

EDK 300 / EDK 300C / EDK 300U Developer's Kit for EnOcean Dolphin Modules



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<http://www.enocean.com/en/patents/>

EDK 300 / EDK 300C / EDK 300U
DEVELOPER'S KIT FOR ENOCEAN DOLPHIN MODULES**REVISION HISTORY**

The following major modifications and improvements have been made to the first version of this document:

| No | Major Changes |
|-----|--|
| 1.0 | Initial version |
| 1.1 | Changed size of ext. energy storage module |
| 1.2 | Updated to new DolphinStudio and WinEtel |
| 1.3 | |
| 1.4 | DolphinView added, WinEtel removed |
| 1.5 | Changed CD/Getting started to Package leaflet |
| 1.6 | EVA 320-2 for evaluation only, replaced Keil limited version by 30-day trial version |
| 1.7 | STM 3xy, PTM 210, ESK 300 and TCM 310 added |
| 1.8 | 902 MHz version added (indication letter: U) |

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Important notes

This information describes the type of component and shall not be considered as guaranteed characteristics. No responsibility is assumed for possible omissions or inaccuracies. Circuitry and specifications are subject to change without notice. For the latest product specifications, refer to the EnOcean website: <http://www.enocean.com> .

As far as patents or other rights of third parties are concerned, liability is only assumed for modules, not for the described applications, processes and circuits. EnOcean does not assume responsibility for use of modules described and limits its liability to the replacement of modules determined to be defective due to workmanship. Devices or systems containing RF components must meet the regulations of the local legal authorities. The modules must not be used in any application with equipment that supports, directly or indirectly, human health or life or within applications that can result in harm for people, animals or property. Components of the modules are considered, and should be disposed of, as hazardous waste. Local government regulations are to be observed. Packing: Please use the recycling operators known to you.

This evaluation kit and its components are intended for evaluation, demonstration or engineering development purposes only. It is not considered to be a finished end product fit for consumer use. Persons handling this developer kit must have electronics expertise and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design, marketing, and/or manufacturing related protective considerations, including product safety and environmental measures typically found in end products that incorporate such electronic components or circuit board. EnOcean will not be reliable for consequences of any HW or SW changes/modifications of the developer board(s) done by the developer. Before using the EDK 300 please consider country specific radio regulations and frequencies, e.g. R&TTE (EDK 300 = 868 MHz) for the European Union or FCC (EDK 300C/U = 315/902 MHz) for US.

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DEVELOPER'S KIT FOR ENOCEAN DOLPHIN MODULES**For users in Japan:**

This developer kit is not certified as confirming to technical regulations of radio law of Japan. If you use this kit in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

Use this product in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on sub-section 1.1 of article 6 of the "Rule for Enforcement of Radio Law of Japan".

Use this kit only after you obtained the license of "Test Radio Station" as provided by the Radio Law of Japan with respect to this product, or use of this product only after you obtained the technical regulations conformity certification as provided by the Radio law of Japan with respect to this product.

Do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

**Observe precautions! Electrostatic sensitive devices!**

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1. General Description

Thank you for purchasing this developer kit. EnOcean welcomes you to the innovative world of self-powered wireless applications.

1.1 Frequency variations and marking

EDK 300 is available in multiple frequency variations:

| | |
|------------|-------------|
| ■ EDK 300 | 868.300 MHz |
| ■ EDK 300C | 315.000 MHz |
| ■ EDK 300U | 902.875 MHz |

Inside this manual the following term, EDK 300x, can be used interchangeably for any of the above frequencies. The same markings apply for the modules shipped within the kit, e.g. a PTM 210C will be shipped with an EDK 300C kit, but the manual will refer to PTM 210x.

The term TCM3x0x will be used interchangeably for all types and frequency variations of the EnOcean TCM module family.

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1.2 Basic Functionality

Before you start developing self-powered solutions it is essential to understand the specific needs of this technology:

- Self-powered devices use micro energy harvesters, energy is always a resource that requires special design attention
- Energy efficiency during radio reception and transmission is of key importance
- Transmission duration directly affects communication robustness
- Data processing capabilities of EnOcean chips and modules are closely linked with the user application and energy budget of a customer specific usage



EDK 300x's are comprehensive developer kits capable of implementing innovative applications in the fast growing market of self-powered sensor/actuator solutions with radio communication. The following image illustrates the basic concept:



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Line powered transceivers:

In most applications line powered transceivers work in conjunction with EnOcean self-powered wireless sensors. They receive telegrams, interpret them, and perform actions. Line powered transceivers can for example be implemented as gateway to other communications systems, as repeater, or as actuator to switch on/off lights. The TCM 3xy module's behaviors are completely programmable to suit your custom needs.

Self-powered, wireless sensor:

The wireless sensor module harvests energy from its environment. This can for example be from a kinetic, solar, or thermo energy converters. More details about micro harvesting technologies are available at:

<http://www.enocean.com/en/energy-harvesting/>

Valuable electrical energy has to be carefully stored and managed in order to power sensor circuits, a microcontroller, and the radio interface. Most of the time a self-powered wireless sensor is in sleep mode to reduce energy consumption, if the sensor value (e.g. temperature) changes it will wake up and send this value via a radio telegram. Periodic wake and send cycles (e.g. 15 min) are providing keep alive telegrams with actual sensor values. EnOcean has optimized the modules of the product family STM 3xy for these event and periodic driven applications.

1.3 Transceiver modules

TCM 300x / TCM 320x modules provide several built-in operating modes. In addition, repeater functionality can be activated (1 or 2 level). With the Dolphin API library, it is possible to write custom software for these modules.

Built-in operating modes (Standard firmware)

- Unidirectional serial communication
- Bidirectional serial communication
- 1-channel & 4 channel relay mode
- 1-channel dimming mode

Features accessible via API

- Integrated 16 MHz 8051 CPU, 32 kB FLASH, 2 kB SRAM
- Up to 14 configurable I/Os
- 10 bit ADC, 8bit DAC

TCM 310x modules enable the realization of gateways for the EnOcean radio systems. It provides a bi-directional radio interface at one end and a bi-directional serial interface at the other end. Radio messages are sent transparently through the serial interface in both directions from and to an externally connected host processor or host PC. In addition, control commands can be sent from the host, e.g. to configure the repeater functionality or to manage the Smart Ack functions. The TCM 310x can act as postmaster for up to 15 bi-directional sensors using Smart Ack technology.

For a detailed technical description see user manuals of specific products.



1.4 Sensor modules

The **STM 300x** module enables the realization of wireless, maintenance free sensors and actuators such as room operating panels, motion sensors or valve actuators for heating control. Using the Dolphin API library it is possible to write custom software for the module.



STM 300x

Features with built-in firmware

- 3 A/D converter inputs
- 4 digital inputs
- Configurable wake-up and transmission cycle
- Wake-up via Wake pins
- Voltage limiter
- Threshold detector

Features accessible via API

- Integrated 16 MHz 8051 CPU with 32 kB FLASH and 2 kB SRAM
- Receiver functionality
- Various power down and sleep modes
- Up to 16 configurable I/Os
- 10 bit ADC, 8bit DAC

For a detailed technical description see STM 300x user manual.

STM 3xy product family enables the fast realization of a wide range of wireless and maintenance free sensors such as temperature sensors, humidity sensors, or room operating panels.

Following add-on kits are available:

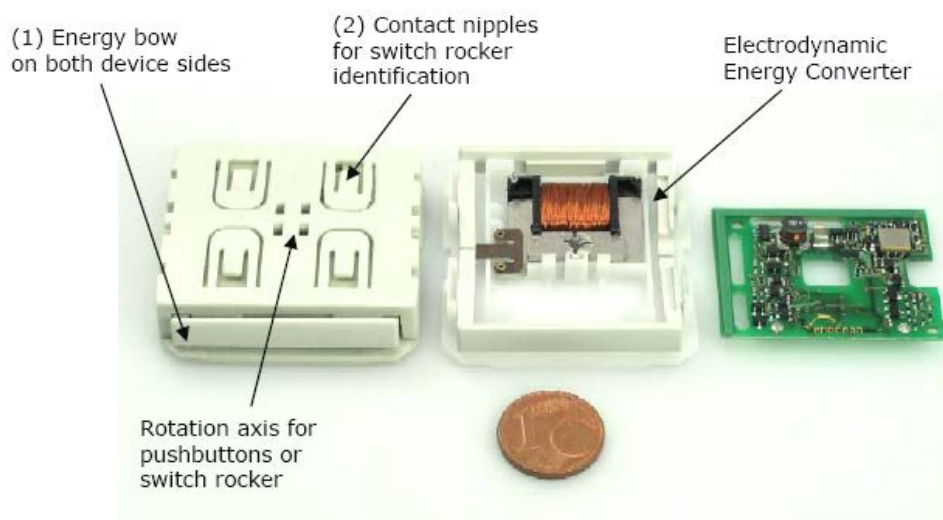
- EDK 310x - Extension Developer's Kit for solar solutions
- EDK 312x - Extension Developer's Kit for thermo solutions

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1.5 Self-powered push button

The PTM 210x enables the implementation of wireless remote controls without batteries. Electrical power is provided by a built-in electro-dynamic power generator.

A PTM 210x device transmits the EnOcean radio interface protocol. Together with a transceiver module (e.g. TCM 310x), this device can be easily integrated in operation and control units for application-specific switching solutions.



A detailed technical description can be found within the specific user manuals:

- PTM 210: http://www.enocean.com/en/enocean_modules/ptm-210/
- PTM 210C: http://www.enocean.com/en/enocean_modules1/ptm-200c/
- PTM 210U: http://www.enocean.com/en/enocean_modules_902mhz/ptm-210u/

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2 Content and ordering information

2.1 Content

EDK 300 (868 MHz Version):

| | |
|------------------------------------|---|
| 1x EVA 300 | Evaluation board for TCM 3x0 |
| 1x EVA 320 | Evaluation board for STM 300 |
| 2x EOP 300 | Programmer and USB interface |
| 1x TCM 300 on adapter board | Transceiver module (SMD mounted on adapter board) |
| 1x TCM 320 | Transceiver module (SIL connector) |
| 1x STM 300 on adapter board | Scavenger module (SMD) |
| 1x PTM 200 | Self-powered switch |
| 2x USB cable | USB 2.0 standard type A <-> type B |
| 1x Package leaflet | Links to tools & user documentation |

EDK 300C (315 MHz Version):

| | |
|-------------------------------------|---|
| 1x EVA 300 | Evaluation board for TCM 3x0C |
| 1x EVA 320 | Evaluation board for STM 300C |
| 2x EOP 300 | Programmer and USB interface |
| 1x TCM 300C on adapter board | Transceiver module (SMD mounted on adapter board) |
| 1x TCM 320C | Transceiver module (SIL connector) |
| 1x STM 300C on adapter board | Scavenger module (SMD) |
| 1x PTM 2x0C | Self-powered switch |
| 2x USB cable | USB 2.0 standard type A <-> type B |
| 1x Package leaflet | Links to tools & user documentation |

EDK 300U (902 MHz Version):

| | |
|-------------------------------------|---|
| 1x EVA 300 | Evaluation board for TCM 3x0C |
| 1x EVA 320 | Evaluation board for STM 300C |
| 2x EOP 300 | Programmer and USB interface |
| 1x TCM 300U on adapter board | Transceiver module (SMD mounted on adapter board) |
| 1x TCM 320U | Transceiver module (SIL connector) |
| 1x STM 300U on adapter board | Scavenger module (SMD) |
| 1x PTM 2x0U | Self-powered switch |
| 2x USB cable | USB 2.0 standard type A <-> type B |
| 1x Package leaflet | Links to tools & user documentation |

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2.2 Ordering information and related extension kits

| Type | Ordering Code | Frequency |
|-------------------------------|--------------------------|-----------|
| ESK 300 EnOcean Starter Kit | S3004-E300 | 868.3 MHz |
| ESK 300C EnOcean Starter Kit | S3034-E300 | 315.0 MHz |
| ESK 300U EnOcean Starter Kit | S3054-E300 ¹⁾ | 902.8 MHz |
| EDK 300 Basic Developer Kit | S3004-X300 | 868.3 MHz |
| EDK 300C Basic Developer Kit | S3034-X300 | 315.0 MHz |
| EDK 300U Basic Developer Kit | S3054-X300 | 902.8 MHz |
| EDK 310 Solar Developer Kit | S3004-X310 | 868.3 MHz |
| EDK 310C Solar Developer Kit | S3034-X310 | 315.0 MHz |
| EDK 310U Solar Developer Kit | S3054-X310 ¹⁾ | 902.8 MHz |
| EDK 312 Thermo Developer Kit | S3004-X312 | 868.3 MHz |
| EDK 312C Thermo Developer Kit | S3034-X312 | 315.0 MHz |
| EDK 312U Thermo Developer Kit | S3054-X312 ¹⁾ | 902.8 MHz |
| USB 300 USB Stick Gateway | S3004-K300 | 868.3 MHz |
| USB 300C USB Stick Gateway | S3034-K300 | 315.0 MHz |
| USB 300U USB Stick Gateway | S3054-K300 ¹⁾ | 902.8 MHz |

¹⁾ = Available soon, please check with your sales contact or distributor.

3 PC Software

3.1 Overview & Installation

EDK 300 comes with a comprehensive software package for firmware development, chip configuration and protocol tracing. The following chapters will describe installation and basic usage of this software.

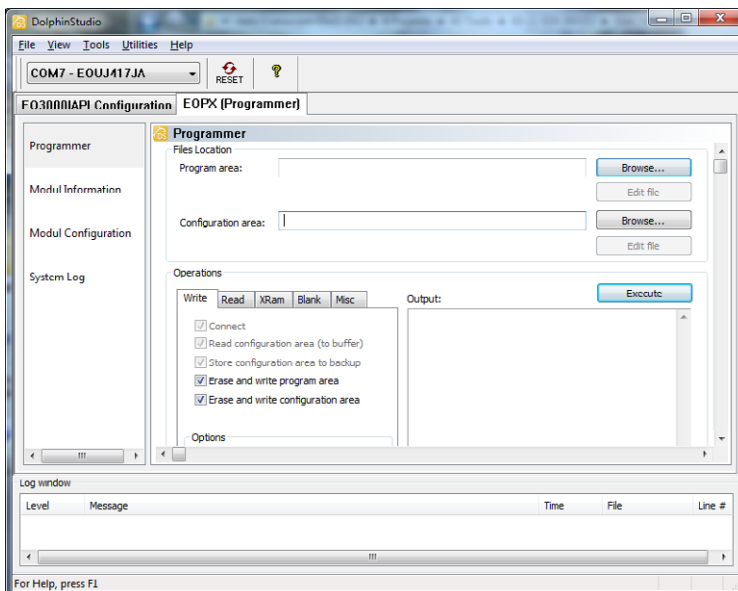
Please obtain the latest software version before starting:
<http://www.enocean.com/en/download/>

3.2 DolphinStudio

The EnOcean DolphinStudio software is a graphical user interface allowing easy configuration and programming of Dolphin modules (STM 300x and TCM 3x0x). New firmware can be uploaded to Dolphin modules. Chip information with boot loader and firmware information can be read. A configuration file can be generated after selecting desired application parameters (e.g. I/O, UART, radio settings).

