Getting started with EnOcean

Contents

Project history

Date	Author	Modification
29.10.09	TCS / sdu	V1 Editing of documentation (version 1) and project for PG5 1.4.300
07.04.2010	TCS / sdu	V2 Revision of documentation and example, inclusion of new FBox Library for PG5 1.4.300
08.04.2010	TCS / sdu	V2 Importing of project into PG5 2.0.110. Adaptation of documentation for PG5 2.0.110.

1 Introduction

This document is intended to offer an easy way to start using the Saia EnOcean library. With the appropriate PG5 project, it can serve as a guide to implementing an EnOcean application.
The information contained in this document has been extracted from the corresponding manuals and online helps and should make getting started easier for you. For further information, please consult the relevant documents (see section “References”).

2 Hardware and software requirements

Hardware
This project has been configured for the following hardware:

- PCD3.M5540 firmware 1.10.16 or higher
- One USB cable (max. 1.8m) for programming the PCD
- One Thermokon STC65-RS485 bidirectional EnOcean gateway
- One Omnio APG03B-RS485 bidirectional EnOcean gateway
  (There is one Fupla project for Thermokon and a second Fupla project for Omnio. One or other gateway can therefore be selected.)
- One door handle, window / door contact
- One room control unit Thermokon SR04PST
- One temperature sensor Sensortec RFFA-10
- One relay UPS230/01 from Omnio
- One relay EnOcean easyfit RCM250

Software
To program the PCD the following software is needed, including a valid licence:

- PG5 2.0.110 patch 5
- EnOcean Saia library (min. 2.6.001)

It is of course also possible to run this project with other hardware. Depending on the hardware, specific adjustments to the configuration will be required (hardware configuration in PG5, software settings in PG5. The appropriate Fupla settings will be necessary for communication between PCDs).

3 Basic principles of EnOcean

This section gives a brief overview of EnOcean.

3.1 History

EnOcean is a battery-free, wireless sensor technology that was launched on the market in 2001 by the company EnOcean GmbH.

Various well known companies in Europe and North America came together in April 2008 to form the EnOcean Alliance, a not-for-profit company with the following aims:

- The further development of sensor profiles to ensure interoperability for wireless products that make use of the free frequency bands.
- Collaboration within a formal standardization committee to make an international standard possible.
- The development of a wide spectrum of fully compatible, wireless products to support the monitoring and control of house and building technology.

3.2 Technology

The basic idea for the technology rests on a simple observation: When a sensor captures measurements, there is also a simultaneous change in energy state. A switch is pressed: the temperature changes or the intensity of lighting varies. In these processes there is enough energy to send wireless signals across a distance of up to 300 meters.
This wireless technology, which can transmit switching signals and measurements without a battery, essentially comprises two components:
First the locally available ambient energy is converted into electrical energy (energy harvesting), then extremely low-energy electronics prepare the data for transmission and send it in the form of short wireless signals to a special receiving unit. The wireless protocol has been created for the low energy, high security transmission of information. EnOcean works on a frequency of 868 MHz.

In this example, EnOcean components from Thermokon, Omnio and Sensortec have been used.

3.3 Planning

EnOcean is a wireless technology with very low signal intensity. The installation, walls, roofs and furniture can all have an influence on range. The environment can also be a determining factor when choosing the number of gateways.

- Up to 64 EnOcean gateways/transmitters (receivers) can be operated on one serial bus. For each bus (RS485) you will need a free communications port.
- Only gateways sourced from the same supplier (Omnio or Thermokon) can be operated together on any one bus.
- When choosing where to position the gateway, select a place that will give it the best possible range, with no furniture or walls etc. that might adversely affect the wireless route.
- EnOcean reception can be verified with appropriate devices. For example, the company Thermokon offers a wireless signal measuring device (www.thermokon.de EPM100 and EPM 110). This device can be used to evaluate easily the best place for the sensor.

3.4 Baud rates, number of devices per gateway

We recommend that the following numbers of EnOcean sensors per RS 485 bus should not be exceeded:

Baud rate	**Number of sensors**
9600	115
19200	230
38400	460

These settings ensure that less than 1% of telegrams are lost to collisions (assuming 2/3 of sensors transmit every 120s and the remaining 1/3 only in case of an event). It is advisable to set the baud rate as high as possible (38400).

3.5 Range planning

Since wireless signals take the form of electromagnetic waves, the signal is damped on its way from the transmitter to the receiver. This means that the strength of both electrical and magnetic fields will decline. The fall will be in inverse proportion to the square of the distance between transmitter and receiver ($E,H \sim 1/r^2$).
Alongside this natural limit to the range can be added further interference factors: metal parts reflect electromagnetic waves, e.g. reinforcement in walls, metal foil on heat insulation or metal coated heat protective glass. This is why a so-called radio shadow is formed behind them. Even though radio waves can penetrate walls, this will increase damping more than if broadcasting were to take place in the open.
Penetration of radio signals (data from Thermokon, no guarantee):

- Wood, plaster, uncoated glass 90...100%
- Brick, compressed fibre board 65...95%
- Reinforced concrete 10...90%
- Metal, aluminium lamination 0...10%

