

LoRaWAN on Senseair ExploraPM_{2.5}

1 Protocol

The protocol consists of different types of data

- LoRaWAN v.1.0.2 standard commands
- Unsolicited uplink status commands during configure state
- Periodic measurement reports
- Downlink commands and queries
- Uplink query response

Note 0x denotation means hexadecimal encoded.

1.1 LoRaWAN standard commands

All standard LoRaWAN v 1.0.2 are supported. Please refer to the LoRaWAN standard for the protocol definition.

1.2 Unsolicited uplink status commands

The sensor polls the server for configuration parameters during the Configure state. This is done by sending unsolicited uplink status report (0x20). This gives quick feedback to the installer that the installation has been successful and enables downlink configuration commands to be sent. After approximately 2 minutes the device changes to Operational state.

Port: Port 1

Payload 0x01 20 00
0x01: Data type
0x20: Status command

0x00: bit0 =0 => Normal startup
bit1 == => No boot problem
bit 2-7 reserved

The expected behavior is 0x01 20 00. If not contact support.

1.3 Periodic measurement report

The sensors transmit periodic unsolicited measurement reports or adaptive reports due to changes in particulate matter level.

1.3.1 Periodic measurement report

The default configuration is that particles, temperature and humidity are measured and transmitted every 15th minute. The data is packed into minimal number of bytes to minimise interference.

Port: Port 2

Payload: Measurement value (see chap 1.3.2)

Size: 5 Bytes

1.3.2 Measurement value

The measurement value for each measurement

Byte 0: Temperature, bit 11 – bit 4

Byte 1: Relative humidity, bit 11 – bit 4

Byte 2:

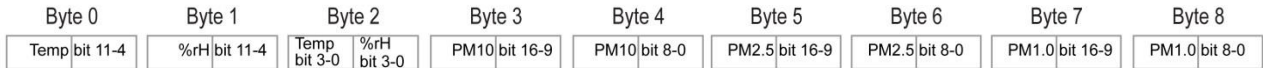
bit 7-4: Temperature, bit 3 – bit 0

bit 3-0: Relative humidity, bit 3 – bit 0

Byte 3-4: PM10 sent as an unsigned 16-bit integer

Byte 5-6: PM2.5 sent as an unsigned 16-bit integer

Byte 7-8: PM1.0 sent as an unsigned 16-bit integer



1.3.2.1 Temperature conversion

The temperature measurement is transmitted using an unsigned 12-bit value. The scaling is 1/10 °C and the offset is 80 °C, which means the received value should be subtracted by 800 and then divided by 10 to get it in °C.

1.3.2.2 Relative humidity conversion

The relative humidity (RH) measurement is transmitted using an unsigned 12-bit value. The scaling is 1/10 %RH and the offset is 25 %RH, which means the received value should be subtracted by 250 and then divided by 10 to get it in %RH.

1.3.2.3 Particulate Matter (PM) conversion

Particulate Matter of different sizes PM10, PM2.5 and PM1.0 is measured in $\mu\text{g}/\text{m}^3$ and is transmitted by using an un-signed 16 bit integer

1.3.3 Example: Single measurement report

Measurement data is sent on LoRaWAN port 2

3E 44 1D 00 17 00 07 00 0D



(3E1)_{HEX}: (993)_{DEC} => 993/10 -80°C => 19.3 gradC



(44D)_{HEX}: (1101)_{DEC} => 1101/10 - 25% => 85.1 % RH

(0017)_{HEX}: (023)_{DEC} => 23 $\mu\text{g}/\text{m}^3$ PM10

(0007)_{HEX}: (007)_{DEC} => 7 $\mu\text{g}/\text{m}^3$ PM2.5

(000D)_{HEX}: (013)_{DEC} => 13 $\mu\text{g}/\text{m}^3$ PM1.0

1.4 Downlink commands and queries

To control the sensor application, in-band commands and queries can be sent from the server application. Contact your LoRaWAN network provider for in-band application API. All downlink application communication is done on LoRaWAN port 1.

Downlink command network => device				
Field	Bytes	Value	Description	Note
Type	1	xx	0x01: Set 0x02: Query 0x03: Action	
Index	1	xx	Command Index	
Data			As defined for Command Index only applicable for set-commands	

Port	Index	Description	Uplink Datatype Response	Encoding	Valid range	Access	Unsolicited	Description	Note
1	0x03	FW build hash	6 x Uint8			Query	No	Unique number that identifies the firmware version	
1	0x05	Device reset				Action	No	Reset of device	
1	0x06	CPU voltage	Uint8	25mV/LSB	0 – 3.6V	Query	No	Read CPU voltage. Max/min ranges depend on battery chemistry.	
1	0x0A	CPU temperature	Uint16 Big endian	50C – 0.01C / LSB	-50 – 125°C	Query	No	Temperature from CPU sensor with 50°C offset. Approximately 5°C accuracy.	
1	0x20	Status	Uint8	Bitfield		Query	Yes	Should be 0, otherwise notice error code information, and contact support.	Cleared through reset.
1	0x23	Measurement Interval	Uint16 Big endian	Minutes	1 – 10080	Query Set	No	Measurement interval in minutes.	Setting measurement interval resets the measurement timer.
2	-	Data	[Uint12, Uint12, Uint16, Uint16]	(°C + 80)*10 (%RH+25)*10 (µg/m ³ PM10) (µg/m ³ PM2.5) (µg/m ³ PM1.0)	1 – 3800 1 – 3500 1 – 65535 1 – 65535 1 – 65535	-	Yes	Current temperature, humidity, PM10, PM2.5 and PM1.0.	

1.4.1 Measurement interval

The measurements are done periodically. The interval time is controlled by the configuration parameter Measurement Interval. The default setting is 15 minutes.

The measurement interval can be set between 1 and 65534 minutes (~1.5 months).

It is also possible to order a batch of Senseair ExploraPM_{2.5} with a different default setting.

Example

Set measurement interval to 5 minutes: Port 1: 0x01230005

Set measurement interval to 15 minutes: Port 1: 0x0123000F

1.4.2 Reset device

The device can be remotely reset and forced into Joining state. All settings are back to factory default.

Example

Remote device reset: Port 1: 0x0305

1.5 Uplink query response

When communication on LoRaWAN port 1 the following header is used:

Uplink command device => network				
Field	Bytes	Value	Description	Note
Type	1	xx	0x01: Data 0x02: Command NACK	
Index	1	xx	Command Index	
Data			As defined for Command Index (only for Type: Data)	

Example:

Port 1: Payload 0x01 20 00

0x01: Data type

0x20: Status command

0x00: Normal startup

The expected behavior is 0x01 20 00. If not, contact support.

The product and product specification are subject to change without notice. Contact Senseair to confirm that the information in this product description is up to date.

www.senseair.com