Installation and first usage:

1. Launch DolphinStudio setup program and follow instructions
2. Connect EOP 300 programmer to PC via USB cable; connect EOP 300 to EVA 300 or EVA 320 evaluation board via ribbon cable
3. Select COM port via drop down menu

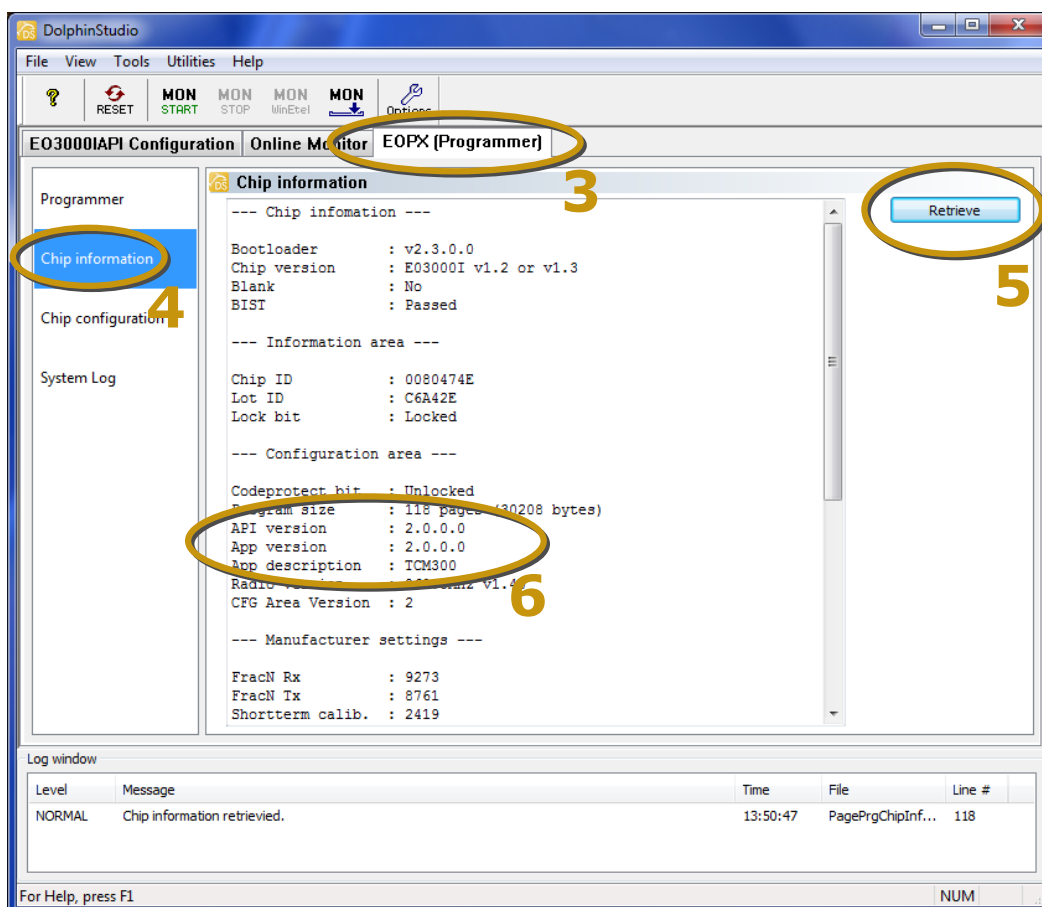


Attention:

- If you have installed a previous DolphinStudio version, it is recommended to uninstall older version
- If you have already installed older FTDI USB driver, it is recommended to remove previous and install latest FTDI driver by cross marking installation menu at the end of setup

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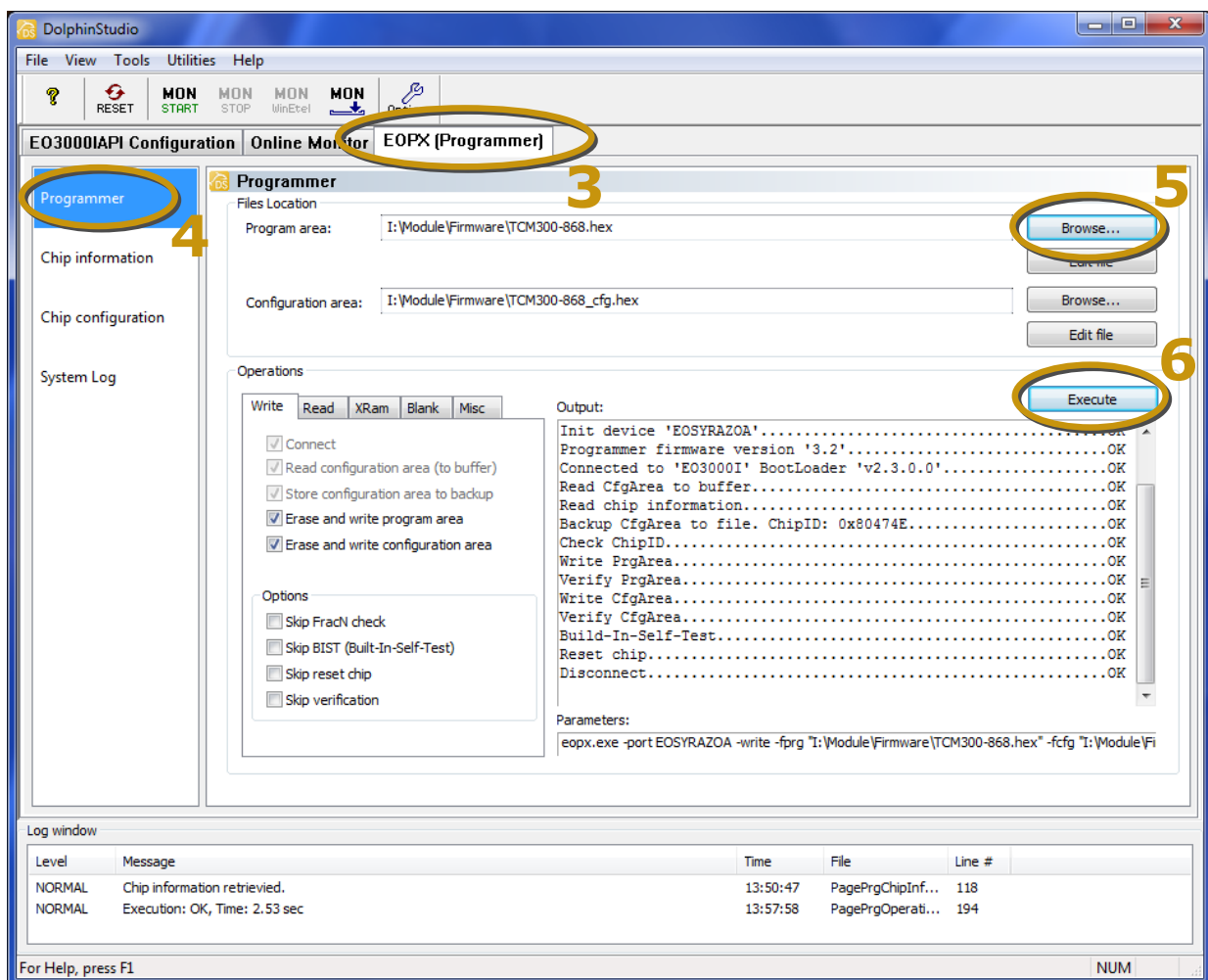
1. Connect EVA 300 or EVA 320 with STM/TCM 3x0x plugged via EOP 300 to PC
2. Launch DolphinStudio
3. Select tab **EOPX (Programmer)**
4. Select **Chip information**
5. Press **Retrieve** button
6. Current application type and version e.g. "TCM 300 2.0.0.0" will be shown



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Download a new firmware:

1. Connect EVA 300 or EVA 320 with STM/TCM 3x0x plugged via EOP 300 to PC
2. Launch DolphinStudio
3. Select **EOPX (Programmer)** tab
4. Select **Programmer**
5. Select FW file via **Browse...** button e.g. TCM300-868.hex;
chip configuration file will be automatically recognized by ending ..._cfg.hex
6. Press **Execute** button to start the update process



Firmware updates for EnOcean modules can be found on EnOcean download website: <http://www.enocean.com/en/download/> . Please register for your personal account.

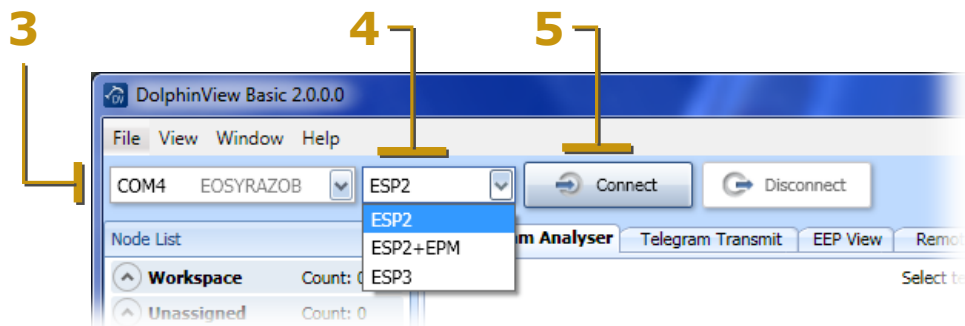
3.3 DolphinView

DolphinView is a dynamic, full featured, GUI based hardware interaction suite. It receives, sends and analyses radio telegrams according to the EnOcean standard. In combination with the transceiver it is possible to simulate e.g. sensors or switch modules (e.g. PTM 2x0) incl. detailed information e.g. subtelegram timing and signal strength. Content of telegrams can be analyzed and logged with time stamps. DolphinView supports remote management features like ping, query and remote learn as well as EnOcean's security features.

The DolphinView license is part of the license agreement of EDK 300

Installation process and basic receiver test:

1. Launch DolphinView setup program and follow instructions
2. Connect EOP 300 programmer to PC via USB cable and connect programmer to EVA 300 or EVA 320 evaluation board via ribbon cable; check jumper settings according to TCM 3x0x mode 1 'serial communication'
3. Select COM port for serial interface "COM ..."
4. Select the ESP* serial protocol type **:
 - ESP2: standard TCM 300/320
 - ESP2+EPM: internal use
 - ESP3: TCM 300/320 incl. gateway controller firmware
5. Connect to EVA 300 board (= transceiver)



6. Check connection by pressing self-powered push button (PTM 2x0)

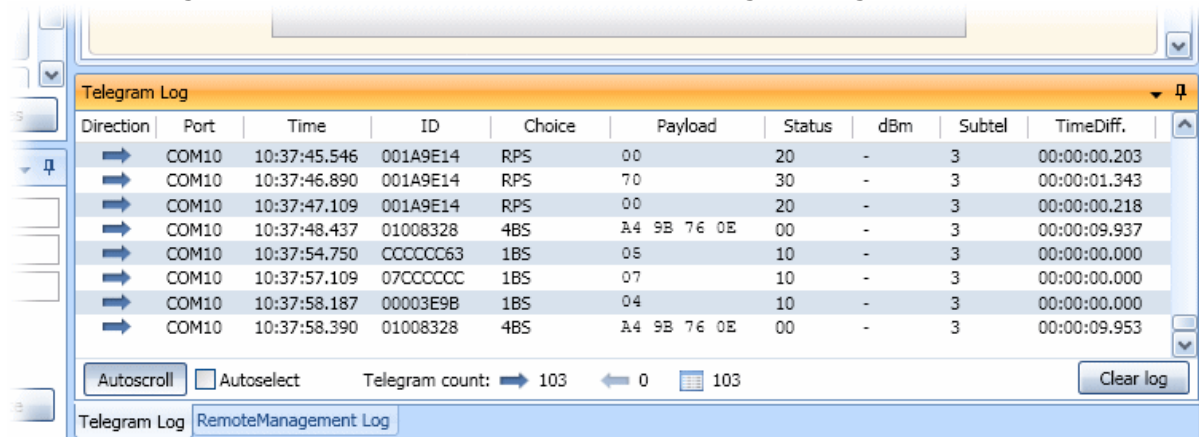
* EnOcean Serial Protocol

** Future DolphinView versions will automatically select the serial protocol type

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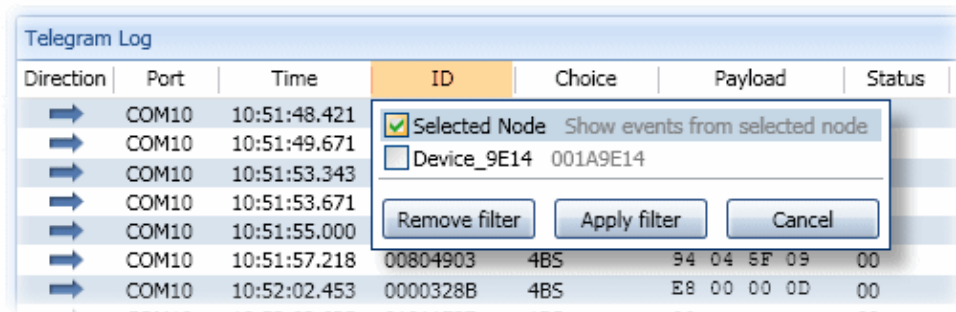
Basic usage of DolphinView:

1. Connect PC with USB receiver (e.g. EOP 300 <-> EVA 300 <-> TCM 3x0) and start DolphinView software
2. Received telegrams are shown in the window area Telegram Log

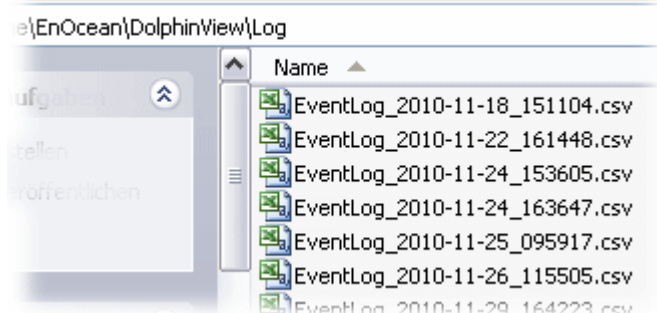


Details about EnOcean Equipment Profile are available at EnOcean Alliance website:
<http://www.enocean-alliance.org/>

3. Telegrams can be filtered by various criteria, e.g. by mouse button click on **ID** (specific telegram hex ID)



4. Received telegrams are automatically logged. The log file location is the path of program installation (Windows Explorer): ... \Program Files\EnOcean\DolphinView\Log



For more details please use the DolphinView help (see menu bar).