In practice, this means that the materials used in a building play an important role when assessing the wireless range. The following are some guide values from Thermokon that allow a rough assessment of the environment to be made:
Wireless distance/penetration:
Sight connections:
Typically 30m range in passages, up to 100m in halls
Plasterboard walls/wood:
Typically 30m range through max. 5 walls
Brick/aircrete walls:
Typically 20m range through max. 3 walls

Reinforced concrete walls/ceilings:
Typically 10m range through max. 1 ceiling
Supply blocks and lift shafts should be viewed as bulkheads.
The angle at which the signal transmitted hits the wall also plays a role. The effective wall thickness – and with it signal damping – will vary depending on the angle. If possible, signals passing through wall materials should be perpendicular. Niches in walls should be avoided.

3.6 Sources of interference

Other components that work with high frequency signals, such as computers, audio / video systems, transformers, etc. should be viewed as sources of interference. In all cases, there should be a distance of 0.5 m from such sources of interference.

3.7 High frequency emissions of radio sensors

Since the advent of cordless telephones and the use of wireless systems in residential buildings, there has also been much discussion about the effects of radio waves on the health of people living and working in the building. Often both those in favour and critics are deeply uncertain because of the lack of measured results and long-term studies. A measurement report from the Institute for Socio-Ecological Research and Training (ECOLOG) has now confirmed that high frequency emissions from wireless switches and sensors with EnOcean technology are clearly lower than with comparable, conventional switches.

It is also important to realize that even conventional switches emit electro-magnetic fields, due to their contact spark. Viewed over the full frequency range, the power flux density emitted (W/m^2) is 100 times higher than with radio controlled switches. In addition, due to the reduced wiring with radio controlled switches there is less potential exposure to low frequency magnetic fields emitted via the cable. If the radio emissions from radio controlled switches are compared with other high frequency sources in the building, such as DECT telephones and base stations, the latter systems exceed radio controlled switches by a factor of 1500.

4 Vendor-specific instructions

4.1 Filter with Omnio gateway

When using more than one Omnio gateway we recommend that a filter should be employed at the EnOcean level. This is because the Omnio gateway does not check whether the bus is free and sends every telegram only once. If an EnOcean sensor is received by two different gateways, there may be telegram collisions unless a filter is used.

The filter is used to define which gateway should receive which sensor addresses and forward them on the RS 485 Bus. Collisions are therefore avoided. The filter can be set with a configuration tool from the company Omnio or with the “APG Filter” FBox.

In the FBox a table can be edited with all the device IDs to be received. This is then transferred to the appropriate gateway.

With the Thermokon gateway it is not possible to define a filter. However, since the Thermokon gateway sends every telegram 3 times, with different pauses between telegrams, it is much less likely that telegrams might be lost. The LED marked Error on the Thermokon gateway signals when the bus is currently busy. This however is not a transmission error.

4.2 Change of gateway address

If several gateways are used on one RS 485 bus, they must have different addresses so that filters can be set or so that the gateway can be used in bidirectional mode.

4.2.1 Address change with Omnio gateway

The possible range for station numbers is from FF800000h to FFFFFF80h.
Since with every gateway, starting from the station number, in total 128 wireless telegrams can be sent, the station address from gateway to gateway must in each case differ by a value of 80h. The following is an example for 5 gateways:

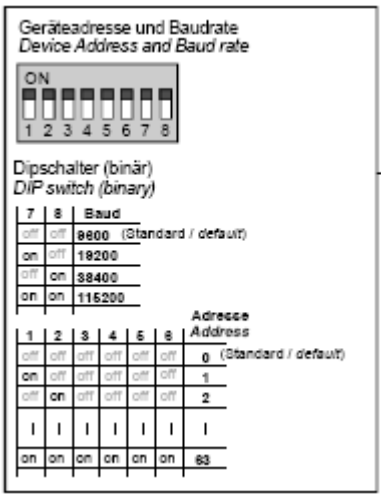
Gateway	**Station number range**
1	FF800000h .. FF80007Fh
2	FF800080h
3	FF800100h
4	FF800180h
5	FF800200h

The address of the Omnio gateway can be changed with the Omnio tool or with the “APG set ID” FBox. For this, the gateway must be set to “Learn Mode” with the S3 key. Once the address has been set, Learn Mode must be switched off by pressing the S3 key again to ensure that the gateway returns to normal operation.

The current address of the gateway can be read with the initialization FBox when the gateway is in “Learn Mode” (by pressing the S3 key). If several gateways are on the bus, it is advisable to initialize every gateway individually before installation and to label them with the ID. When all sensors and gateways are in operation it is difficult to read individual gateway addresses.

4.2.2 Address change with Thermokon gateway

Every Thermokon gateway is supplied with another device ID. The address can be read with the STC FBox.
An additional device address is entered via the DIP switches. This should be adjusted in the FBox when transmitting or querying the ID.


