Setting of the E4000-NG air quality probe

in LoRa or LoRaWAN Class A mode

The Lora module plugs in place of an EnOcean Radio module without having to change the firmware

Ver	Date	Modification / Update
V1	Initial	Initial Version English

Summary

1. Overview

The E4000NG probe can receive a LoRaWAN radio module in place of an EnOcean radio module.

2. Join a network:

Choose between private mode and public mode on the radio module: By default, the module is in public mode. Thanks to a jumper, the module goes into private mode. Put the jumper probe off. The mode will be applied at startup. At startup, the green LED on the module flashes once in public mode and twice in private mode.

Go into OTAA mode in the web page of the LoRaWAN network used.

Enter the following keys:

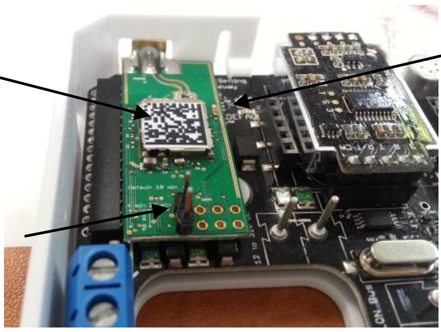
Key	Bits	Byte	Contend	Contend in hexadecimal for input
Device EUI	64	8	“Unique”	Scan the DataMatrix on the radio module supplied by the manufacturer
Application EUI	64	8	IAQ-Data	49 41 51 2d 44 61 74 61 (supplied by the manufacturer)
Application Key	128	16	“Unique”	supplied by the manufacturer.

The keys are confidential and sent by email to the buyer in the form of a table.

The Dev EUI is available as a DataMatrix on the radio module. Use a smartphone or suitable scanner to read and associate to other codes of the table provided elsewhere.

DataMatrix

Private mode jumper



LoRaWAN Joined LED

At startup, the radio module will automatically be recognized by the LoRaWAN network.
When the radio module is connected to the LoRaWAN network, the green LED of the radio module is On.
Be careful, recording on an operated network may require several radio transmission cycles.

2.1. Setting the LoRa emission rate

The transmission rate depends mainly on the operator and the contract with him. It is generally allowed to transmit up to an average rate of 10 minutes in an operated network. In a private network, the rate can be faster.
By default, the rate of the LoRa Radio module is 10 minutes.

The transmission rate can be set by the downlink.
T the following order must be send:
0x01 0xdd 0xdd
0x01: number of the command for the time cycle change. (See chapter 5.2.2)
0xdd 0xdd is the delay between two frames in minutes, it will be taken into account after the next transmission.

3. LoRaWAN Payload

3.1. Contend of LoRaWAN Payload

By default, the probe sends a message containing a series of telegrams every 10 minutes Each telegram corresponds to a profile (CO2 + T° + RH, VOC, PM)

Regularly, the LoRa module sends 4 sets of measurements distributed over its emission rate. This message can be timestamped on receipt. It belongs to a gateway or the database that archives the recordings to time stamp the data.

1.1. LoRa messages format

1.1.1. Uplink

LoRa QAI E4000 message with CO2, T °, humidity, VOC, particles, presence and windows:

Presence sensor	4x		CO2, T°, humidity	COV	PM	Presence & windows
1 Byte			4 Bytes	2 Bytes	4 Bytes	1 Byte

Total 45 Bytes

Detail of physical values:

CO2	Hum.	Temp.	Reserved	COV (high)	COV (low)	PM (high)	PM (mid high)	PM (mid low)	PM (low)
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte

Detail of PM data :

<table>
<tr><td colspan="8">PM (high)</td><td colspan="8">PM (mid high)</td><td colspan="8">PM (mid low)</td><td colspan="8">PM (low)</td></tr>
<tr><td colspan="9">PM 10</td><td colspan="9">PM 2.5</td><td colspan="9">PM 1</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
</table>

PM (low) :

- Bit 0 : 0 → PM 1 non active
  1 → PM 1 active
- Bit 1 : 0 → PM 2.5 non active
  1 → PM 2.5 active
- Bit 2 : 0 → PM 10 non active
  1 → PM 10 active

Conversion of physical values:

Measured	Size	Range of	Resolution	physical values:

Parameters		values		
CO2	1 Byte	0…255	1 LSB = 19.6ppm	0…5000 ppm
Humidity	1 Byte	0…200	1 LSB = 0.5%	0…100 %RH
Temperature	1 Byte	0…255	1 LSB = 0.2°C	0…+51 °C
COV	2 Bytes	0…65535	1 LSB = 10 µg/m^3	0…65535 µg/m^3
PM10, PM2.5, PM1	9 bits per value	0…511	1 LSB = 1 µg/m^3	0…511 µg/m^3