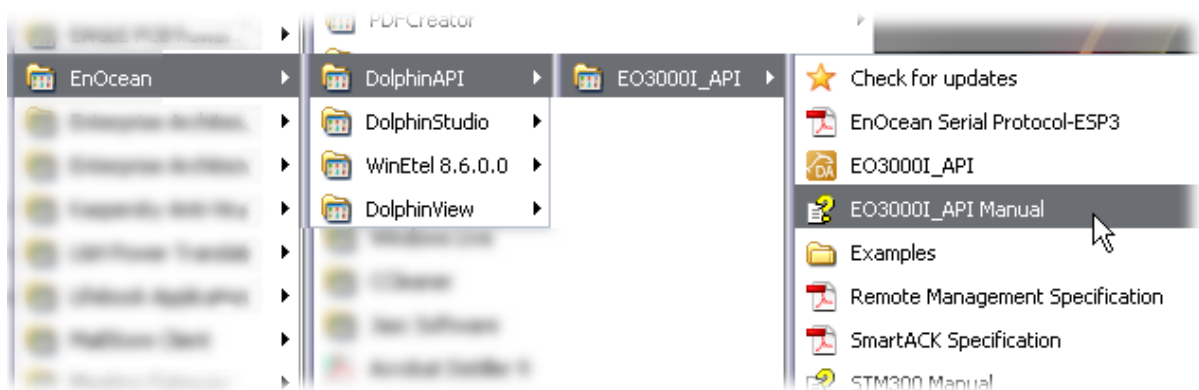
3.4 DolphinAPI (Documentation)

EnOcean modules are designed to cover an unlimited range of applications. In some cases it might be necessary to implement application specific firmware; DolphinAPI will help you design around custom requirements.

EnOcean DolphinAPI is a powerful application programming interface for programming TCM 3x0x and STM 300x modules. The API enables you to quickly develop your application software. The DolphinStudio provides a graphical user interface to configure all necessary chip parameters easily for the use API.

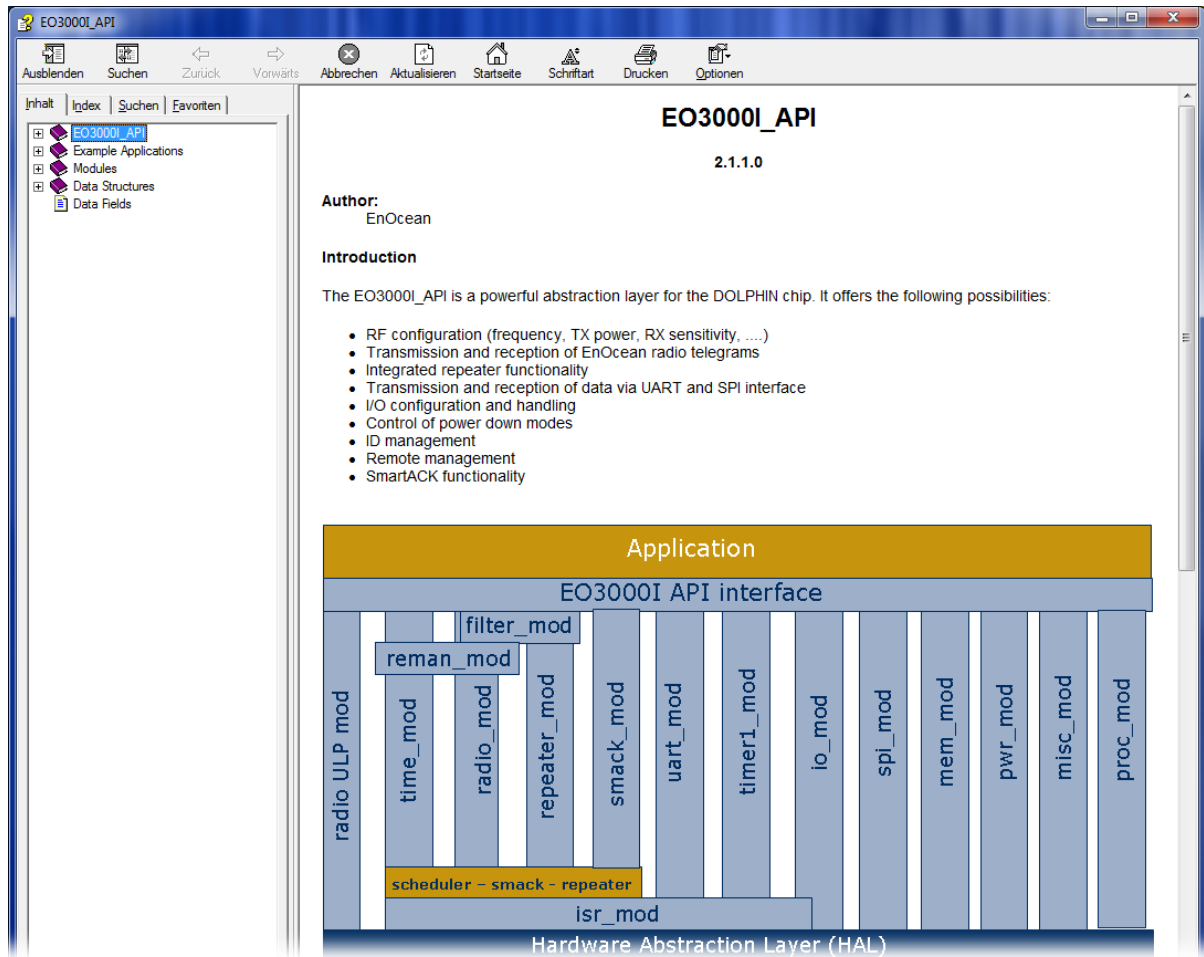
Installation process:

1. Uninstall previous DolphinAPI (if already installed)
2. Execute DolphinAPI setup program and follow instructions
3. Start EO3000I_API Manual help file via Windows user interface



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4. Select desired chapter



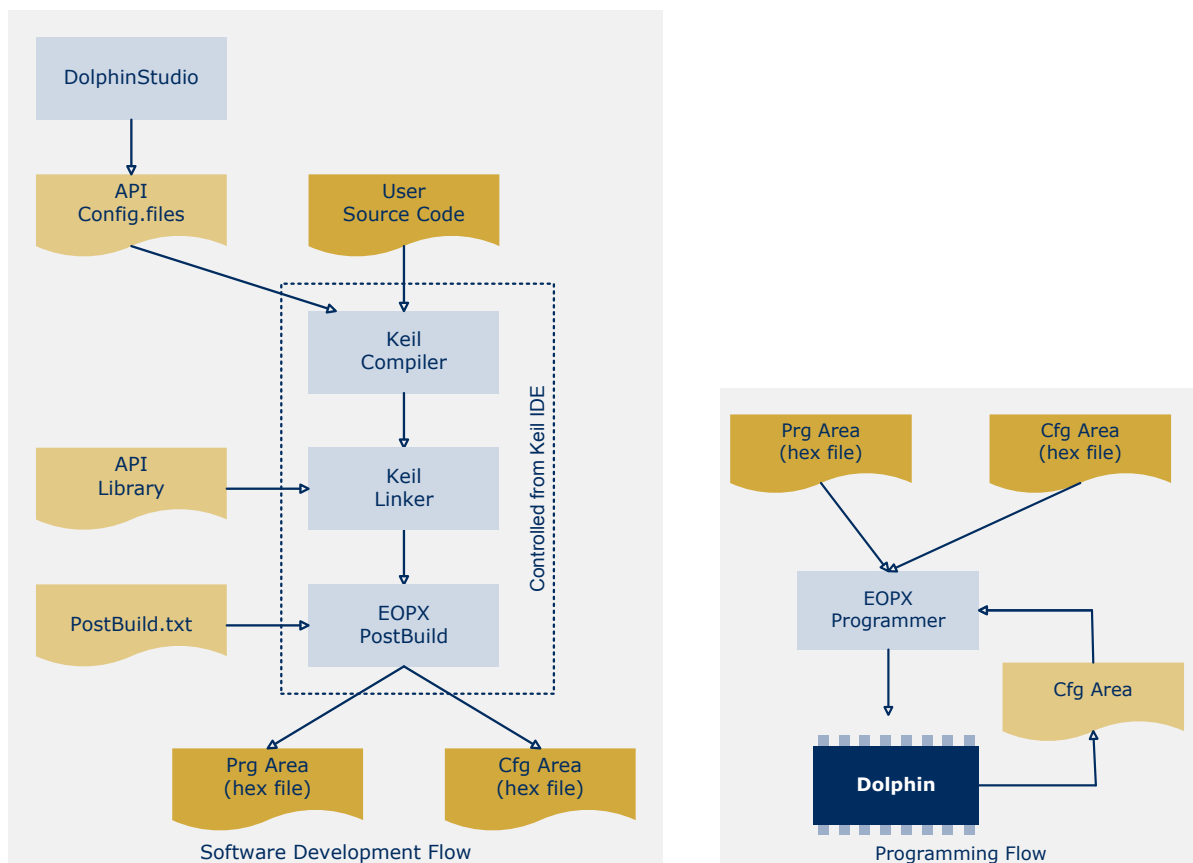
3.5 Firmware Development Process

All EnOcean radio modules based on Dolphin EO3000I chip can be customized by developing application specific software. The following chapter provides a short introduction how to implement software with the EDK 300 developer kit.

Basically three components are necessary to generate a new application:

- A configuration file with Dolphin EO3000I settings generated by DolphinStudio
- C-Source code of user application
- Dolphin API library

Following image shows the standard build process of Dolphin software:



The compiled and linked application can be downloaded via DolphinStudio (EOPX.EXE) programming feature and EOP 300 programmer attached to the EVA 300 or EVA 320 evaluation board. Programming and software debugging can be done e.g. by using Keil µVision invoking EOPX command line applications. For details also see DolphinStudio help.

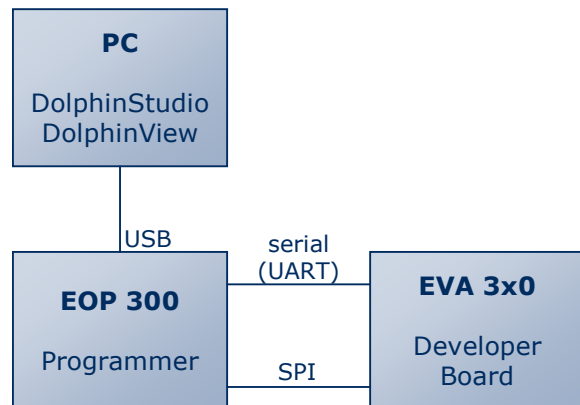
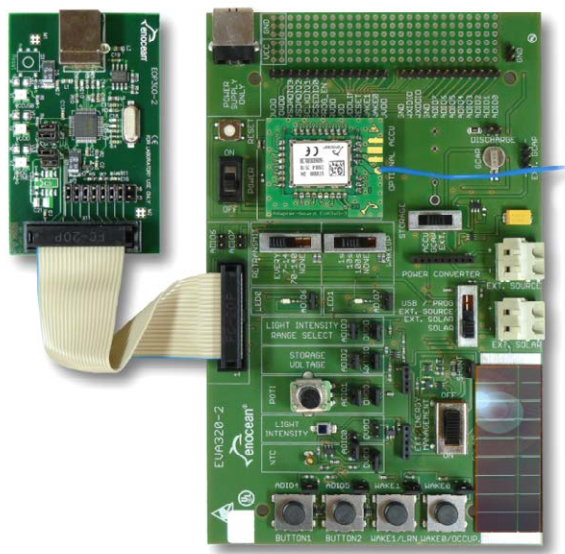
3.6 Development Process and Keil μ Vision (PK51) EnOcean

Keil μ Vision (C51) has been optimized for the EnOcean Dolphin platform. The Keil μ Vision IDE is used for compiling and linking 8051 firmware for modules based on EnOcean's Dolphin (EO3000I) platform.

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4 EOP 300 programmer

In order to use serial communication or program modules with new firmware you need to connect the evaluation boards to a PC via EOP 300 programmer. The programmer translates standard serial (UART) and programming interface (SPI) signals to the PC's USB interface. Following images provide an overview of PC <-> EOP 300 <-> EVA 3x0 connections:



EnOcean serial protocol (UART):

TCM 3x0x and STM 300x modules support a serial interface protocol. This protocol is used to translate received and sent data from the radio interface to the serial interface. Respective commands and protocol details can be found in the TCM 3x0x and STM 300x user manuals. WinEtel uses this protocol to communicate with EnOcean modules.

Programming interface (SPI):

The programming interface of TCM 3x0x and STM 300x is used to upload new software to the modules. For details about the EO3000I SPI interface, please see the Dolphin EO3000I user manual. DolphinStudio uses this protocol for programming.

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5 EVA 300 evaluation board for TCM 3x0

The EVA 300 is designed to implement and test applications based on TCM 3x0 modules. It has the following key features:

- Supports all line powered applications e.g. switching actuator, gateway and repeater
- Programming interface for customer specific applications
- Two slots for TCM 300x and TCM 320x variants
- Easy prototyping of customer specific HW with patch area, jumpers and pin connectors for all module signals
- LEDs for various signals and optional signal strength indication (RSSI)
- Supports all standard operation modes of TCM 3x0x

5.1 Overview

EVA 300 is designed to evaluate line powered applications based on TCM 300x or TCM 320x modules.

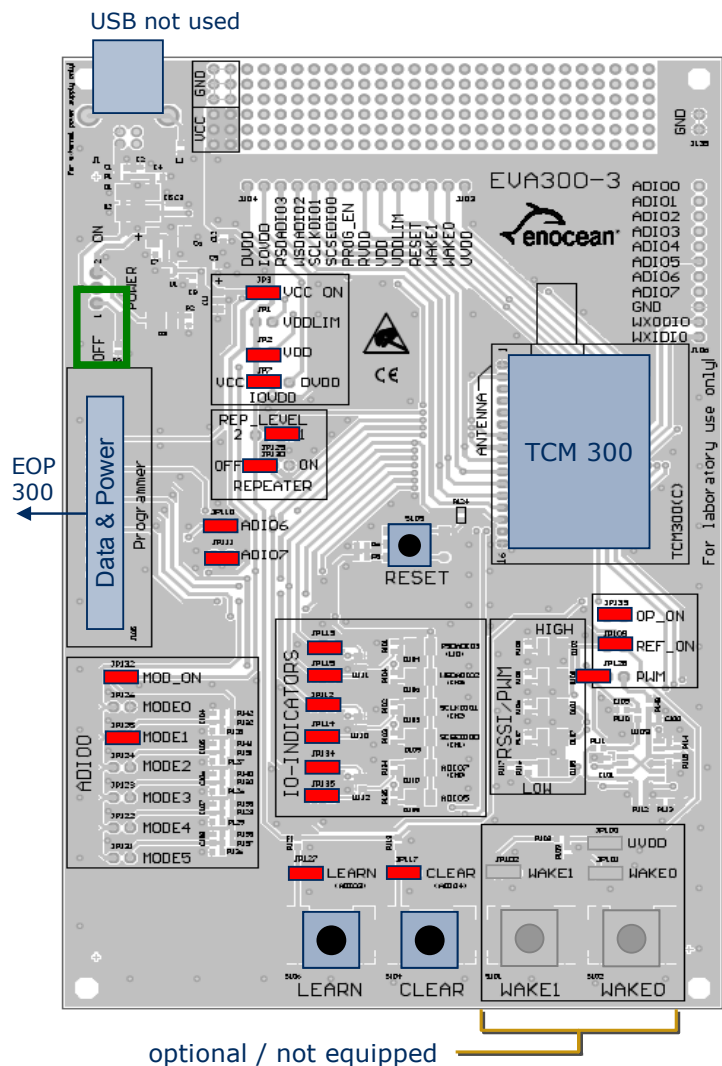
The TCM 300x is horizontally mounted via an adapter board. The TCM 320x should be vertically mounted into the labelled slot.

The evaluation board can be either supplied from the EOP 300 programmer or via (power supply only) USB connector.

EVA 300 supports all TCM 3x0x standard firmware modes via jumper settings. In repeater mode, 1 or 2 level repeating can be selected.