Geräteadresse und Baudrate
Device Address and Baud rate

ON
1 2 3 4 5 6 7 8

Dipschalter (binär)
DIP switch (binary)

7	8	Baud
off	off	9600 (Standard / default)
on	off	19200
off	on	38400
on	on	115200

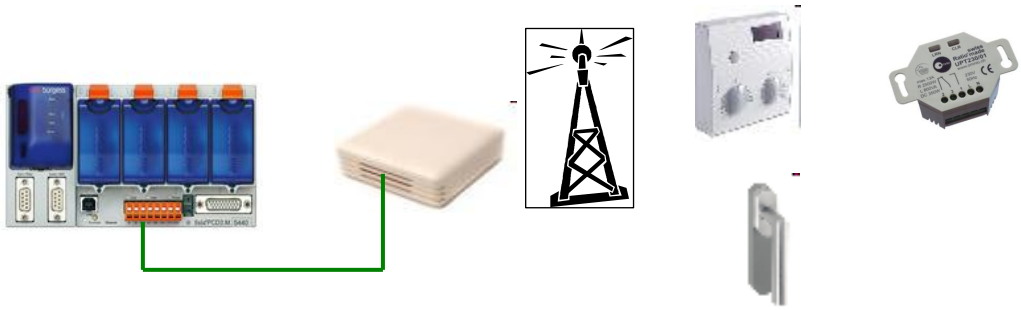
1	2	3	4	5	6	Adresse / *Address*
off	off	off	off	off	off	0 (Standard / default)
on	off	off	off	off	off	1
off	on	off	off	off	off	2
I	I	I	I	I	I	I
on	on	on	on	on	on	63

5 Description of project example

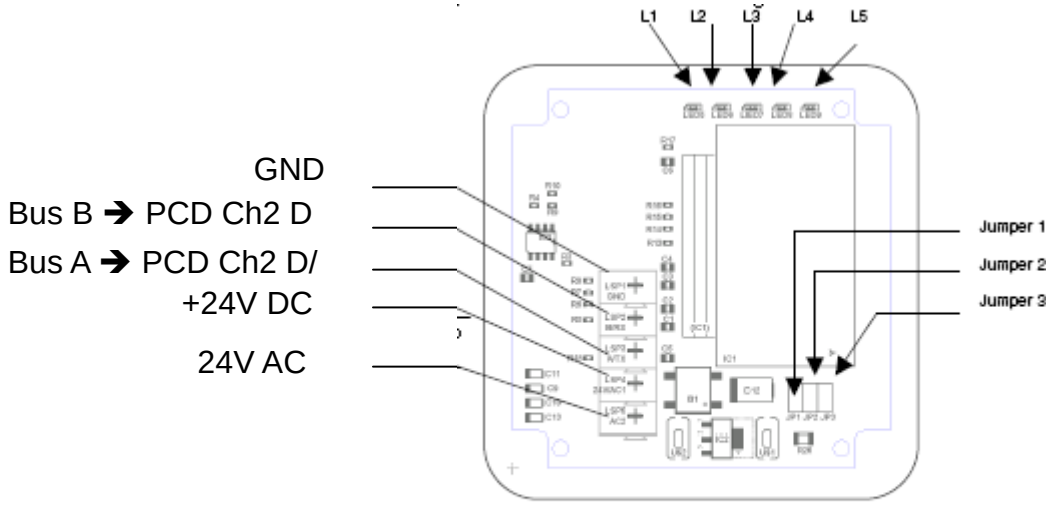
The project example consists of a PCD3.M5540 CPU. The EnOcean gateway is connected to port 2. There is one Fupla project for the Thermokon gateway and another Fupla project for the Omnio gateway. The Fupla project may only ever be linked to the gateway used, never to both at once, since both configurations are identical and located on the same port.

5.1 Omnio

Omnio supplies both unidirectional (APG03U-RS485-Eno) and bidirectional (APG03B-RS485-Eno) gateways.
If transmission is required, a bidirectional gateway must be used:
APG03B-RS485 => bidirectional
If the gateway only needs to receive, a unidirectional gateway may also be used:
APG03U-RS485 => unidirectional

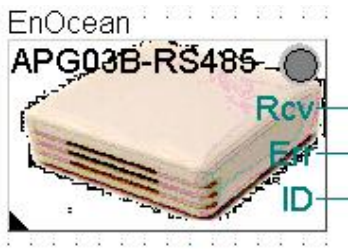


The gateway is connected to the PCD as shown in the following diagram. It must also have a 24V DC or AC supply. The Baud rate can be set by means of 3 jumpers.



Baudrate				
Steckbrücke J1	on	off	on	off
Steckbrücke J2	on	on	off	off
	9600	19200	38400	57600

The same Baud rate must also be set in the EnOcean Init FBox.



