometric average; sum; diagnostic measure for battery voltage. Calculable measurements (if the weather sensors that allow the calculation are present): Evapotranspiration Et0, TD Dew point temperature, TWB wet bulb temperature
Alarm management	**Locally**: via SMS with Butterfly configuration (max 8 analog measurements) **Remotely**: via email by using MeteoGraph web software
Date clock	Inside on board RTC; automatic update with GPRS link (if present) on NTP server
Sampling rate	2s
Data storage	Programmable 5-10-15-30-60' (1' or other on request) on 2GB SD Card with circular data management (500 days)
Communication ports	n.1 RS232 n.1 switched serial port n.1 I2C port
Data transmission	Wireless: GSM/GPRS via FTP (via e-mail on request) Wired: RS232, RS485, LAN 10/100Mbit with free software Geodesk for data download Programmable 5-10-15-30-60' (1' or other on request)
Local HMI	n.3 multifunction keys 2r. 16 crt. display LCD with sliding pages
Working temperature	-40…+80°C
Power	10…14.4Vdc (typical 12Vdc) On-board battery charger, input from photovoltaic panel, with battery monitoring (deactivation of the load <10,5Vdc, restart >12Vdc)
Consumption	<10mA@12Vdc
Protection	IP20 (for indoor)
Mounting	DIN bar
Dimensions (Lxhxp)	105x110x55mm
Sensor connection	removable terminals with screw contacts
Conformity	WMO, IEC60904, D.Lgs.36/2003

ACCESSORIES	
Photovoltaic panel power supply	n.1 30W Photovoltaic panel (or more), Vnom. 12Vdc, Vmax 21Vdc@1000W/m^2 @ 25°C n.1 12Vdc/12Ah (or 7, 18Ah) backup sealed battery
Mains (220Vac) power supply	n.1 2A sectionalising switch n.1 12Vdc/2Ah backup sealed battery n.1 power supply unit with integrated battery charger; IN:220Vac / OUT:12Vdc@2A
Enclosures	IP65 enclosure, in polycarbonate (option: stainless steel) with anti-radiation treatment, key enclosure, crossarms for fastening on poles (ø50…150mm) or on walls. Dimensions (Lxhxp) Box1: 250x350x160mm, Box2: 300x500x160mm, Box3: 300x500x200mm.

ModBus Interface

As an alternative to the LPDL data logger, the sensor system can be equipped with an analog / digital interface with **ModBus RS485 RTU or TCP / IP** output. This device allows to connect all the measurement sensors to external connection devices such as LoraWan devices, SCADA systems, routers, etc ...