A set of buttons support multiple applications. RESET button is most likely used for customer specific application development. LEARN, CLEAR, WAKE0 and WAKE1 buttons are typically used by standard firmware to configure and learn actuators or gateways.

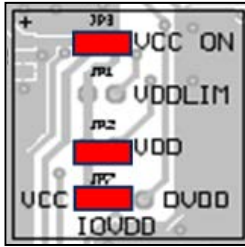
IO indicator LEDs show the status of IO ports e.g. for LMI and CH0 - CH3. Additional RSSI/PWM LEDs are used to display dimming status (PWM) or signal strength (RSSI).



EDK 300 / EDK 300C / EDK 300U DEVELOPER'S KIT FOR ENOCEAN DOLPHIN MODULES

5.1.1 Voltage jumpers

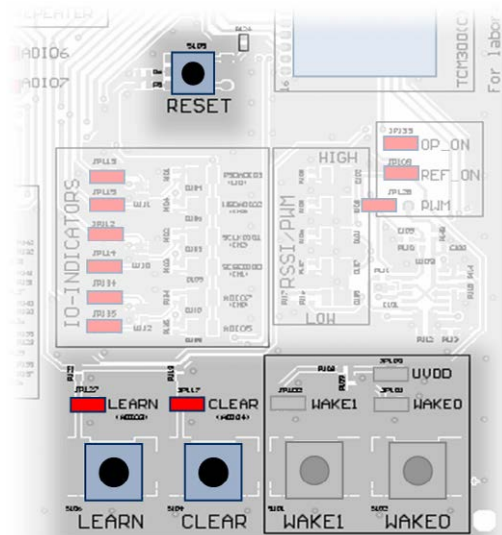
Dolphin modules can work with different supply and IO voltage levels. For details see the respective user manual. Voltage level on EVA 300 board can be set according to application. Standard line powered TCM 3x0x applications will work with following voltage settings:



- VCC ON = connected: connect power supply (allows current measurement)
- UDDLIM = not connected: limits voltage level for energy harvesting, STM 300 only!
- VDD = connected: connect power supply (allows current measurement)
- IOVDD = VCC: select VCC as IO voltage (3,3 V)

5.1.2 Buttons

Most line powered transceiver applications need buttons for user interactions. EVA 300 provides a standard set of buttons connected to input pins:

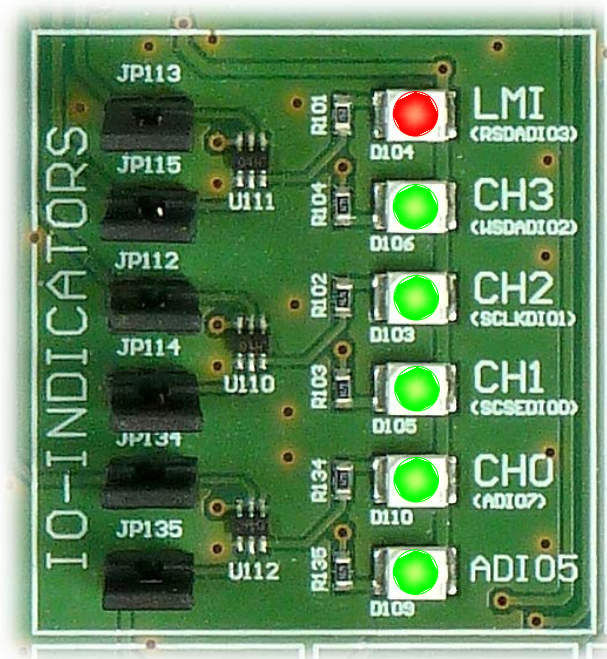


- RESET: Most likely used during development phase only
- LEARN (ADIO03): Learn new EnOcean device IDs
- CLEAR (ADIO4): Clear all EnOcean device IDs
- WAKE0/1: Optional for STM 300 usage only

EDK 300 / EDK 300C / EDK 300U DEVELOPER'S KIT FOR ENOCEAN DOLPHIN MODULES

5.1.3 LED indicators

The EVA 300 provides the following indicators LEDs:



- **LMI:**
(RSDADIO3) Learn Mode Indicator; lit if in active learn mode (switching/dimming actuator)
- **CH0 - CH3:**
(CH0: ADIO7)
(CH1: SCSEDIO0)
(CH2: SCLKDIO1)
(CH3: WSDADIO2) Shows specific channel output signal (switching actuator)
- **ADIO5:** Shows ADIO5 output signal

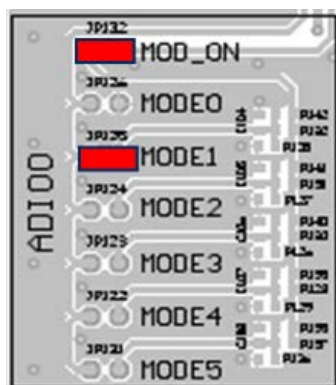
EDK 300 / EDK 300C / EDK 300U DEVELOPER'S KIT FOR ENOCEAN DOLPHIN MODULES

5.1.4 TCM 3x0x modes of standard firmware

TCM 3x0x standard firmware can be configured for 5 (6) different operating modes. These modes are mainly used for building and industry automation applications. Following table provides an overview of this feature:

| Mode | Function | Description | No. of channels |
|------|---|---|-----------------|
| 0 | Unidirectional serial interface (ESP2) | Compatible mode to TCM 220C, no teach-in capability | - |
| 1 | Bidirectional serial interface (ESP2) | Teach-in capability for up to 30 transmitters | - |
| 2 | 1 channel switch | Supplies the desired logic switching state "on/off" at CHANNEL0 when pushing the switch rockers | 1 |
| 3 | 4 channel switch | Same as Mode 2 but operation of 4 receiver channels (CHANNEL0, CHANNEL1, CHANNEL2, CHANNEL3) | 4 |
| 4 | 1 channel dimming | PWM pin generates pulse with modulated signal for dimming circuit | 1 |
| 5 | Reserved | - | - |

The TCM 3x0x mode can be changed on EVA 300 board by jumper settings for the ADI00 pin:



1. MOD_ON jumper has to be set to use TCM 3x0 standard modes
2. MODE0 – MODE5 jumper selects the desired TCM mode



IMPORTANT: As long as IDs are stored in ID memory, the operating mode can only be changed after deleting all IDs from memory, e.g. via CLR!

5.1.5 EnOcean address ID learn procedure (teach-in)

Every transmitter or transceiver has a unique EnOcean ID (address) which has to be learned by its corresponding receiver (actuator/gateway). TCM 3x0x modes 1 to 4 support teach-in of EnOcean IDs from transceivers (e.g. push button or self-powered sensor).

Following methods exist to learn new EnOcean IDs:

1. Manually learn new IDs via LEARN or CLEAR button
2. Remote Management via radio interface (see TCM 3x0 user manual)
3. Serial interface commands (see TCM 3x0 user manual)

Manual learning of EnOcean IDs will be confirmed depending on TCM 3x0x mode by following LEDs on EVA 300:

| Mode | Function | LMI | Channel |
|------|--------------|--------|--|
| 0 | Uni-serial | - | No Learn capability |
| 1 | Bi-serial | LED on | CH1 LED toggling every 1s |
| 2 | 1-ch switch | LED on | CH0 LED toggling every 1s |
| 3 | 4-ch switch | LED on | Current CHx toggling every 1s |
| 4 | 1-ch dimming | LED on | CH1 and PWM toggling every 1s between 10% and 100% |
| 5 | Reserved | - | - |



IMPORTANT: In order to delete a PTM transmitter the same rocker as during learn has to be operated. If several rockers of a PTM transmitter have been learned, all have to be deleted separately.

[illegible]

EDK 300 / EDK 300C / EDK 300U
 DEVELOPER'S KIT FOR ENOCEAN DOLPHIN MODULES

5.3 TCM 3x0x mode 2: 1-channel relay switch

Mode 2 is used to switch on/off **a single** electrical actuator (e.g. a lamp).

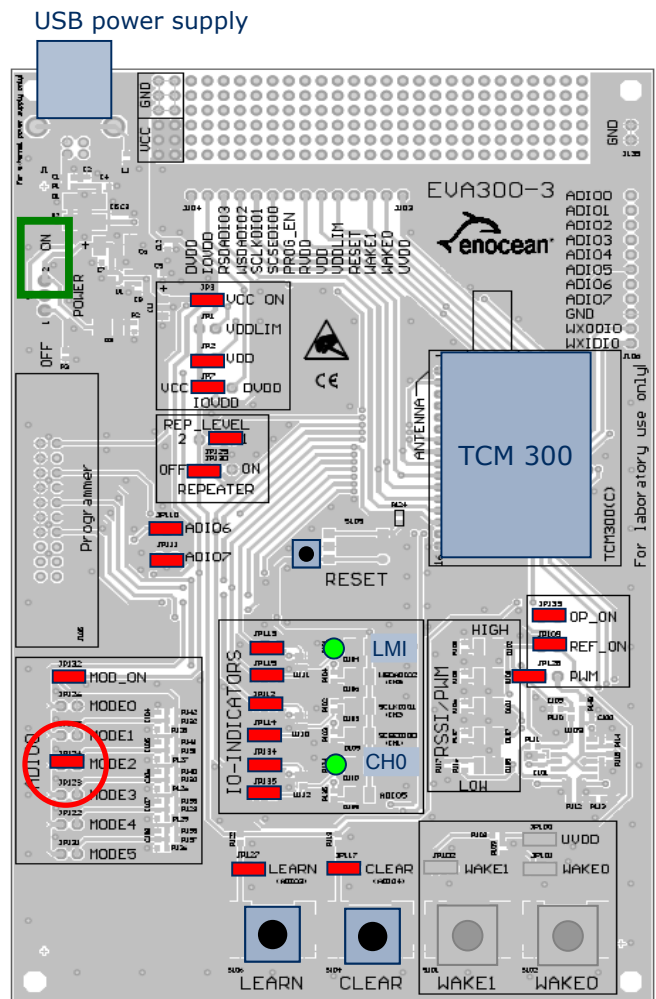
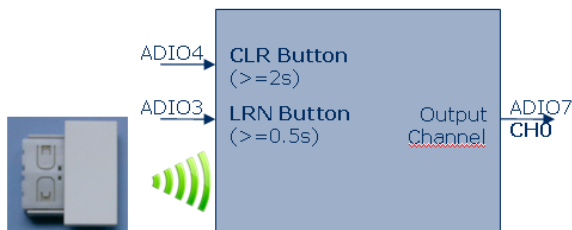
LMI (Learn Mode Indicator) LED will show learn status and channel 0 (CH0) LED will display status of controlled output signal.

The image below illustrates the necessary jumper settings.

Learn procedure:

1. Press CLEAR button to clear (existing) device Ids and start learn procedure. LMI LED will turn on and CH0 LED will flash.
2. Press self-powered button (PTM 2x0x)
3. Stop learn procedure by pressing LEARN or wait 30s until it stops automatically

-> CH0 LED (actuator) can be switched on/off by pressing PTM

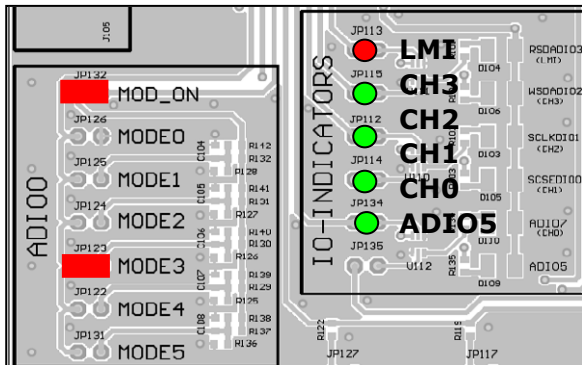


optional / not equipped

EDK 300 / EDK 300C / EDK 300U DEVELOPER'S KIT FOR ENOCEAN DOLPHIN MODULES

5.4 TCM 3x0x mode 3: 4-channel relay switch

This mode is used to switch on/off **multiple** (up to 4) electrical actuators (e.g. lamps). LMI (Learn Mode Indicator) LED will show learn status and channel 0 to channel 4 LEDs (IO indicator) will display status of controlled output signals. Image below illustrates necessary jumper settings and indicator signals.



Learn procedure:

You will need up to four PTM switches or 2 PTM switches with double rocker to fully utilize the 4 channels. Different PTM switches can be assigned to all four output channels.

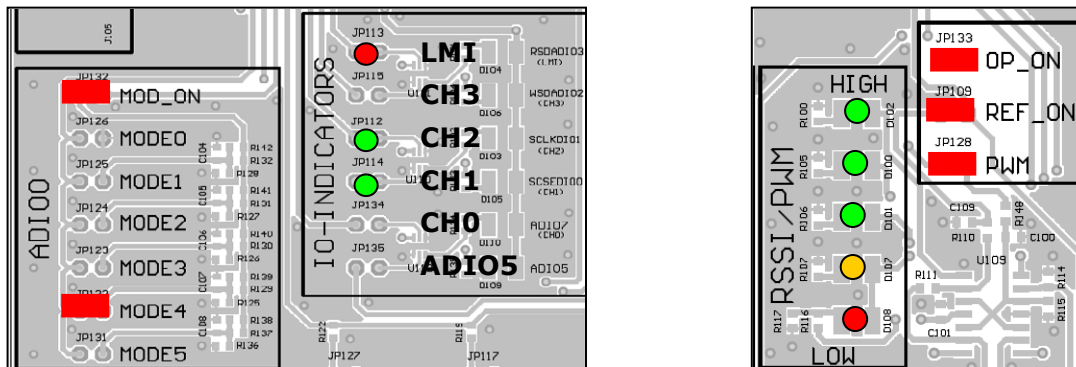
Example to learn 4 PTM switches to all four channels:

1. Press CLEAR button to clear (existing) device IDs and start learn procedure. LMI LED will turn on and CH0 LED will flash.
2. Press self-powered PTM #1, CH0 will be on for a few seconds
3. Press LEARN button, CH1 will flash
4. Press self-powered PTM #2, CH1 will be on for a few seconds
5. Press LEARN button, CH2 will flash
6. Press self-powered PTM #3, CH2 will be on for a few seconds
7. Press LEARN button, CH3 will flash
8. Press self-powered PTM #3, CH3 will be on for a few seconds
9. Stop learn procedure by pressing LEARN
10. Every PTM can switch on/of its corresponding channel

EDK 300 / EDK 300C / EDK 300U DEVELOPER'S KIT FOR ENOCEAN DOLPHIN MODULES

5.5 TCM 3x0x mode 4: 1-channel dimmer

This mode is used to dim a single electrical actuator (e.g. a lamp). LMI (Learn Mode Indicator) LED will show learn status and Channel 0 (CH0) LED will display status of controlled output signal. Image on below illustrates necessary jumper settings.



1. Press CLEAR button to clear (existing) device IDs and start learn procedure. LMI LED, CH1 and CH2 LEDs will turn on.
2. Press self-powered button (PTM 210x)
3. Stop learn procedure by pressing LEARN
4. Press PTM 210x I-Button (if rocker is not signed e.g. with "1", bottom side) long time will rise PWM signal from low to high
5. Press PTM 210x O-Button long time will decrease PWM signal from high to low
6. By pressing I-Button short time, TCM 3x0x will switch on with the last known PWM value

For details please look at the TCM 3x0x user manual.