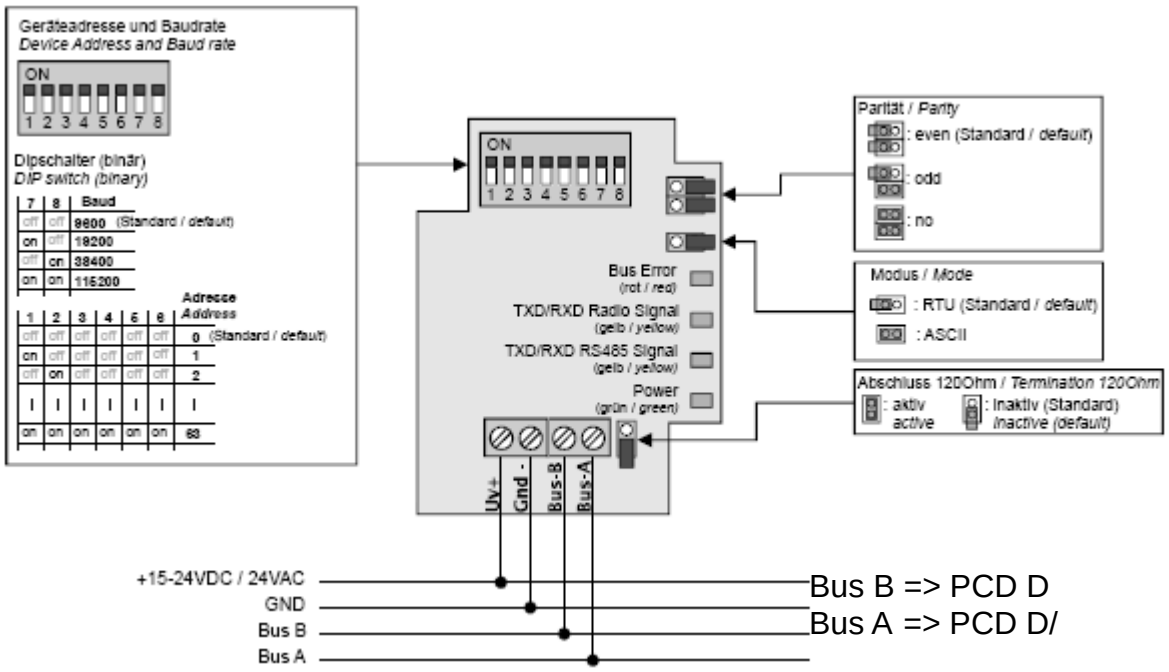
Adjust Parameters	
Communication	
Serial line	Port 2
Baudrate	38.400 bps
Receive	
LiveCheck turn around	60

5.2 Thermokon

Thermokon supplies unidirectional (SRC65-RS485) and bidirectional (STC65-RS485) gateways.

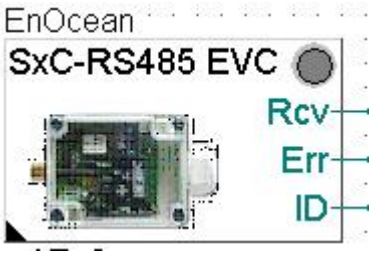
If transmission is required, a bidirectional gateway must be used:
STC65-RS485 => bidirectional
If the gateway only needs to receive, a unidirectional gateway may also be used:
SRC-RS485 => unidirectional

The gateway is connected to the PCD as described in the following diagram.



Baud rate and device address are adjusted via the DIP switch.

The same communications parameters must also be set in the initialization FBox.



Adjust Parameters	
Communication serial	
Serial line	Port 2
Baudrate	38.400 bps
Parity	None (N)
Receive	
LiveCheck turn around	60

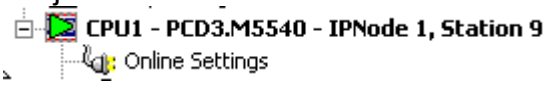
6 Preparation of the project example

To import the project into the PG5, the “Restore” function from the “Project” menu in the PG5 Project Manager may be used.

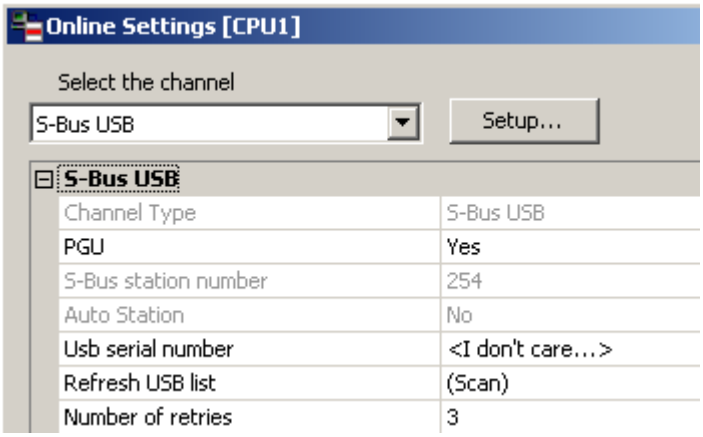
6.1 PCD configuration

Three steps are necessary to prepare the PCD:

Establish online connection to PCD
Before a connection can be established, the PG5 must “know” which medium/cable is to be used for accessing the PCD. This is defined in the “Online settings” of the PG5 Project Tree:



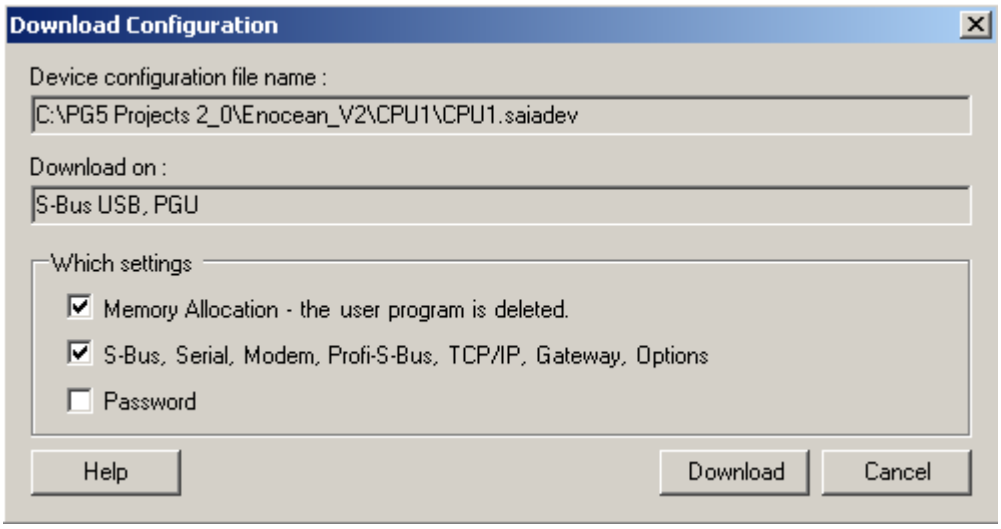
The channel to select here is “S-Bus USB”. The PGU option should be enabled.



Once these settings are complete, the “Online Configurator” can be used to check whether communication is working.

Hardware configuration
The “Device Configurator” is used to configure such settings as the IP address, memory settings and enabling the PCD’s “Run/Stop” switches. The PCD’s “Device Configurator” is to be found in the PG5 Project Tree, directly beneath “Online Settings”.

To download the configuration to the controller, just click on the “Download Configuration” in the “Device Configurator” window.
When asked what should be downloaded onto the controller, the “Memory Allocation” option must also be checked for the first download to configure memory correctly.

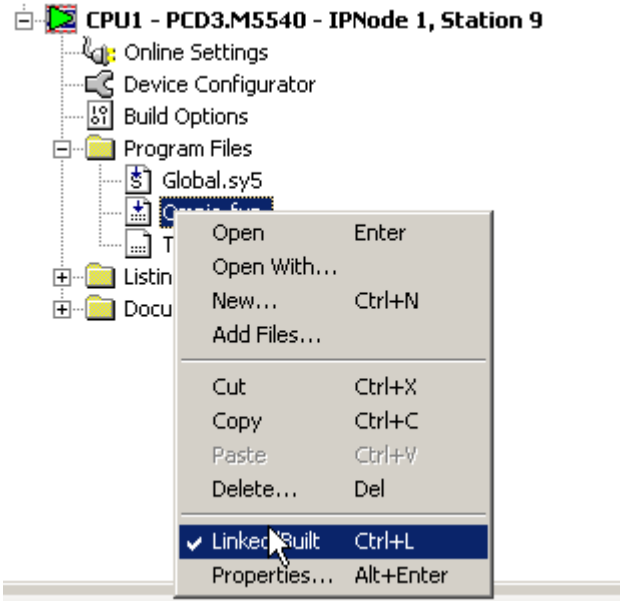


If the exact PCD type is not known, or if the existing hardware configuration must not be changed, it is also possible to use the “Upload” button in the “Device Configurator”. This will transfer the current PCD configuration to the PG5 project.

The hardware settings must be adjusted accordingly on any PCDs that will be used. No special hardware configurations are necessary to operate EnOcean projects. Just ensure that the port used for communication with the EnOcean gateway (port 2) has not been configured elsewhere.

6.2 Further configuration

The example has been designed so that there is one Fupla project for the Thermokon gateway and a second Fupla project for the Omnio gateway. Only enable one of the two Fuplas projects, depending on the gateway used.



7 Programming the PCD

This section includes a short description of the application.

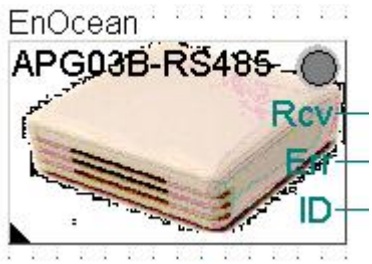
7.1 Downloading the program to the controller

The only thing now missing is the PCD programming. For this, the program must first be translated (“built”). This can be achieved with the “Rebuild All” button .

When the program build has taken place correctly, you can download the program into the PCD with the “Download Program” button . The PCD is now ready. Depending on your PG5 setting, the controller will automatically go into RUN after the download. If not, put the controllers in RUN.

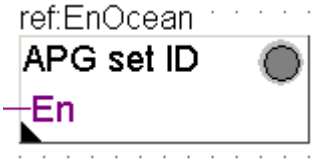
7.2 Initialization

7.2.1 Omnio



Adjust Parameters	
Communication	
Serial line	Port 2
Baudrate	38.400 bps
Receive	
LiveCheck turn around	60

In the example the gateway is connected to port 2 (orange terminal of PCD3).
Omnio connection A => terminal D/ PCD3
Omnio connection B => terminal D PCD3
The Baud rate must match the Baud rate set on the gateway.