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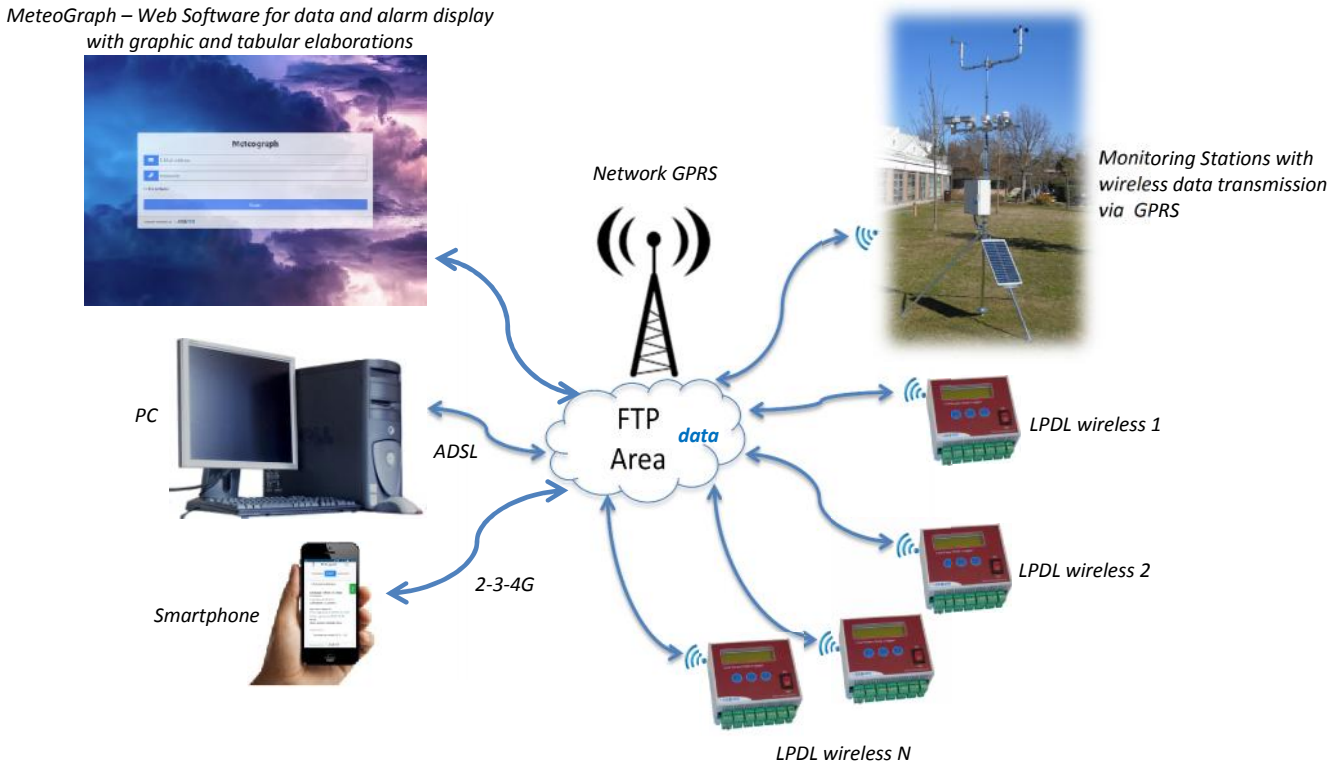
Layout of the LPDL Smart City data transmission system



SPECIFICATIONS

Air quality sensors

Air pollution monitoring consists of detecting the main polluting gases that damage health or the environment. The pollutants that will be considered are represented by emissions generated by primary sources of pollution such as the industrial emissions, the release of vapors / fumes / odors released by industrial processes, plants with bio-filters, landfills, etc ...

For these applications Geoves has developed a sensor for monitoring medium gas concentrations, the **SAirHR** sensor, which is available both in the **stand-alone** version with 4-20mA output and in the **Smart-City** assembled version combined with the LPDL datalogger or with a simple ModBus or LoraWan interface for external connection.

The sensors can be used in numerous industrial applications, including the measurement of sulfur compounds **SO2** and **H2S** or **SMELL** sensor (typical olfactory nuisance from waste water treatment plants and paper manufacturing / processing plants), ammonia **NH3** (characteristic odor from decomposition processes) and methane **CH4**. Also available are sensors for the most common pollutants of ozone **O3**, nitrogen oxides **NO2**, carbon monoxide **CO** and carbon dioxide **CO2**, volatile organic substances (**VOC** and hydrocarbons) and chlorides **Cl2**.

In addition to these pollutants, Smart City can be set up with the **PM2.5 and PM10** (**PM1** optional) particulate meter, the **noise** and **meteorological parameters** necessary to evaluate any dispersions into the atmosphere.