The sensor presence Byte allows to take into account the contents of the measurements of these

Bit	
0	1 = CO2, T°, RH active
1	1 = COV active
2	1 = PM active
3	1 = Occupation (EnOcean occupancy sensor paired) *
4	1 = opening sensor (EnOcean opening sensor paired) *
5	1 = Suspicion presence *
6	1 = Suspicion window opening *
7	Reserved

The last Byte is thus composed (logical content of the sensors or suspicion of the previous Byte):

Bit	
0	1 = Occupation *
1	1 = window open *
2	Reserved
3	Reserved
4	Reserved
5	Reserved
6	Reserved
7	Reserved

* Not available with standard firmware version of E4000NG probe (EnOcean, KNX, LON, Modbus compatible): Reserved for hybrid version with EnOcean and LoRa module.

The difference between the 4 measurements sent depends on the transmission rate, for example:

For 4 minutes	every minute
For 10 minutes	every 2.5 minutes (default value)
For 20 minutes	every 5 minutes
For 40 minutes	every 10 minutes

It belongs to the gateway which receives the telegram to time stamp the measurements knowing that the order of the 4 successive measurements goes from the oldest to the most recent.

Example:

Cycle 9h00 9h02.30 9h05 9h07.30 9h10

Measured at	9h02.30	9h05	9h07.30	9h10
Measure #	1	2	3	4
Emission	9h00			9h10

1.1.2. Downlink

The transmission of the configuration data is done on port 2.

Byte 1 Code of command	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0x01	Emission rate in minutes		Not used	Not used	Not used
0x02	T° comfort	T° Eco	T° Night	Mode	Exemption
0x03	CO2 setpoint		COV setpoint		Exemption
0X04	PM10 setpoint		PM2.5 setpoint		Exemption
0X05	Ext. T°	free cooling Delta T°	free cooling speed	Not used	Exemption

Total 6 Bytes

Emission rate command 0x01
This command is used to set the transmission rate.
The two Bytes of rate are a delay between two frames expressed in minutes, it will be taken into account after the next transmission.
By default, the value is at zero which corresponds to a transmission rate of 10 minutes. Note that values greater than 720 also correspond to the default value of 10 minutes.
The range goes from 1 minute to 12 hours.

Parameter setting command 0x02
This command is used to set the thermal regulation for the E4000NG probes in the EnOcean + Lora hybrid version (specific firmware).

Bytes of T ° use the standard content of the profile EnOcean the EEP A5 02 05

The Byte Mode allows to force a mode and is composed as follows:

Bit	
0	1 = Auto
1	1 = Comfort
2	1 = Eco
3	1 = Nuit
4	1 = Vacancy
5	1 = Summer
6	1 = Winter
7	1 = Maintenance (ventilation & heating Off)

Mode change affects the regulation of temperature and ventilation

The exemption Byte allows to define the durability of the exemption transmitted by the downlink:

Exemption Byte Value	Meaning
0	Permanent
1	End on event
2	15 minutes
3	30 minutes

5	1 hour
9	2 hours
25	6 hours
49	12 hours
97	24 hours

A downward exemption is only valid for the time allowed by the exemption byte. It must therefore be renewed regularly to be sustainable if the duration is limited in time.

An event corresponds to a mode change on sensor or suspicion (but window opening).