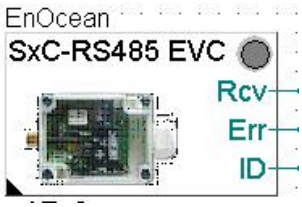
Adjust Parameters	
Old Device ID (hex)	FFFFFF80
New Device ID (hex)	FF800000

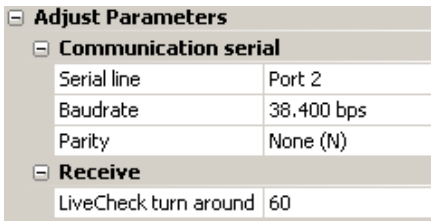
Every gateway has the default address FFFFF80. To give the gateway a new address with the FBox, its original address must be entered in the field “Old Device ID”. The new address is entered in the field “New Device ID”. The FBox’ “En” input must be set high and the Omnio gateway set to “Learn Mode” by pressing the S3 key for 3 seconds. The address can then be written with the “Execute” button. When it has been successfully written, the Omnio gateway is reset from “Learn Mode” to normal mode by pressing the S3 key again for 3 seconds. Otherwise it will stop reacting to sensor transmissions.

Adjust Parameters	
Device Identifier ID (hex)	FF800000
Filter	
List	Inactive
Position 1	10D6CD
Position 2	
Position 3	

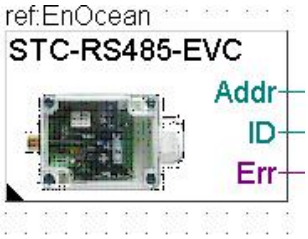
A filter can be set with the “APG Filter” FBox. When several Omnio gateways are used, a filter is necessary to prevent a sensor telegram from being received by several gateways at once, which can lead to telegram collisions on the bus.
The gateway ID is entered in the field “Device Identifier ID”. The IDs of sensors to be received by that gateway can then be entered in the table. The FBox “En” input must be high, so that the FBox reacts to instructions. The table is transferred to the gateway by pressing the “Write filter table” button. The stored table is read with the “Read filter table” button.
If someone wants to turn the filter off, the position “List” can be switched to inactive. The arrow key is used to transfer this “Offline Parameter” to the “Online Parameters”. It is switched to inactive by pressing the “Write filter table” button on the gateway.

7.2.2 Thermokon





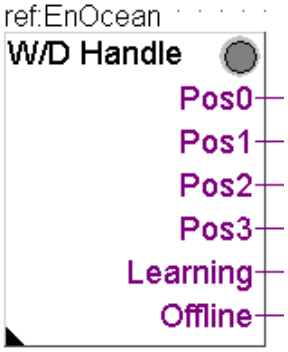
FBox SxC for initializing the interface to the gateway

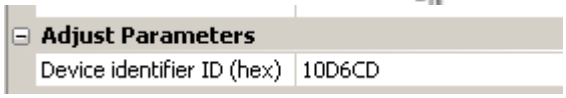


FBox STC is additionally necessary for initializing the bidirectional gateway.
The Thermokon device address is the address set on the DIP switch (default 0).
In this example the gateway is connected to port 2 (orange terminal of PCD3).
Thermokon connection A => terminal D/ PCD3
Thermokon connection B => terminal D PCD3
The Baud rate must match the Baud rate set on the gateway.

7.3 Unidirectional reception

7.3.1 Door / window contact (handle)

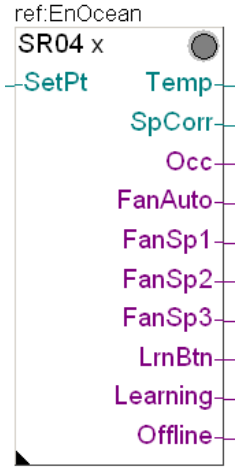


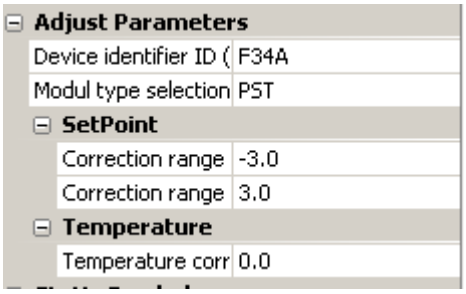


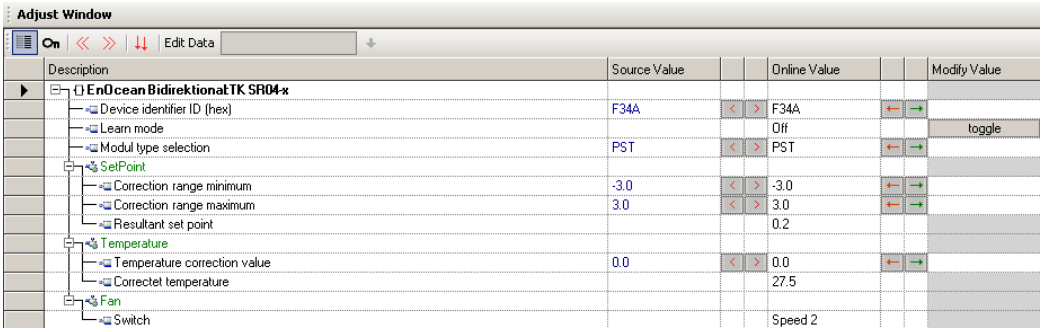
Until the handle has been initialized, positions 0, 1 and 2 are set high, because handle position is only transmitted by an action. In the idle state no signal is transmitted. As soon as the handle has been activated, it will have the correct position again.

