



LoRaWAN on Senseair ExploraCO₂

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: Normal startup

The expected behaviour 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 CO₂ level.

1.3.1 Periodic measurement report

The default configuration is that temperature, humidity and CO₂ level are transmitted every 20th minute. The data is packed into minimal number of bytes to conserve energy and 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

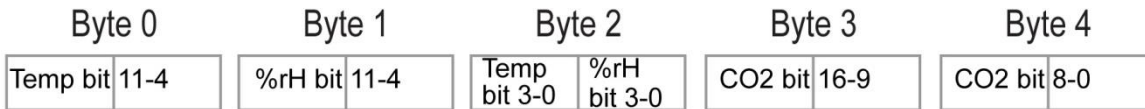
Byte 1: Relative humidity, bit 11 – bit 4

Byte 2:

bit 7-4: Temperature, bit 3 – bit 0

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

Byte 3-4: CO₂ 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 Carbon dioxide conversion

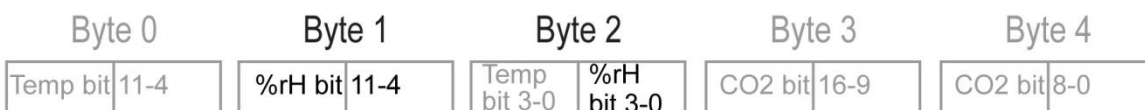
The carbon dioxide (CO₂) measurement in parts-per-million (ppm – 1*10⁶). The CO₂ data is averaged over a measurement period. The data is transmitted using an un-signed 16-bit integer. The value 0xFFFF indicates an error in the CO₂ reading, and should be displayed as an alarm or error code in the application, not as a measurement value.

1.3.3 Example: Single measurement report

Data sent on LoRaWAN port 2: 3E 44 1D 02 1B



3E₁₆: 993₁₀ => 993/10-80°C => 19.3°C



44D₁₆: 1101₁₀ => 1101/10 – 25% => 85.1 % RH

021B₁₆: 539₁₀ => 539 ppm CO₂

1.4 Downlink commands and queries

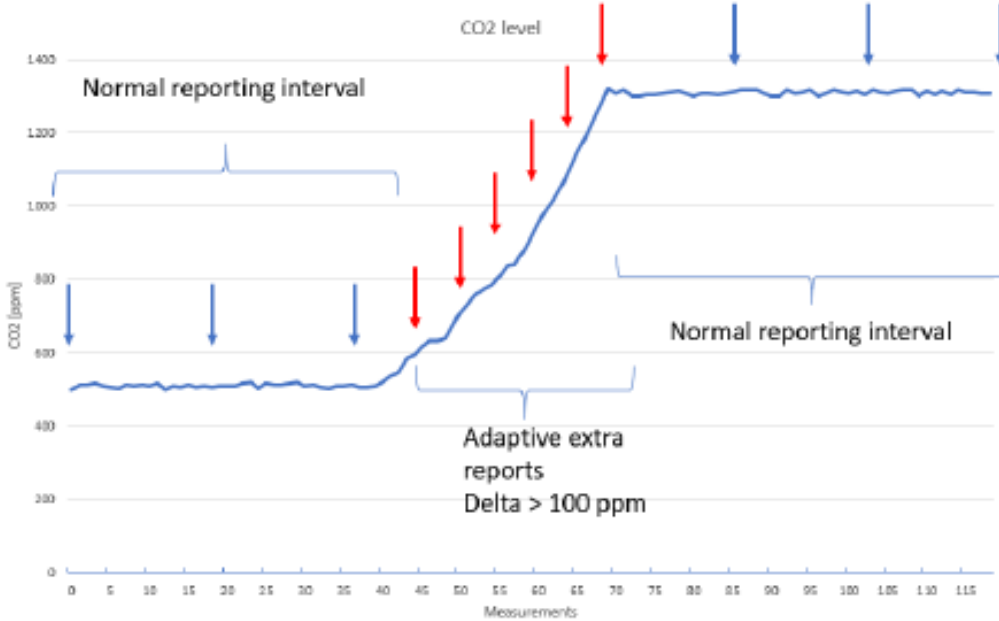
To control the sensor application, in-band commands and queries can be sent from the server application. Contact your LoRaWAN network provider for in-band application API. All downlink application communication is done via LoRaWAN port 1.

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	Un-solicited	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	-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	0x30	Measurement Interval	Uint16 Big endian	Seconds	15 – 7200	Query Set	No	Measurement interval in seconds controlling how often sensors data is acquired. Default 60 seconds.	Setting measurement interval resets the measurement timer.
1	0x31	Measurement cycles per reporting event	Uint16 Big endian	Number of measurement cycles	1 – 2000	Query Set	No	Maximum number of measurement cycles before transmitting sensor data over LoRa uplink. default 20 cycles	
1	0x32	CO2 concentration variation threshold	Uint16 Big endian	PPM	0 – 65535	Query Set	No	Maximum CO2 concentration change from last LoRa uplink reporting event before inserting an additional reporting event. Default 100ppm.	Set to 0ppm to disable all additional reporting events based on CO2 level.
1	0x33	CO2 concentration absolute threshold	Uint16 Big endian	PPM	0 – 65535	Query Set	No	Minimum absolute CO2 concentration level under which all additional reporting events are committed. Default 750ppm.	
1	0x34	Internal CO2 sensor status bits	Uint32 Big endian	CO ₂ sensor status	0 – 2000	Query	No	Query only, for internal use	
2	-	Data	[Uint12, Uint12, Uint16]	(°C + 80)*10 (%RH +25)*10 (ppm CO ₂)	0 – 3800 0 – 1500 0 – 65535	-	Yes	Current temperature, humidity and CO2 level.	See Ch 4.3

1.4.1 Measurement and reporting interval

Both the measurement interval and reporting interval can be set with downlink commands. The default setting is a measurement interval of 60 sec. The default reporting interval is every 20th measurement interval. The device sends extra reports when above a configurable CO2 level, default setting 750 ppm and larger difference than 100 ppm from last report. The reporting interval counting is reset after an extra measurement report



1.4.2 Reset device

The device can be reset by three methods, long press on button, removal of battery (note the internal SuperCap will power the device for approximately 24 hours without battery), or forced into Joining state by OTA commands.

Example: Remote device reset: Port 1: 0305

1.5 Uplink query response

Uplink messages are sent on port 1 with the following heading:

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 behaviour 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.

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