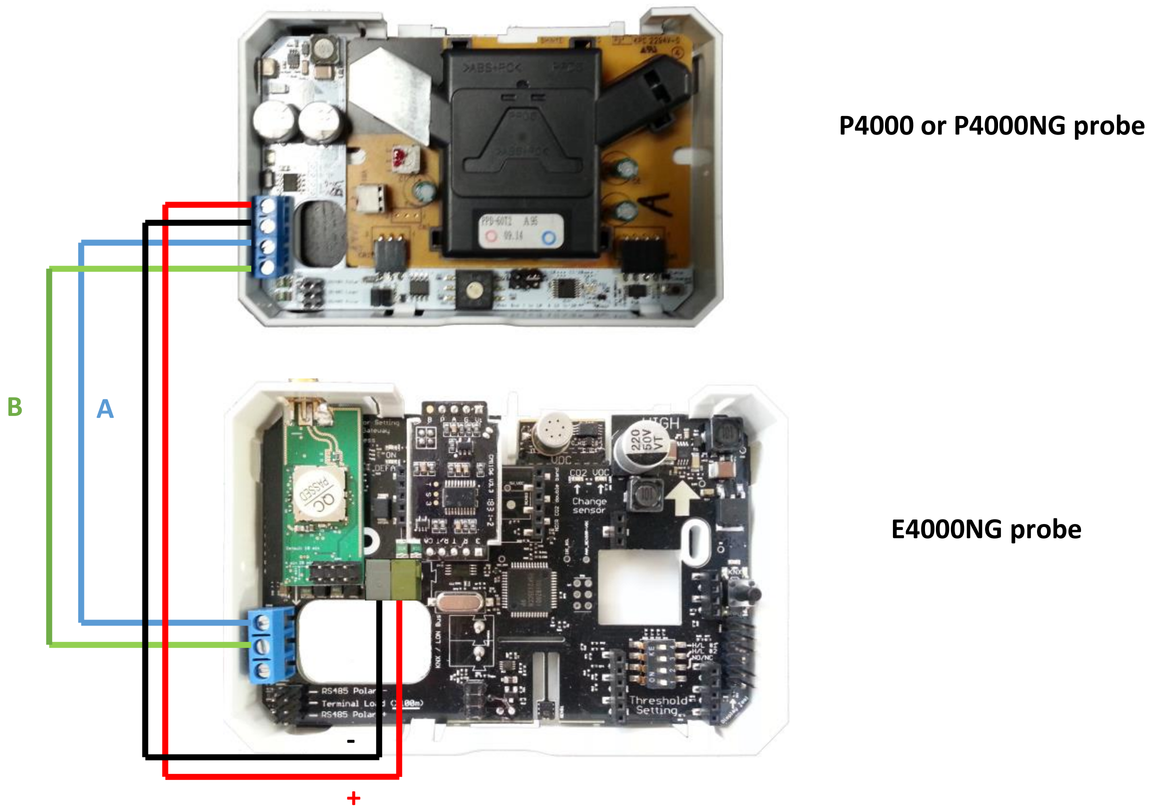
2. Telegrams Activation

The E4000NG probes equipped with a LoRa radio module are Plug and Play. They are already set to send the measurements. Including in case of adjoining a PM sensor.

3. Modbus

The E4000-NG probe has a Modbus RS485 port.
When there is a radio module, this port is configured as master and can therefore interrogate Radon or Particle related probes.
RS485 ASCII Auxiliary probes can be connected to the E4000-NG probe which will provide the measurement gateway to the radio. However, it is necessary for the E4000-NG probe to know the address of the probes in order to interrogate them.
Each additional probe has an address selector ranging from 1 to 20.
When switched on, the E4000-NG probe will automatically scan the RS485 addresses of the potential probes (from 1 to 20), so there is nothing to do.
An E4000-NG probe can identify only one RS485 Annex probe of each type (first found, first selected).
If in doubt consult the installation manual

4. Example of wiring an auxiliary particles probe.



A non-twisted cable can be used if the auxiliary probe is close (<2m). Do not use jumpers if the distance is <100m.

If the Modbus is well connected, the PM sensor appears on the screen tool of the pairing menu (The inversion of the bus is not destructive).

5. CODEC

A codec is a code that decodes the LoRa telegram data.
Example of Objenious codec.
Pay attention to the "time_offet" setting: see explanations below the CODEC.

{
"attributes": {

"sensor_dummy" : {
"type": "bool",
"length": 1,
"hidden": true
},

"sensor_Open_Calc" : {
"type": "bool",
"length": 1
},

"sensor_Presence_Calc" : {
"type": "bool",
"length": 1
},
"sensor_Open_Sensor" : {
"type": "bool",
"length": 1
},

"sensor_Presence_Sensor" : {
"type": "bool",
"length": 1
},

"sensor_PM" : {
"type": "bool",
"length": 1
},

"sensor_VOC" : {
"type": "bool",
"length": 1
},

"sensor_CO2" : {
"type": "bool",
"length": 1

},

"CO2_Value": {
"type": "uint",
"length": 8,
"divide": 255,
"multiply": 5000
},
"humidity": {
"type": "uint",
"length": 8,
"divide": 2
},
"temperature": {
"type": "uint",
"length": 8,
"divide": 5
},
"CO2_Dummy1": {
"type": "uint",
"length": 1,
"hidden": true
},

"CO2_BatAutonomy": {
"type": "uint",
"length": 3
},

"CO2_Dummy2": {
"type": "uint",
"length": 4,
"hidden": true
},

"VOC_Value": {
"type": "uint",
"length": 16,
"multiply": 10
},

"PM10_Value": {
"type": "uint",
"length": 9
},
"PM2_5_Value": {
"type": "uint",
"length": 9
},