Pressing the toggle button will set the FBox to “Learn Mode”. If the handle is now activated a few times (approx. 4 times) the handle address will be read and Learn Mode will be automatically reset. It is, of course, also possible to simply enter the address in the FBox. As a rule, every EnOcean station is provided with a sticker to indicate its ID.

7.3.2 Room control unit SR04PST



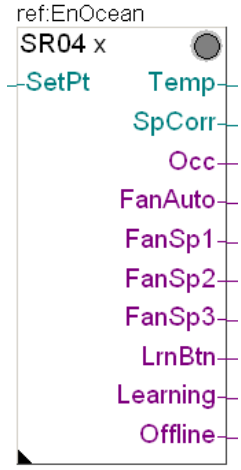


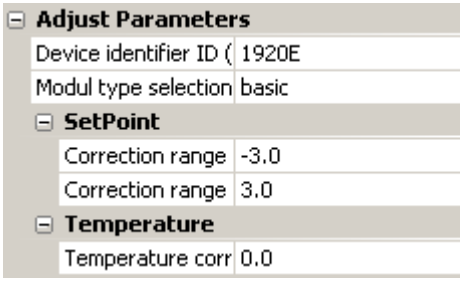


With this room control unit, data is transferred every 100ms (EnOcean standard). If the device is set to “Learn Mode”, identification can be speeded up by pressing the occupancy button (approx. 4 times). As soon as the device has been identified, “Learn Mode” will be switched off again. This FBox can be used for different room

control units. Module type can be selected in the FBox. This is normally indicated on a sticker inside the housing, together with the ID.

7.3.3 Room sensor Sensortec RFFA



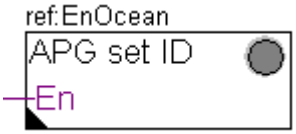


There are no dedicated FBoxes for this room sensor yet, but it can be operated with FBox SR04x. However, it only provides a room temperature. None of the other outputs are used. This room sensor also transmits every 100ms. There is a switch inside the housing for Learn Mode. As soon as the ID has been recognized, Learn Mode is switched off. The ID can also be read on the inside of the housing.

7.4 Bidirectional transmission

7.4.1 Omnio

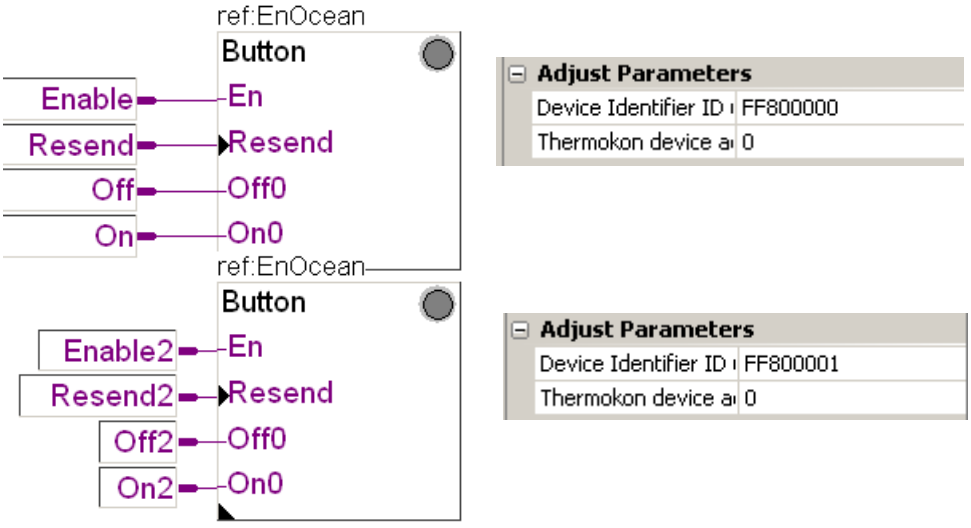
On delivery, all Omnio gateways have the same address: FFFFFF80h. If several Omnio gateways are operated in a network, the addresses must be adjusted accordingly. This can be done with a tool from Omnio (www.omnio.ch) or with the "APG set ID" FBox.



The possible range for station numbers is from FF800000h to FFFFFF80h.
Since with every gateway, starting from the station number, in total 128 wireless telegrams can be sent, the station address from gateway to gateway must in each case differ by a value of 80h. The following is an example for 5 gateways:

Gateway	**Station number**
1	FF800000h
2	FF800080h
3	FF800100h
4	FF800180h
5	FF800200h

Caution! To prevent misuse, a station number cannot be modified more than 10 times.
The tool from Omnio or the "APG Filter" FBox can also be used to set a filter so that each gateway only receives certain addresses. This prevents collisions on the bus.