EDK 300 / EDK 300C / EDK 300U
DEVELOPER'S KIT FOR ENOCEAN DOLPHIN MODULES

5.6 TCM 3x0x repeater

The repeater feature is used to extend the range of an EnOcean radio signal. A repeater is placed between the transmitter (e.g. PTM 200x or STM 300x) and receiver (e.g. TCM 300x). Up to two repeaters can be used on any transmitted information. The second repeater has to be configured as level 2 repeater. The repeater can be configured for use in parallel with any mode.

Example level 1 repeater:



EVA 300/
TCM 320

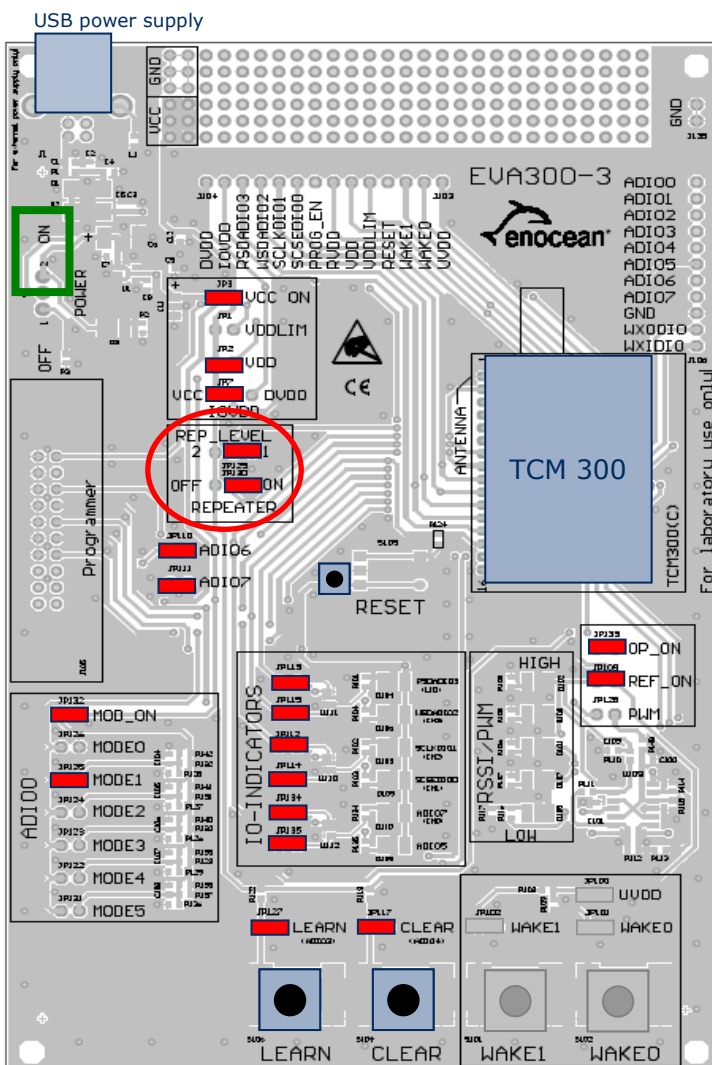
repeater
mode



EVA 320/
TCM 300

receiver
mode

Jumper configuration:



6 EVA 320 evaluation board for STM 300x

6.1 Overview

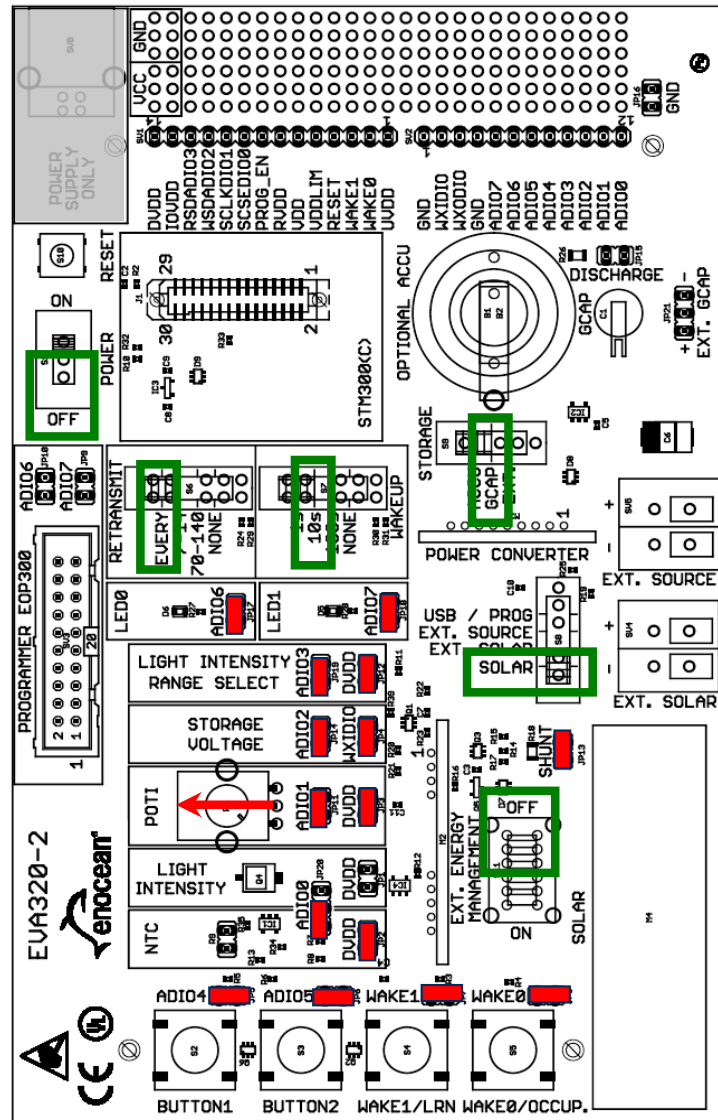
The EVA 320 is designed to evaluate self-powered, battery less sensor applications based on STM 300x modules.

A STM 300x module on adapter board has to be plugged into the labelled slot.

On-board solar cell and external solar cells are supported by the on-board energy management. EVA 320 can be connected to other energy harvesters by using the external power converter slot, examples are ECT 300 thermo harvester or ECO 100 or ECO 200 push button converter.

The EVA 320 comes with a short term energy storage (tantal capacitor) to ensure short setup times for initial sensor operation and a long term storage (Goldcap) for operation during several days darkness. An optional lithium accumulator (e.g. VL2320-1HF or VL1220-1HF) can extend runtime during darkness to several months. Additional power storage concepts can be added via the external energy slot.

Various sensor applications can be tested via on-board temperature sensor, brightness sensor and potentiometer. The status of the long term energy storage can be tracked by a voltage measurement circuit. Wake up (1-100s) and retransmission interval (7-140s) can be set via switches. Application specific buttons enable LEARN, WAKE and OCCUPANCY features. LEDs can be used to show status of the ADIO6/7 pins. This can be used for example to display the event of sending a telegram.



IMPORTANT: EVA 320-2 is designed for evaluation purposes of STM 300. It is not intended to be considered as a reference design. For reference circuit see latest application notes.

AN208: STM 300 Energy Storage – Design Considerations

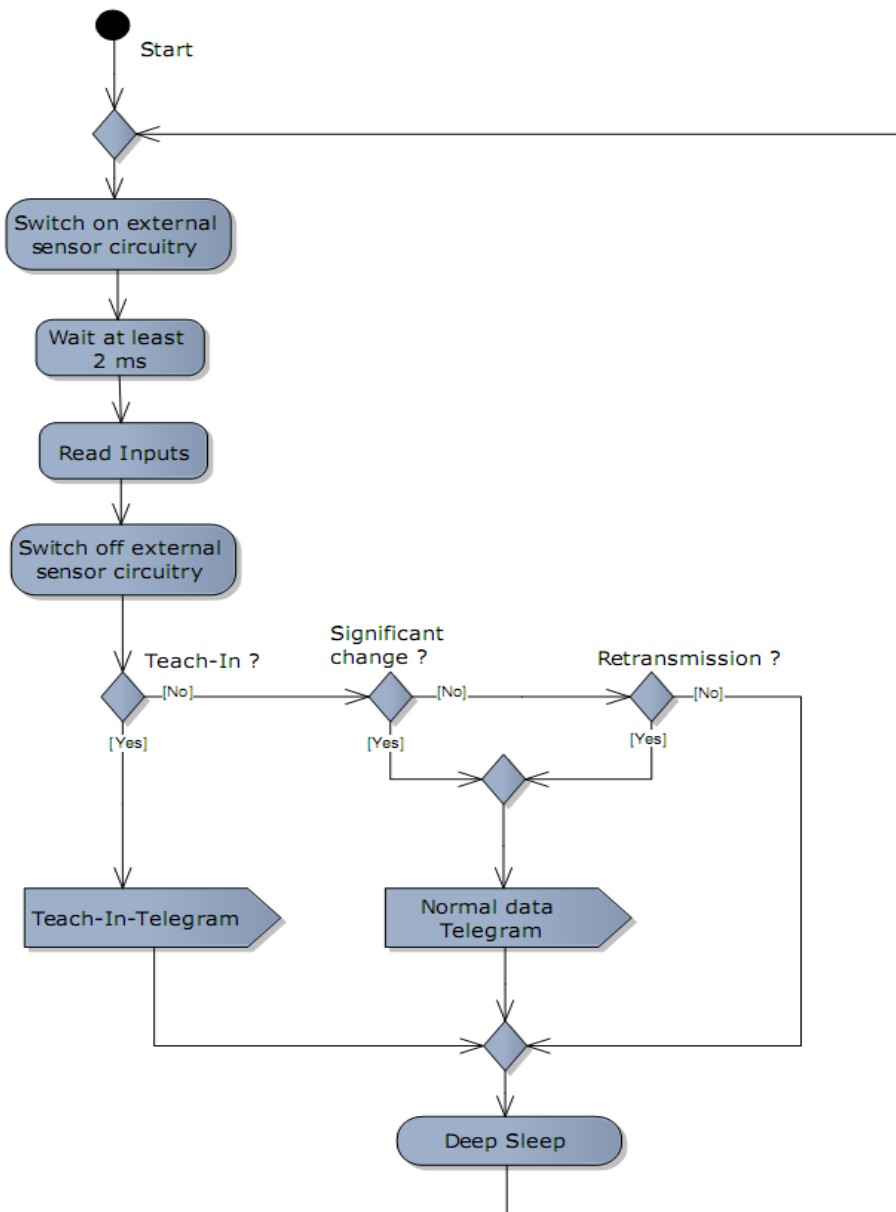
AN314: Rail-to-Rail Sensor Applications using STM 31x

<http://www.enocean.com/application-notes/>

EDK 300 / EDK 300C / EDK 300U
DEVELOPER'S KIT FOR ENOCEAN DOLPHIN MODULES

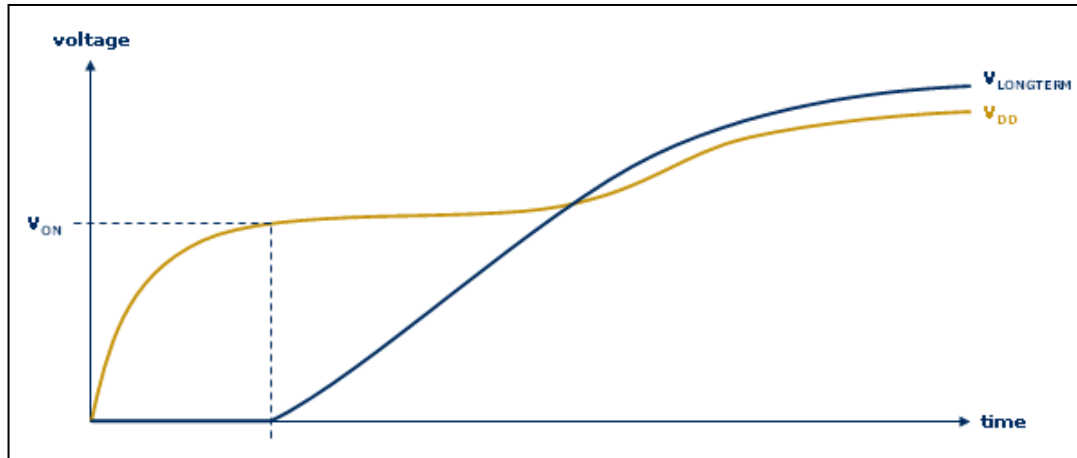
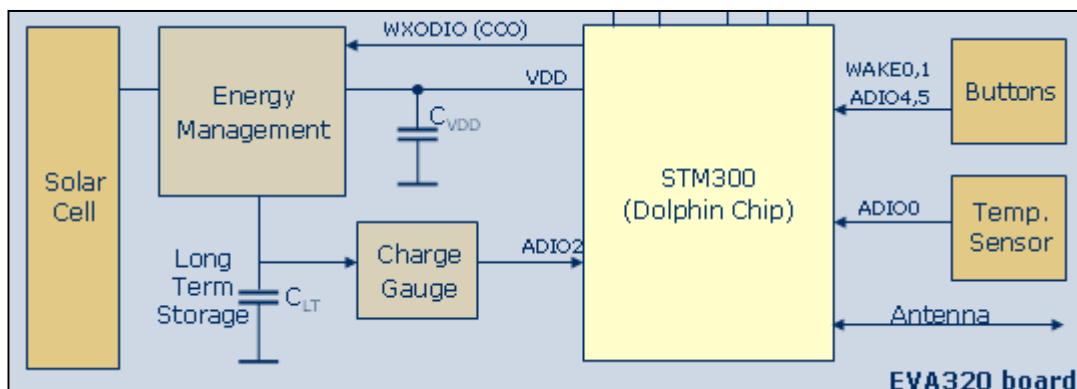
The STM 300x module provides a very flexible self-powered sensor platform. Standard firmware offers multiple sensor scenarios and can be configured via digital input pins (e.g. jumper) and firmware parameterization (configuration area). Multiple digital or analogue inputs are measured and sent via the EnOcean radio interface. Wakeup and send cycles are configured via input pins (switch settings). The STM 300 user manual offers a detailed description.

Following diagram shows the basic sequence of STM 300x standard firmware:



6.2 Power management and energy storage

Power management and energy storage are essential parts of self-powered applications. The EVA 320 provides a power management circuit optimized for solar cells. First it will charge the short term energy storage (470 uF capacitor) till V_{ON} (~ 2.45 V) is reached. Then it will charge the long term storage (e.g. 250mF PAS614L). An optional lithium accumulator VL2320-1HF or VL1220-1HF can be assembled.