"PM1_Value": {
"type": "uint",
"length": 9
},

"PM_Dummy": {
"type": "uint",
"length": 5,
"hidden": true
},

"State_Dummy":{
"type": "uint",
"length": 6,
"hidden": true
},

"State_Window": {
"type": "uint",
"length": 1
},

"State_Occupancy": {
"type": "uint",
"length": 1
}

},
"format":[
{"attributes":["sensor_dummy","sensor_Open_Calc","sensor_Presence_Calc","sensor_Open_Sensor","sensor_Presence_Sensor","sensor_PM","sensor_VOC","sensor_CO2"]},

{
"repeat":
[
{
"attributes": [
"CO2_Value","humidity","temperature",
"CO2_Dummy1","CO2_BatAutonomy",
"CO2_Dummy2",
"VOC_Value",
"PM10_Value","PM2_5_Value","PM1_Value",
"PM_Dummy",
"State_Dummy",
"State_Window","State_Occupancy"

],
"time_offset": "(-loop_index-1)*150"
}

  ]
}

]
}

The repeat loop requires the use of a time offset allowing the timestamp of the data.

You must manually set the time between each data group with a number in seconds.

In the above example, the interval between two groups of data is 150 seconds, or 2 minutes and 30 seconds for a LoRa frame transmission every 10 minutes.

Examples of settings:

LoRa transmission rate	**Interval between each data group**	**Parameterization to be done in the CODEC**
4 minutes	1 minute	"time_offset": "loop_index*60"
10 minutes	**2 minutes 30 seconds**	**"time_offset": "loop_index*150"**
20 minutes	5 minutes	"time_offset": "loop_index*300"
40 minutes	10 minutes	"time_offset": "loop_index*600"

6. Example of Payload after decoding.


```
[
  {
    "timestamp": "2019-06-17T09:16:28Z",
    "data": {
      "CO2_BatAutonomy": 0,
      "CO2_Value": 803.92156862745,
      "PM10_Value": 2,
      "PM1_Value": 0,
      "PM2_5_Value": 0,
      "State_Occupancy": 0,
      "State_Window": 0,
      "VOC_Value": 820,
      "humidity": 26,
      "sensor_CO2": true,
      "sensor_Open_Calc": false,
      "sensor_Open_Sensor": false,
      "sensor_PM": true,
      "sensor_Presence_Calc": false,
      "sensor_Presence_Sensor": false,
      "sensor_VOC": true,
      "temperature": 26.2
    }
  },
  {
    "timestamp": "2019-06-17T09:18:58Z",
    "data": {
      "CO2_BatAutonomy": 0,
      "CO2_Value": 784.3137254902,
     "PM10_Value": 3,
      "PM1_Value": 0,
      "PM2_5_Value": 0,
      "State_Occupancy": 0,
      "State_Window": 0,
      "VOC_Value": 790,
      "humidity": 26,
      "sensor_CO2": true,
      "sensor_Open_Calc": false,
      "sensor_Open_Sensor": false,
      "sensor_PM": true,
      "sensor_Presence_Calc": false,
      "sensor_Presence_Sensor": false,
      "sensor_VOC": true,
      "temperature": 26
    }
  },
  {
```



```
    "timestamp": "2019-06-17T09:21:28Z",
    "data": {
      "CO2_BatAutonomy": 0,
      "CO2_Value": 745.09803921569,
      "PM10_Value": 2,
      "PM1_Value": 0,
      "PM2_5_Value": 0,
      "State_Occupancy": 0,
      "State_Window": 0,
      "VOC_Value": 690,
      "humidity": 26,
      "sensor_CO2": true,
      "sensor_Open_Calc": false,
      "sensor_Open_Sensor": false,
      "sensor_PM": true,
      "sensor_Presence_Calc": false,
      "sensor_Presence_Sensor": false,
      "sensor_VOC": true,
      "temperature": 26.2
    }
  },
  {
    "timestamp": "2019-06-17T09:23:58Z",
    "data": {
      "CO2_BatAutonomy": 0,
      "CO2_Value": 725.49019607843,
      "PM10_Value": 5,
      "PM1_Value": 1,
      "PM2_5_Value": 1,
      "State_Occupancy": 0,
      "State_Window": 0,
      "VOC_Value": 610,
      "humidity": 26,
      "sensor_CO2": true,
      "sensor_Open_Calc": false,
      "sensor_Open_Sensor": false,
      "sensor_PM": true,
      "sensor_Presence_Calc": false,
      "sensor_Presence_Sensor": false,
      "sensor_VOC": true,
      "temperature": 26.2
    }
  }
]
```