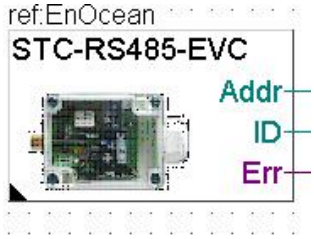


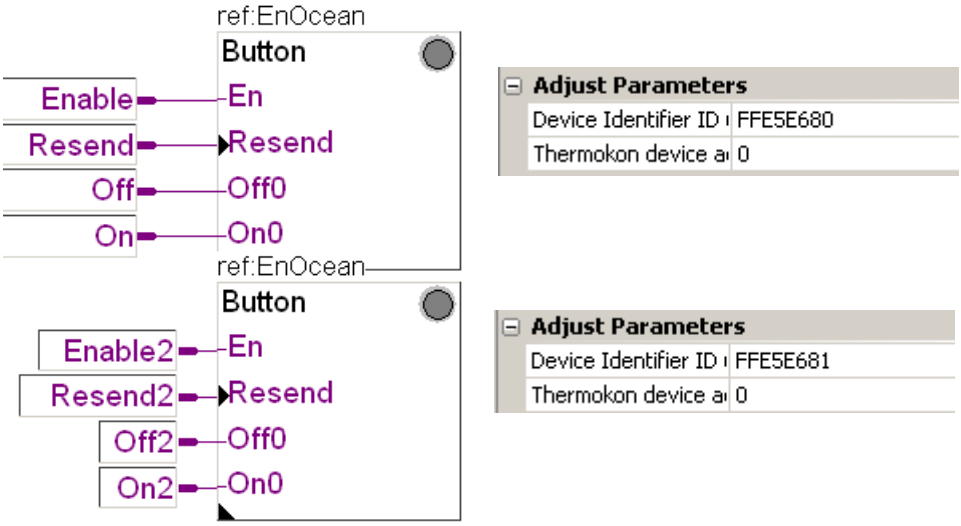
The default address of Omnio's bidirectional gateway is always FFFFFF80 (address range 80h=128 stations). If there are several gateways in the network, to avoid conflicts they must be given different addresses with the Omnio tool or with the "APG set ID" FBox. In this example, two relays are switched: the UPS230/01 Swiss Ratio and the RCM250 easyfit. Both work in quite a similar way. They are set to "Learn Mode" with a "Learn" button. The relay now switches on and off, it is in "Learn Mode". Then the appropriate FBox is used to set an On or Off (at address FF800000 for the UPS and address FF800001 for RCM). As soon as the relay receives the instruction, the on/off switching of the relay will stop. It has learnt this address. By pressing the

"Learn" button again, "Learn Mode" can be exited. However, additional addresses may still be learnt.
If the addresses have been correctly learnt, the UPS relay can now be switched with the first FBox and the RCM relay with the second FBox.

7.4.2 Thermokon

The address of the bidirectional gateways is set through the DIP switch. The following FBox can be used to read the address. In bidirectional mode, this FBox must be set in addition to the initialization FBox.





In this example, the address of the bidirectional gateway has been set to FFE5E680 (address range 80h=128 stations). If there are several gateways in the network, to avoid conflicts they must be given different addresses with DIP switch. In this example, two relays are switched: the UPS230/01 Swiss Ratio and the RCM250 easyfit. Both work in quite a similar way. They are set to "Learn Mode" with a "Learn" button. The relay now switches on and off, it is in "Learn Mode". Then the appropriate FBox is used to set an On or Off (at address FFE5E680 for the UPS and address FFE5E681 for RCM). As soon as the relay receives the instruction, the on/off switching of the relay will stop. It has learnt this address. By pressing the "Learn" button again, "Learn Mode" can be exited. However, additional addresses may still be learnt.
If the addresses have been correctly learnt, the UPS relay can now be switched with the first FBox and the RCM relay with the second FBox.

With the Thermokon gateway, the device address must be entered in addition to the ID. This is set via the DIP switch (default 0)

8 Troubleshooting

Symptom	Possible cause	Solution
With every transmission from an EnOcean station, an error is indicated in the Init FBox	Bad communication. Connections D and D/ may have been inverted.	Check wiring and correct if necessary.
Not every signal is recognized	- Distance too great between sensor and gateway - Too little energy for the transmission - Distance too great from sensor parts (e.g. window contact) - Telegram collision if a sensor is in receiving range of several receivers	- Reduce distance - Better illumination of solar cell, possible addition of battery - Check/improve mounting of sensor - Switch on receiver filter
Many errors with Init FBox	- Line termination resistors missing on bus - Telegram collision - RS 485 cable badly shielded or not twisted	- Check and if necessary terminate bus - Switch on receiver filter - Check and if necessary change cable

9 References

Topic	Document	No.
Misc.	Saia® FAQ Manager www.sbc-support.ch/faq	-