6.3 Pin and data byte assignment of sensor inputs

The EVA 320 comes with a set of sensors and specific measurement circuits. Following table shows the assignment between STM 300 pins, telegram data bytes and specific EnOcean telegram profiles:

| Pin | EEP telegram byte / bit | Profile Temp Sensor | Profile Light | Profile Room Operating Panel |
|--------|-------------------------|---------------------|----------------|------------------------------|
| ADIO_0 | DB_1 | NTC Sensor | Illumination | NTC Sensor |
| ADIO_1 | DB_2 | - | - | Potentiometer |
| ADIO_2 | DB_3 | - | Supply Voltage | - |
| ADIO_3 | DB_0.BIT_0 | - | Jumper | - |
| WAKE0 | DB_0.BIT_0 | - | - | Occupancy button |
| ADIO_4 | DB_0.BIT_1 | - | - | - |
| ADIO_5 | DB_0.BIT_2 | - | - | - |
| WAKE1 | DB_0.BIT_3 | Learn button | Learn button | Learn button |

The EVA 320 supports at least the following standardized EnOcean Equipment Profiles (EEP):

- Temperature Sensor EEP V2.0 No.: 07-02-05 (from EEP V2.1: A5-02-05)

DB_1: Temperature 0...40°C, linear n=255...0

DB_0.BIT_3 = 0: Teach-in telegram (learn button pressed)

DB_0.BIT_3 = 1: Data telegram (sensor value transferred)

- Light Sensor EEP V2.0 No.: 07-06-02 (from EEP V2.1: A5-06-02)

DB_3: Supply voltage 0...5.1V, linear n=0...255

DB_2: Illumination 0...510 lx, linear n=0...255*

DB_1: Illumination 0...1024 lx, linear n=0...255

DB_0.BIT_3: Learn button, 0 = Teach-in telegram, 1 = Data telegram

DB_0.BIT_0: Range select, 0 = Range acc. to DB_1, 1 = Range acc. to DB_2*

- Room Operating Panel EEP V2.0 No.: 07-10-05 (from EEP V2.1: A5-10-05)

Temperature sensor, Set point and Occupancy Control (push button)

DB_2: Set point Min. - ... Max. +, linear n=0...255 (Poti)

DB_1: Temperature 0...40°C, linear n=255...0

DB_0.BIT_3: Learn button, 0 = Teach-in telegram 1 = Data telegram

DB_0.BIT_0: Occupancy button, 0 = Button pressed, 1 = Button released

For details about the EnOcean Equipment Profiles (EEP) see chapter 9.3 "Radio Telegrams according to EnOcean Alliance Standardization", page 48.

* not supported

EDK 300 / EDK 300C / EDK 300U
DEVELOPER'S KIT FOR ENOCEAN DOLPHIN MODULES**Example of sensor data interpretation:**

STM data field: 0xDE00690E

Data byte 0: 0x0E b1110 Digital Inputs (e.g. range select)
Data byte 1: 0x69 105 Temperature or brightness sensor (depends on ADIO0 jumper)
Data byte 2: 0x0A 10 Potentiometer
Data byte 3: 0xDE 222 Long term storage voltage

Temperature (DB1):

$$T = (1-105/255) \cdot 40^{\circ}\text{C} = 23.5^{\circ}\text{C}$$

or

Brightness / Light intensity (DB1):

$$Li = 105/255 \cdot 1,8\text{V} \cdot 529.1\text{lx/V} = 329\text{ lx}$$

Potentiometer:

$$Po = 10/255 \cdot 100\% = 3.9\%$$

Long term storage voltage (DB3):

$$U = 222/255 \cdot 1,8\text{V} \cdot 2 + 0.3\text{V} = 3.34\text{V}$$

See STM 300 manual for further details of the internal A/D converter.

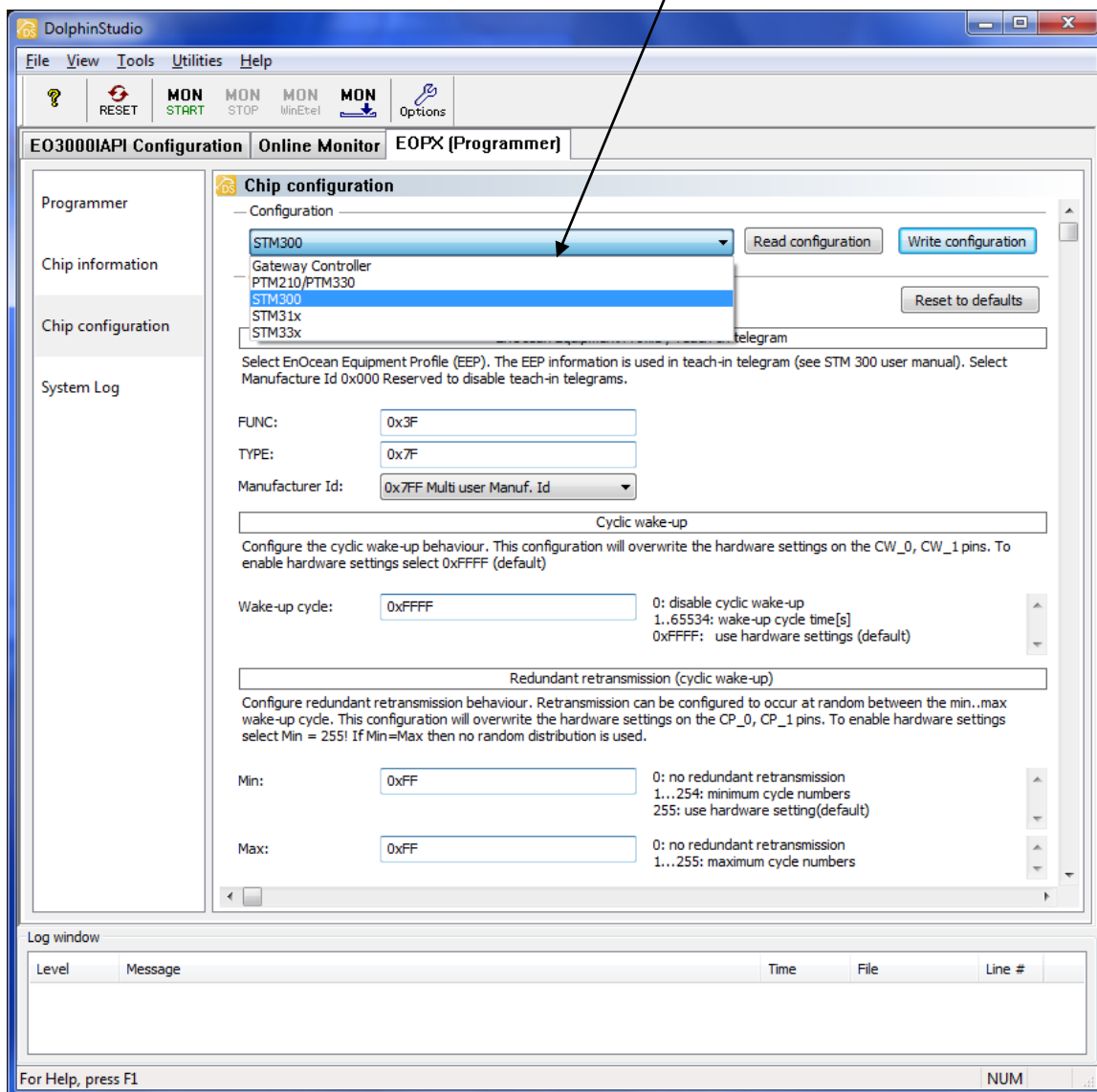
EDK 300 / EDK 300C / EDK 300U DEVELOPER'S KIT FOR ENOCEAN DOLPHIN MODULES

6.4 STM 300x firmware configuration with DolphinStudio

Wakeup and retransmit intervals on the STM 300x can be either configured via external circuitry, e.g. switches on the EVA 320 (see STM 300x configuration pins). Additionally STM 300x firmware offers the possibility to configure those parameters within the configuration area of flash memory. DolphinStudio is used to set this configuration area, e.g. following values can be set: manufacturer ID, EnOcean Equipment Profile and threshold values etc.

The following image illustrates the configuration tool:

Selection is dependent on DolphinView version



Sensor values are sent via temperature sensor profile (EEP: A5/07-02-05). Make sure that you have configured EVA 320 switches/jumpers and set the right profile via DolphinStudio.

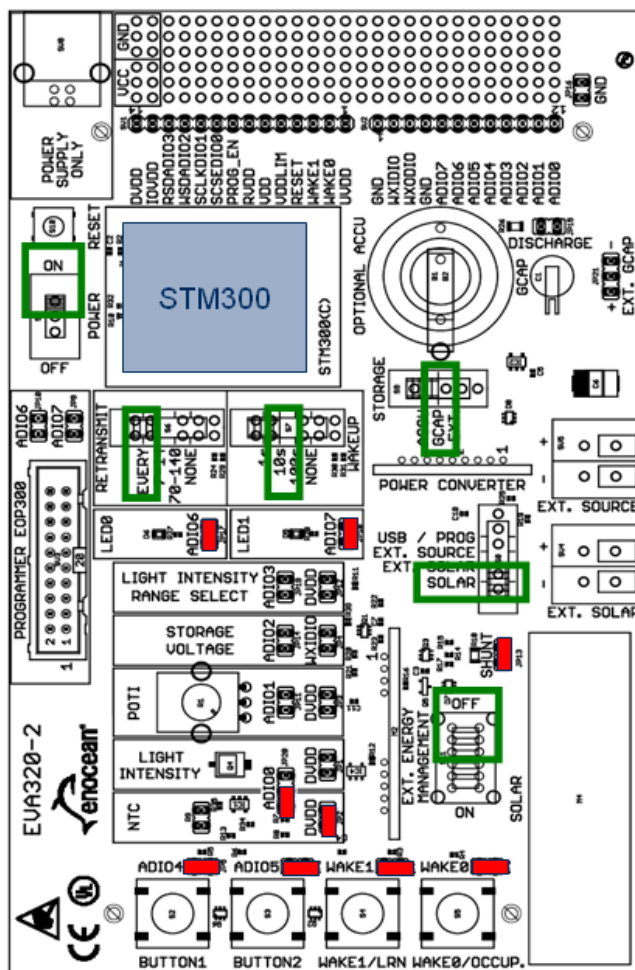


The EVA 320 is equipped with following temperature sensor: NTCLE100E3224JB0
Temperature can be calculated from data byte 1 (ADIO0) with the following equation:

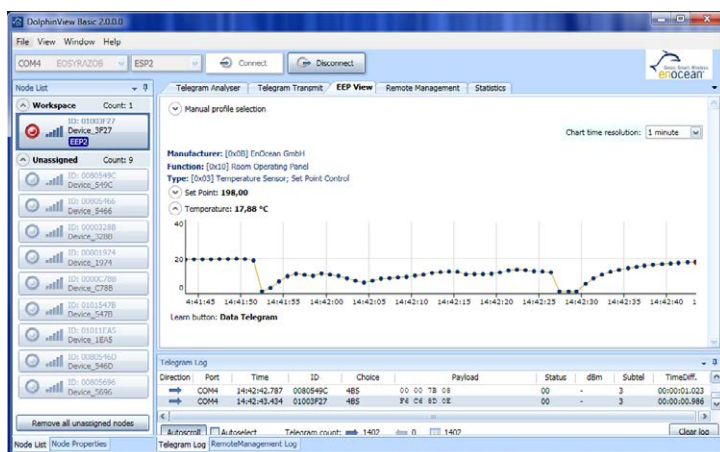
$$T = (1 - N/255) * 40^{\circ}\text{C}$$



Temperature sensor (NTC) on EVA 320 board is not calibrated.



EVA320 temperature sensor configuration



EDK 300 / EDK 300C / EDK 300U DEVELOPER'S KIT FOR ENOCEAN DOLPHIN MODULES

6.6 Self-powered room operating panel demonstration

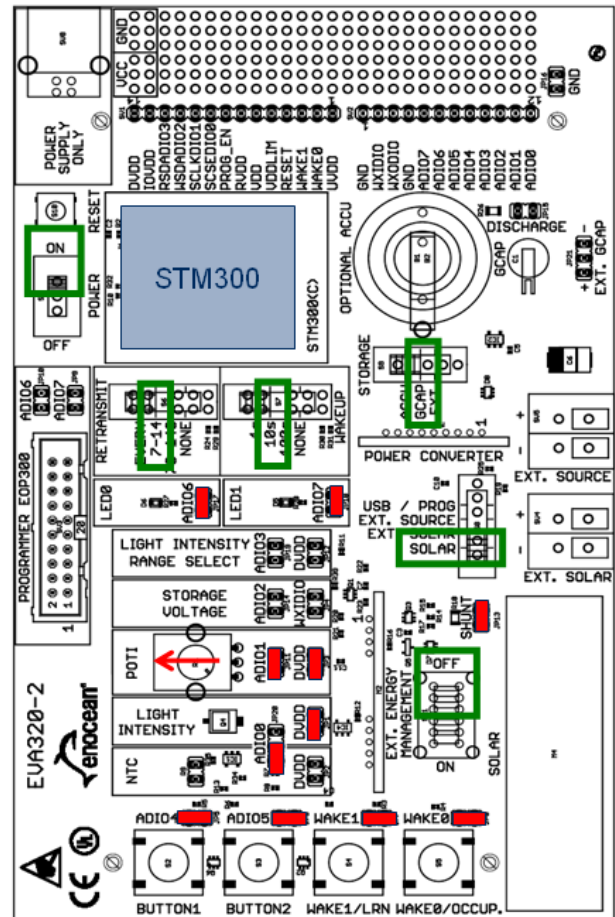
This example demonstrates a solar powered room controller. Following parameters are measured via AD-converter pins:

ADIO0: actual temperature (NTC)
 ADIO1: target temperature (potentiometer)
 WAKE0: occupancy button

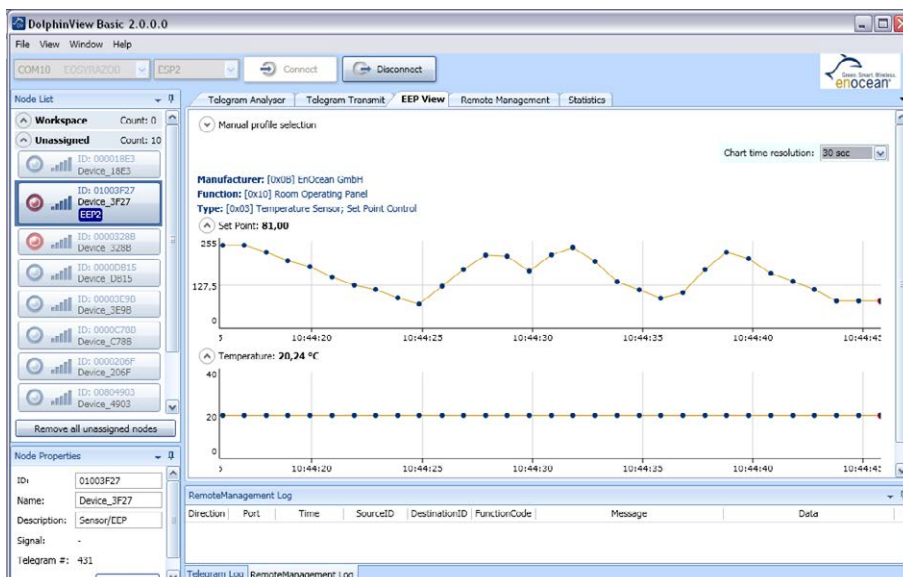
Sensor values are sent via Room Operating Panel profile (EEP: A5/07-10-05). Make sure that you have configured EVA 320 switches/jumpers and set the right profile via DolphinStudio.



With default settings the STM 300 will wakeup every 10s and send the temperature and potentiometer values if they have changed significantly. If there is no significant change of temperature or potentiometer value there will be a retransmit at least every 70-140s. Pressing the WAKE0 (occupancy) button will immediately wake the STM 300 and send a telegram with actual temperature and potentiometer value.