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Model	Measurement	Range (other on request)	Resolution	Accuracy
SCO2- I	Carbon dioxide (CO2)	0…2.000 o 0…5.000ppm	0,5…1% f.s.	±1% fino al 25% del range di f.s. ±2% dal 26 al 50% del range di f.s. ±5% per range >50% del range di f.s.
SNO- I	Nitrogen monoxide (NO)	0…5.000ppm	0,5ppm	0,5…1% f.s.
SCH4HR-I	Methane (CH_4)	0…100ppm	50ppm	±3% f.s.
SCOHR- I	Carbon monoxide (CO)	0…10.000ppb	10ppb	±5% del fondo scala
SSO2HR-I	Sulphur dioxide (SO_2)	0…5.000ppb	10ppb	
SH2SHR-I	Sulphured hydrogen (H_2S)	0…5.000ppb	10ppb	
SNO2HR-I	Nitrogen dioxide (NO_2)	0…5.000ppb	10ppb	
SO3HR-I	Ozone (O_3)	0…5.000ppb	10ppb	
SCL2HR-I	Chlorides (Cl_2)	0…5.000ppb	10ppb	
SNH3HR-I	Ammonia (NH_3)	0…10.000ppb	10ppb	
SSMELL-I	Odorous substances *	0…5.000ppb	10ppb	
SHCHO-I	Formaldehyde (HCHO)	0…5.000ppb	10ppb	
SVOCHR-I	Volatile Organic Compounds (VOC)	0…10.000ppb	10ppb	
Output	4…20mA			
Power / consumption	9…24Vdc <0.6W			
Response time	depending on the model (tip. < 3s (T90 < 30-80s))			
Expected lifetime (maintenance)	>3 years (calibration check every 12 months)			
Time drift	<1% / month			
Working conditions	Temperature: -40…+55°C; Rel. Humidity: 15…95% (not condensing)			
Connector	IP68 plug			
Mounting	Universal bracket for fixing on horizontal or vertical pipes ø:25…42mm			
Materials	White painted and anodized aluminium, Polycarbonate			
Dimensions and weight	Sensor body: 140 x 120 x 120mm (support excluded), weight: 700g			

PM10-2,5-1 particulate sensor

Models	SPM10-2,5-I - SPM10-2,5-1-I
Working principle	Light laser scattering
Measurement range	PM2.5: 0…1000 µg/m^3 ; PM10: 0…1000 µg/m^3; PM1: (option)
Resolution	1µg/m^3
Accuracy	±10%
Preheating time	≤ 120s
Time response	90s
Outputs	4…20mA
Power	12…24Vdc
Consumption	100mA@12Vdc
Load Resistance	100Ohm@12Vdc (<600 Ohm@24Vdc)
Working conditions	-20…+60°C, 0…80%

Noise sensor

Model	SFON
Transducer	Condenser microphone
Measurement range	30…120dB
Frequency band	20Hz…12.5 kHz
Accuracy	±0.5 dB (94dB @ 1 KHz)
Resolution	0.1 dB
Time response	≤ 3s
Output	4…20mA
Power	12…24Vdc
Consumption	1.2W
Load resistance	100Ohm@12Vdc (<600 Ohm@24Vdc)
Working conditions	-20…+60°C, 10…90%

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Main meteorological sensors

Model	mSTAUR – Air temperature-humidity sensor
Temperature - Range	-40…+60 °C
Transducer	Pt100 with anti-radiation shields
Accuracy	±0.2°C
Rel. Humidity - Range	0…100 %
Transducer	Capacitive with anti-radiation shields
Accuracy	±2%

Model	RG200 – Rain gauge (available also with anti-icing heater)
Range	infinite
Orifice area	200cm^2 (option: 400 cm^2)
Transducer	Double contact (n.o.) tilting bucket
Accuracy	Class B UNI 11452:2012 (class A connected to the Geoves datalogger)
Resolution	0.2 mm/commutation (or 0.1mm 400cm^2 version)
Power supply	Without heater: none; With heater (Vers.-R): 12-24Vdc 60W

Models	mWS1 – Wind speed sensors (available also with anti-icing heater)
Range	0…50 m/s (typical) gusts >75m/s
Transducer	Magnetic with sinusoidal AC signal not powered
Rotation	High performance bearings
Anti-icing heater	12Vdc/1W (only for WS2 model)
Accuracy	< ±0.1m/s