EVA320 room operating panel



EDK 300 / EDK 300C / EDK 300U
 DEVELOPER'S KIT FOR ENOCEAN DOLPHIN MODULES

6.7 Solar-Powered ambient light sensor

This example demonstrates a solar powered brightness sensor. The brightness sensor circuit is connected to ADIO00. The sensor value is sent via light sensor profile (EEP A5/07-06-02). Make sure that you have configured the EVA 320 switches and jumpers according to the image below.

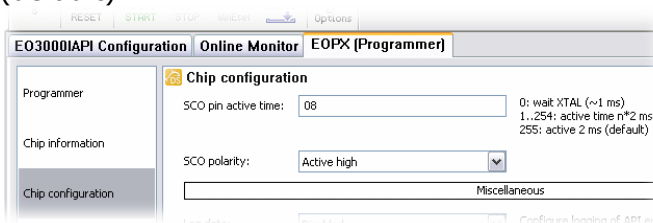
Brightness:

The EVA 320 is equipped with following brightness sensor: SFH 2430

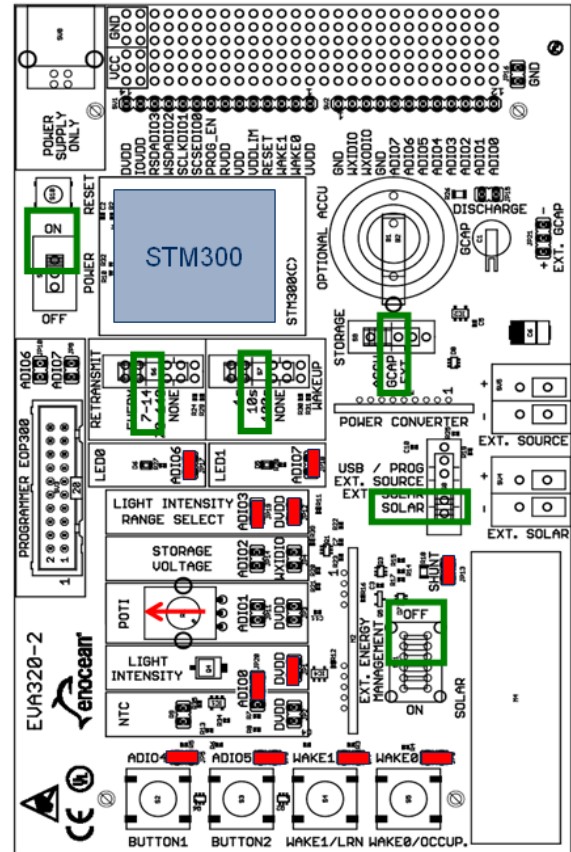
Light intensity can be calculated with following formula:

$$Li = N/255 * 1,8V * 529.1lx/V$$

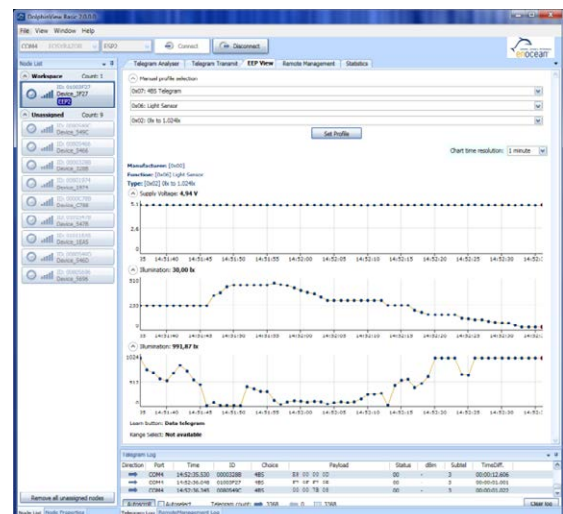
Max brightness value will be about 950Lux.
 16 ms SCO active leads to higher energy consumption. This can be configured via Dolphin-Studio: **value 08 = 16 ms**, value 255 = 2 ms (default).



The EVA 320-2 brightness circuit delivers different measurement results in case of fluorescent lamps. Energy consumption and fluorescent lamps light correction can be optimized by implementing the following application note:
http://www.enocean.com/fileadmin/redaktion/pdf/app_notes/AN304_LIGHT_SENSOR_Jan10.pdf



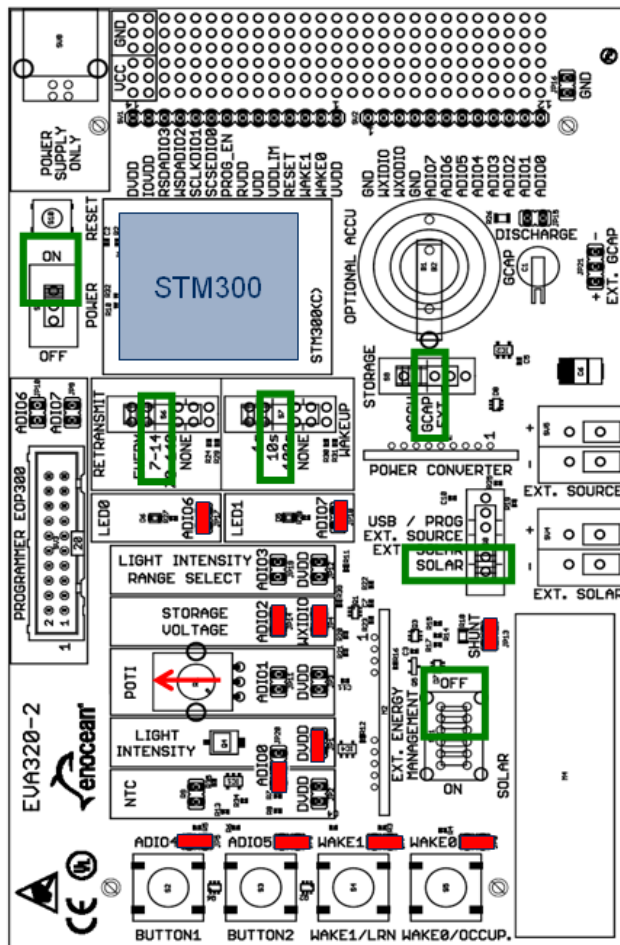
EVA320 brightness sensor



EDK 300 / EDK 300C / EDK 300U
 DEVELOPER'S KIT FOR ENOCEAN DOLPHIN MODULES

6.8 Self-Powered temperature sensor with long term storage status

The following example demonstrates a solar powered temperature sensor transmitting also the current status of long term energy storage (voltage). Make sure that you have configured the EVA 320 switches and jumpers according to the image below.



EVA320 temperature & storage voltage

Long term storage Voltage:

The voltage at energy long term energy storage (e.g. Goldcap) is measured via a resistive voltage divider. According to the measurement circuit a typical 0.3V drain-source voltage has to be added. Long term energy storage can be calculated with following formula:

$$U \approx N/255 * 1.8V * 2$$

EDK 300 / EDK 300C / EDK 300U DEVELOPER'S KIT FOR ENOCEAN DOLPHIN MODULES

DolphinView can be used to visualize voltage levels on long term storage (GCAP). Load eva320.xml to interpret the data bytes. *



* This feature will be available for DolphinView versions $\geq 3.x.x.x$

EDK 300 / EDK 300C / EDK 300U
 DEVELOPER'S KIT FOR ENOCEAN DOLPHIN MODULES

6.9 Extensions

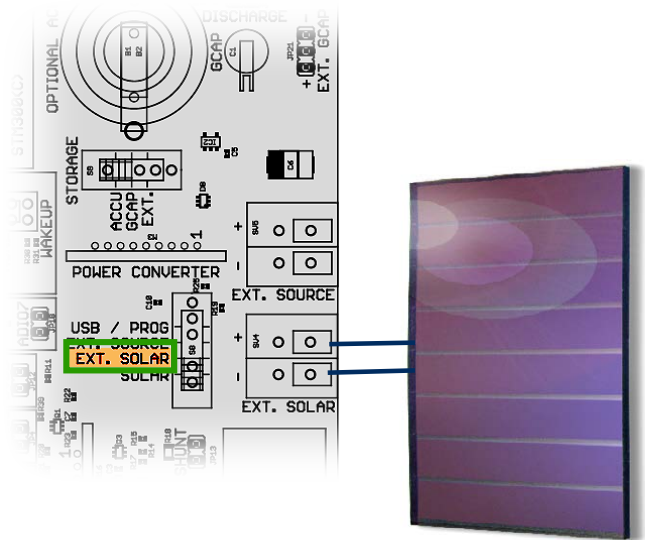
6.9.1 External energy harvester

Additional harvesters, e.g. thermo harvester or push button harvester, can be connected via "Ext. source" clamp. If electrical characteristics do not fit to on-board solar charging circuitry, a specific energy converter module can be plugged into the "Power Converter" slot.

6.9.2 External solar cell

The required size (area) of the solar cell depends on the application requirements. E.g. how much energy is need, size / space limitations due to the housing or pricing.

The EVA 320 has a "medium" size solar cell (50x20mm) assembled on the pcb board. Other solar cells can be connected via "External solar" connector.

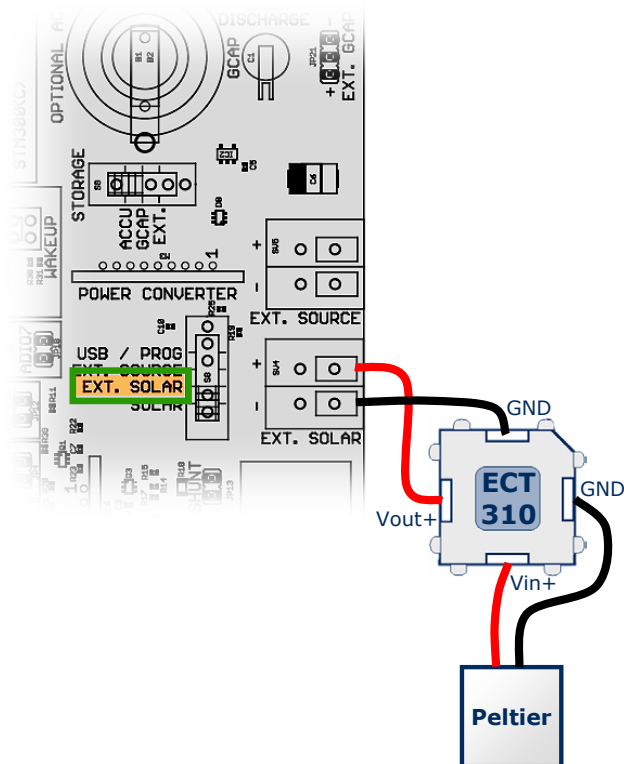


6.9.3 ECT 310 Perpetuum Module

Connect a Peltier element (e.g. TEC2L-15-15 5.6/73CS) with heat sink to "Ext. solar" clamp

- Plug ECT300 into "Power Converter" Slot

For the STM 3xy product family an Extension Developer's Kit is available: the EDK 312



7 Further documents

User Manuals can be downloaded from following website:

<http://www.enocean.com/en/products-technology/>

Software, Firmware, API and documents can be downloaded from:

<http://www.enocean.com/en/download/>

- EDK 300 Getting Started
- EVA 300 Schematics
- EVA 320 Schematics
- TCM 3x0 User Manual
- STM 300 User Manual
- PTM 2x0 User Manual
- DolphinAPI Online Help
- Applications notes

EnOcean Alliance Equipment Profile (EEP) can be downloaded from following website:

<http://www.enocean-alliance.com>

8 Abbreviations

| | |
|-------|--|
| 1BS | 1-Byte Sensor Communication |
| 4BS | 4-byte Sensor Communication |
| ADIO | Analogue Digital Input Output (pin) |
| API | Application Programming Interface |
| CE | Conformité Européenne |
| CH | Channel |
| CLR | Clear |
| ECT | EnOcean Thermo Converter/Harvester |
| ECO | EnOcean Push Button Harvester |
| EDK | EnOcean Developer Kit |
| EEP | EnOcean Equipment Profiles |
| EMC | Electro Magnetic Compatibility |
| EOP | EnOcean Programmer |
| EPM | EnOcean Field Intensity Meter |
| ESD | Electrostatic discharge |
| EVA | Evaluation Board |
| FCC | Federal Communications Commission (US) |
| FW | Firmware (Module) |
| IDE | Integrated Development Environment |
| LMI | Learn Mode Indicator |
| LRN | Learn |
| PTM | Push Button Transmitter Module |
| PWM | Pulse Width Modulation |
| R&TTE | Radio Equipment and Telecommunications Terminal Equipment (EU) |
| RF | Radio Frequency |
| RPS | Repeated Switch Communication |
| Rx | Receive (RF, SPI, UART) |
| RSSI | Received Signal Strength Indicator |
| SPI | Serial Peripheral Interface |
| STM | Scavenger Module |
| SW | Software (PC) |
| TCM | Transceiver Module |
| Tx | Send (RF, SPI, UART) |
| UART | Universal Asynchronous Receiver/Transmitter (e.g. RS232) |
| USB | Universal Serial Bus |
| XTAL | Crystal |
| XTO | Crystal Oscillators |

9 Annex

9.1 EVA 300 jumpers, buttons and LEDs

Switch and buttons:

- Power : Power on/off switch
- RESET : Reset TCM 3x0 module
- LEARN : Enter EnOcean ID learn mode
- CLEAR : Clear EnOcean ID table and enter learn mode
- WAKE0 : STM 300 only feature e.g. occupancy button (optional)
- WAKE1 : STM 300 only feature e.g. learn button (optional)

Serial interface jumper:

- ADIO6 : Receive/Transmit serial interface cut off
- ADIO7 : Receive/Transmit serial interface cut off

Voltage jumper:

- VCC ON : Cut off on board voltage regulator for ext. Power supply
TCM 300=2,5-4,5V, TCM 320=2,5-3,6V
- VDDLIM : Activate Voltage Limiter for power supply (only STM 300)
- VDD : Supply Voltage for Module (cut off), e.g. for current measurement
- IOVDD : IO Voltage selection (3,3V = line powered / default, or 1,8V)

Repeater jumper:

- 2LEVEL : Selector for one- or two-level repeater (GND=1level, IOVDD=2level)
- REPEATER : Selector for repeater mode (GND=off, IOVDD=on)

Signal LEDs:

- POWER : Signals power on
- ADIO7 : Programming pin & IO CH0
- SCSEDIO0 : Programming pin & IO CH1
- SCLKDIO1 : Programming pin & IO CH2
- WSDADIO2 : Programming pin & IO CH3
- RSDADIO3 : Programming pin & LMI output
- RSSI/PWM : PWM signal from ADIO7

9.2 EVA 320 jumpers, buttons and LEDs

Switch and buttons:

- Power : Power on/off switch
- RESET : Reset switch
- BUTTON1 : wake capable switch (connected to ADIO4 and WAKE1)
- BUTTON2 : wake capable switch (connected to ADIO5 and WAKE1)
- OCCU/WAKE0 : wake capable switch (typical used for occupation signal)
- LRN/WAKE1 : wake capable switch (typical used for learn EnOcean ID)
- RETRANSMIT : selects retransmit interval (see STM300 user manual)
- WAKEUP : selects wakeup interval (see STM300 user manual)
- STORAGE : selects long term storage device (optional Accu, GCAP GoldCAP or external connected storage device)
- Power Source : selects power source (solar cell, ext. solar cell, ext. source connector or from USB programmer)
- Ext. Energy Management: turns off on board energy management circuitry (allows the use of plug in circuitry)

Serial interface jumper:

- ADIO6 : Receive/Transmit serial interface cut off
- ADIO7 : Receive/Transmit serial interface cut off

Signal LED:

- ADIO6 : Signals ADIO6 state
- ADIO7 : Signals ADIO7 state

Sensor and measurement jumper:

- ADIO3/DVDD : Light Intensity Range Select
ADIO3 used as digital input (jumper set = low)
DVDD connects DVDD to pull up resistor
- ADIO2/WXIDIO : Storage voltage measurement circuitry
ADIO2 connects measurement circuitry to ADIO2
WXIDIO trigger signal for measurement
- ADIO1/DVDD : Potentiometer measurement circuitry
ADIO1 connects potentiometer to ADIO1
DVDD connects DVDD to potentiometer
- ADIO0/DVDD : Light Intensity / Temperature Sensor (NTC) measurement circuitry
ADIO0 selects Light Intensity or Temperature sensor to ADIO0
DVDD connects DVDD to respective sensor
- ADIO4 : disconnects BUTTON1
- ADIO5 : disconnects BUTTON2
- WAKE1 : disconnects WAKE1/LRN button
- WAKE0 : disconnects WAKE0/OCCUP. button

9.3 Radio Telegrams according to EnOcean Alliance Standardization

All interoperable EnOcean enabled devices need to be declared compliant to one or more of the EnOcean Equipment Profiles (EEP). Such declaration needs to be done by the vendor prior to market introduction and in line with the Certification Specification of the EnOcean Alliance.