Models	mWD1 – Wind direction sensors (available also with anti-icing heater)
Range	0…359°
Transducer	Linear Potentiometer with continuous 360°
Rotation	High performance bearings
Anti-icing heater	12Vdc/1W (only for WD2 model)
Accuracy	< ±2°

Model	PIRSC – Silicon cell pyranometer (global solar irradiance)
Measuring range	0…2000 W/m^2
Spectral Range	0.4…1.1µm
Transducer	Silicon cell
Accuracy (typ.)	±3,5%

Model	mPA – Barometer
Range (typical)	800…1100 hPa (on request 600…1100 hPa for sites over 1000m above s.l.)
Transducer	Piezoresistive
Average accuracy @ 25°C	BAR: ±0.5hPa; mPA: ±0.6hPa
Long-term stability	±0.01hPa/year

Importance of meteorology

Meteorological variables are of fundamental importance in correlating with air pollution levels. They regulate how fast pollutants are transported and dispersed in the air (e.g., wind speed, turbulent flows of thermal or mechanical origin, evaluation of atmospheric stability classes) or brought to the ground (removal by rain). Meteorological parameters define the volume in which pollutants disperse: the mixing height, connected to the altitude of the first thermal inversion, can be identified as the maximum altitude up to which pollutants dilute. They also influence the rate (or even the presence) of certain chemical reactions that result in the formation of secondary pollutants in the atmosphere, such as ozone (e.g., solar radiation)

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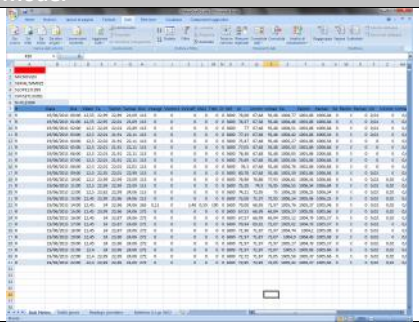
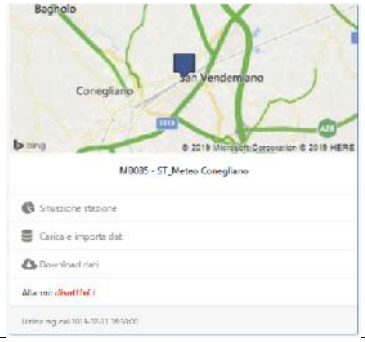
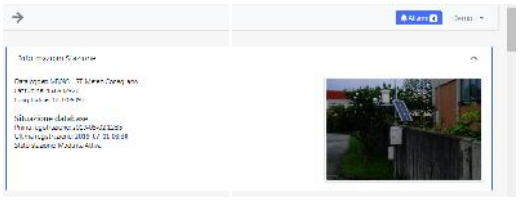
SOFTWARE Model	Geodesk & MeteoGraph
	**Geodesk** is a basic service software, free supplied with all Geoves datalogger, that can import data recorded (on SD card or sent via GPRS or transmitted by cable from the datalogger) and generate a single data file in Excel format. In this way it's possible to create data aggregation of desired period (eg. Monthly) and then derive the tabular and graphical reports. Besides Geodesk creates the setup configuration for the functioning of Butterfly, Micro3 and LPDL Geoves dataloggers
	**MeteoGraph** is a web application for the numerical and graphic display of data transmitted via GPRS on FTP area from environmental monitoring stations with Geoves datalogger. The software relies on an FTP Geoves area where data is sent autonomously by the control units at fixed times and are available in **standard text format** with fields separated by commas (**CSV format**). The data is therefore **always usable** without the need to use proprietary communication protocols or specific programs for data decoding; furthermore, the software **does not require any installation** as Internet access is sufficient and a username and password must be entered to enter the dedicated web page and display the measurements from a PC, tablet or smartphone. The data in text format are processed by MeteoGraph to obtain on the web page both the measurement in numeric format (eg average minimum maximum trend, etc.) and in graphic format that can be downloaded in jpg bitmap format.
	**Station dashboard** The available functions are:) *Station situation*: access to the graphic processing page and to the station's synoptic) *Load and import data*: the data saved on the datalogger SD card are imported, or on a PC folder (or other support)) *Data download*: data are downloaded in text format with fields separated by commas for simple backups or subsequent processing with other applications (eg Excel, Access, external databases or other commercially available software)) *Alarms*: access to the station alarm management menu (optional on request)
	**Station situation - *Station information*** The parameters displayed are: • Station unique identifier (ID) • Name of the station • Geographic coordinates (Latitude and Longitude) • Data base status: o Date and time of Start data storage o Date and time Last data storage o Operation status of the station • Photos of the station
	**Real-time synoptic of the station** The synoptic is a very useful tool for assessing the situation of the latest measurements taken by the monitoring station and assessing the meteorological or environmental situation of the site. For each measurement it is possible to associate one or more dedicated processes. For example, for the temperature it is possible to indicate the minimum and maximum value and the time in which it occurred in addition to other calculated measures such as the dew point. The synoptic also shows: • calculated measures

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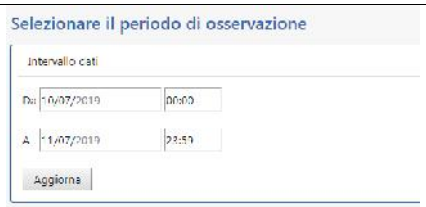
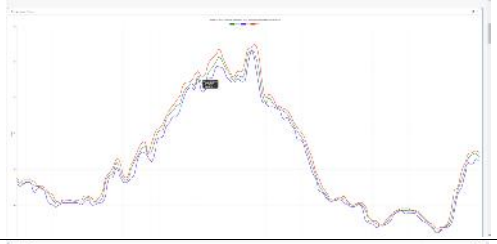
- Diagnostic data (eg battery voltage)
- Significant data for the interpretation of the measure (eg barometric tendency, wind chill, monthly precipitation, etc.)

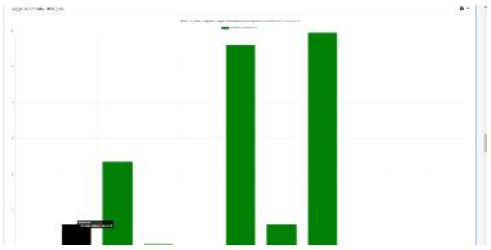


Observation period
It is possible to select the observation period in which to carry out all the elaborations that are displayed by MeteoGraph

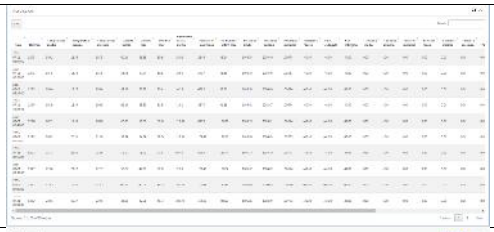


Graphic elaborations
- **Linear multi-line** for measurements where the arithmetic average is applied (eg temperature, humidity, pressure, etc.) with representation of the minimum and maximum value

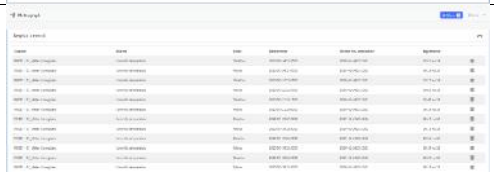
Graphic elaborations
- **Wind-rose** for the anemometer measurements



Graphic elaborations for precipitation
- Graph with hourly summation
- Monthly or annual precipitation histogram
- Other graphs are available on request or can be customized with simple filters



Tabular elaborations
Daily data table can be downloaded both in text and in .png image format



Alarm management
To manage alarms, the software allows you to set upward (> value) or downward (<value) intervention thresholds, after which alert emails are sent to the personnel in charge.
The alarms are then represented on the screen with adequate effects and colors to attract the attention of the operator

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