The EnOcean Equipment Profile (EEP) is a unique identifier that describes the functionality of an EnOcean device irrespective of its vendor.

In total, all technical requirements define three profile elements, which make up the organizational description of all profiles:

- 1) The EnOcean Radio Protocol (ERP) telegram type (RORG \geq EEP 2.1, ORG = EEP 2.0)
- 2) Basic functionality of the data content (FUNC)
- 3) Type of device in its individual characteristics (TYPE)

Therefore, every EEP profile has a number, which is made up of three components:

| | | | |
|--------------|-----------|-----------|-----------|
| EEP 2.0: | ORG | FUNC | TYPE |
| EEP 2.1: | RORG | FUNC | TYPE |
| Range (hex): | 00 ... FF | 00 ... 3F | 00 ... 7F |
| | 8 bit | 6 bit | 7 bit |

Telegram types:

| Telegram | RORG | ORG | |
|----------|------|------------------|--------------------------------|
| RPS | F6 | 05 | Repeated Switch Communication |
| 1BS | D5 | 06 | 1 Byte Communication |
| 4BS | A5 | 07 | 4 Byte Communication |
| VLD | D2 | \triangle RORG | Variable Length Data |
| MSC | D1 | \triangle RORG | Manufacturer Specific Protocol |

A details description of the EnOcean Alliance standard can be downloaded from:
<http://www.enocean-alliance.org>

10 AGENCY CERTIFICATIONS

The modules have been tested to fulfil the approval requirements for CE (868 MHz devices) 320) and FCC/IC (315 MHz and 902.875 MHz) based on the built-in firmware.



When developing customer specific firmware based on the API for this module, special care must be taken not to exceed the specified regulatory limits, e.g. the duty cycle limitations!

10.1 CE approval

The modules bear the EC conformity marking CE and conform to the R&TTE EU-directive on radio equipment. The assembly conforms to the European and national requirements of electromagnetic compatibility. The conformity has been proven and the according documentation has been deposited at EnOcean. The modules can be operated without notification and free of charge in the area of the European Union, and in Switzerland. The following provisos apply:

- EnOcean RF modules must not be modified or used outside their specification limits.
- EnOcean RF modules may only be used to transfer digital or digitized data. Analog speech and/or music are not permitted.
- The final product incorporating EnOcean RF modules must itself meet the essential requirement of the R&TTE Directive and a CE marking must be affixed on the final product and on the sales packaging each. Operating instructions containing a Declaration of Conformity has to be attached.
- If the transmitter is used according to the regulations of the 868.3.3 MHz band, a so-called "Duty Cycle" of 1% per hour must not be exceeded. Permanent transmitters such as radio earphones are not allowed.
- The module must be used with only the following approved antenna(s).

| Type | Parameter | Value |
|---------------------------|--------------|---------|
| Wire/Monopole at RF_WHIP | Maximum gain | 1.0 dBi |
| | | |
| External antenna at RF_50 | Antenna type | Passive |
| | Impedance | ~50 Ohm |
| | Maximum gain | ≤ 0 dBd |

10.2 FCC (United States) Certification

TCM 300C / TCM 320C / STM 300C / TCM 300U / TCM 320U / STM 300U LIMITED MODULAR APPROVAL

This is an RF module approved for Limited Modular use operating as an intentional transmitting device with respect to 47 CFR 15.231(a-c) and is limited to OEM installation. The module is optimized to operate using small amounts of energy, and may be powered by a battery. The module transmits short radio packets comprised of control signals, (in some cases the control signal may be accompanied with data) such as those used with alarm systems, door openers, remote switches, and the like. The module does not support continuous streaming of voice, video, or any other forms of streaming data; it sends only short packets containing control signals and possibly data. The module is designed to comply with, has been tested according to 15.231(a-c), and has been found to comply with each requirement. Thus, a finished device containing the TCM 300C / TCM 320C / STM 300C / TCM 300U / TCM 320U / STM 300U radio module can be operated in the United States without additional Part 15 FCC approval (approval(s) for unintentional radiators may be required for the OEM's finished product), under EnOcean's FCC ID number. This greatly simplifies and shortens the design cycle and development costs for OEM integrators. The module can be triggered manually or automatically, which cases are described below.

Manual Activation

The radio module can be configured to transmit a short packetized control signal if triggered manually. The module can be triggered, by pressing a switch, for example.

The packet contains one (or more) control signals that is(are) intended to control something at the receiving end. The packet may also contain data. Depending on how much energy is available from the energy source, subsequent manual triggers can initiate the transmission of additional control signals. This may be necessary if prior packet(s) was(were) lost to fading or interference. Subsequent triggers can also be initiated as a precaution if any doubt exists that the first packet didn't arrive at the receiver. Each packet that is transmitted, regardless of whether it was the first one or a subsequent one, will only be transmitted if enough energy is available from the energy source.

Automatic Activation

The radio module also can be configured to transmit a short packetized control signal if triggered automatically, by a relevant change of its inputs or in response to receiving a signal from another transmitter, for example. Again, the packet contains a control signal that is intended to control something at the receiving end and may also contain data. As above, it is possible for the packet to get lost and never reach the receiver. However, if enough energy is available from the energy source, and the module has been configured to do so, then another packet or packets containing the control signal may be transmitted at a later time.

The device is capable to operate as a repeater, which can receive signals from the following list of FCC/IC approved transmitters, and retransmit the signals.

TCM 3x0C (315 MHz):

| | | |
|------------|--------------------|------------------|
| ■ PTM 200C | FCC ID:SZV-PTM200C | IC:5713A-PTM200C |
| ■ STM 110C | FCC ID:SZV-STM110C | IC:5713A-STM110C |
| ■ TCM 200C | FCC ID:SZV-TCM2XXC | IC:5713A-TCM2XXC |
| ■ TCM 220C | FCC ID:SZV-TCM2XXC | IC:5713A-TCM2XXC |
| ■ TCM 300C | FCC ID:SZV-STM300C | IC:5713A-STM300C |
| ■ STM 300C | FCC ID:SZV-STM300C | IC:5713A-STM300C |
| ■ TCM 320C | FCC ID:SZV-TCM320C | IC:5713A-TCM320C |

EDK 300 / EDK 300C / EDK 300U DEVELOPER'S KIT FOR ENOCEAN DOLPHIN MODULES

TCM 300U / TCM 320U:

| | | |
|------------|--------------------|------------------|
| ■ PTM 210U | FCC ID:SZV-PTM210U | IC:5713A-PTM210U |
| ■ STM 300U | FCC ID:SZV-STM300U | IC:5713A-STM300U |
| ■ TCM 300U | FCC ID:SZV-STM300U | IC:5713A-STM300U |
| ■ TCM 310U | FCC ID:SZV-STM300U | IC:5713A-STM300U |
| ■ TCM 320U | FCC ID:SZV-TCM320U | IC:5713A-TCM320U |

OEM Requirements

In order to use EnOcean's FCC ID number, the OEM must ensure that the following conditions are met:

- End users of products, which contain the module, must not have the ability to alter the firmware that governs the operation of the module. The agency grant is valid only when the module is incorporated into a final product by OEM integrators.
- The end-user must not be provided with instructions to remove, adjust or install the module.
- The Original Equipment Manufacturer (OEM) must ensure that FCC labeling requirements are met. This includes a clearly visible label on the outside of the final product. Attaching a label to a removable portion of the final product, such as a battery cover, is not permitted. The label must include the following text:

TCM 300C:

Contains FCC ID: SZV-STM300C

The enclosed device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (i.) this device may not cause harmful interference and (ii.) this device must accept any interference received, including interference that may cause undesired operation.

STM 300C:

Contains FCC ID: SZV-STM300C

The enclosed device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (i.) this device may not cause harmful interference and (ii.) this device must accept any interference received, including interference that may cause undesired operation.

TCM 320C:

Contains FCC ID: SZV-TCM320C

The enclosed device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (i.) this device may not cause harmful interference and (ii.) this device must accept any interference received, including interference that may cause undesired operation.

EDK 300 / EDK 300C / EDK 300U DEVELOPER'S KIT FOR ENOCEAN DOLPHIN MODULES

TCM 300U:

Contains FCC ID: SZV-STM300U

The enclosed device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (i.) this device may not cause harmful interference and (ii.) this device must accept any interference received, including interference that may cause undesired operation.

STM 300U:

Contains FCC ID: SZV-STM300U

The enclosed device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (i.) this device may not cause harmful interference and (ii.) this device must accept any interference received, including interference that may cause undesired operation.

TCM 320U:

Contains FCC ID: SZV-TCM320U

The enclosed device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (i.) this device may not cause harmful interference and (ii.) this device must accept any interference received, including interference that may cause undesired operation.

When the device is so small or for such use that it is not practicable to place the statement above on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

The user manual for the end product must also contain the text given above.

- Changes or modifications not expressly approved by EnOcean could void the user's authority to operate the equipment.
- The module must be used with only the following approved antenna(s).

| Part Number | Type | Gain |
|-------------|----------------------------|---------|
| N.A. | Wire/Monopole | 1.0 dBi |
| N.A. | Helical (for TCM300U only) | 1.0 dBi |

- The OEM must ensure that timing requirements according to 47 CFR 15.231(a-c) are met.
- The OEM must sign the OEM Limited Modular Approval Agreement with EnOcean

10.3 IC (Industry Canada) Certification

In order to use EnOcean's IC number, the OEM must ensure that the following conditions are met:

- Labeling requirements for Industry Canada are similar to those required by the FCC. The Original Equipment Manufacturer (OEM) must ensure that IC labeling requirements are met. A clearly visible label on the outside of a non-removable part of the final product must include the following text:

TCM 300C:

Contains IC: 5713A-STM300C

Contient le module d'émission IC: 5713A-STM300C

STM 300C:

Contains IC: 5713A-STM300C

Contient le module d'émission IC: 5713A-STM300C

TCM 320C:

Contains IC: 5713A-TCM320C

Contient le module d'émission IC: 5713A-TCM320C

TCM 300U:

Contains IC: 5713A-STM300U

Contient le module d'émission IC: 5713A-STM300U

STM 300U:

Contains IC: 5713A-STM300U

Contient le module d'émission IC: 5713A-STM300U

TCM 320U:

Contains IC: 5713A-TCM300U

Contient le module d'émission IC: 5713A-TCM300U

- The OEM must sign the OEM Limited Modular Approval Agreement with EnOcean

EDK 300 / EDK 300C / EDK 300U
DEVELOPER'S KIT FOR ENOCEAN DOLPHIN MODULES

Pour utiliser le numéro IC EnOcean, le OEM doit s'assurer que les conditions suivantes sont remplies:

- Les exigences d'étiquetage pour Industrie Canada sont similaires à ceux exigés par la FCC. Le fabricant d'équipement d'origine (OEM) doit s'assurer que les exigences en matière d'étiquetage IC sont réunies. Une étiquette clairement visible à l'extérieur d'une partie non amovible du produit final doit contenir le texte suivant:

TCM 300C:

Contains IC: 5713A-STM300C

Contient le module d'émission IC: 5713A-STM300C

STM 300C:

Contains IC: 5713A-STM300C

Contient le module d'émission IC: 5713A-STM300C

TCM 320C:

Contains IC: 5713A-TCM320C

Contient le module d'émission IC: 5713A-TCM320C

TCM 300U:

Contains IC: 5713A-STM300U

Contient le module d'émission IC: 5713A-STM300U

STM 300U:

Contains IC: 5713A-STM300U

Contient le module d'émission IC: 5713A-STM300U

TCM 320U:

Contains IC: 5713A-TCM300U

Contient le module d'émission IC: 5713A-TCM300U

- L'OEM doit signer l'accord OEM limitée Approbation modulaire avec EnOcean

10.4 FCC Regulatory Statements

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Any changes or modifications not expressly approved by manufacturer could void the user's authority to operate the equipment.

IMPORTANT! Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/ TV technician for help.

10.5 Industry Canada Regulatory Statements

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

IMPORTANT! Tous les changements ou modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner cet équipement.

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada

10.6 PTM 210 and PTM 215 CE Approval

The devices bear the EC conformity marking CE and conform to the R&TTE EU-directive on radio equipment. The assembly conforms to the European and national requirements of electromagnetic compatibility. The conformity has been proven and the corresponding documentation has been deposited at EnOcean. The PTM devices can be operated without notification and free of charge in the area of the European Union, and in Switzerland. The following provisos apply:

- EnOcean RF devices must not be modified or used outside their specification limits.
- EnOcean RF devices may only be used to transfer digital or digitized data. Analog speech and/or music are not permitted.
- The final product incorporating EnOcean RF devices must itself meet the essential requirement of the R&TTE Directive and a CE marking must be affixed on the final product and on the sales packaging each. Operating instructions containing a Declaration of Conformity has to be attached.

If transmitters are used according to the regulations of the 868.300 MHz band, a so-called "Duty Cycle" of 1% per hour for each transmitter must not be exceeded. Permanent transmitters such as radio earphones are not allowed. For conventional applications, it must be ensured that the PTM 215 or PTM 210 radio device is not operated more than 6000 times within one hour (one operation: energy bow is pressed and released). Within this calculation, the extraordinary short telegram length is considered including three subtelegrams. Also a tolerance of 5% in the telegram length is included.

10.7 PTM 210C FCC and Industry Canada Regulatory Statements

| | |
|---------|---------------|
| FCC ID: | SZV-PTM210C |
| IC: | 5713A-PTM210C |

This device complies with part 15 of the FCC rules and Industry Canada ICES- 003. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Any changes or modifications not expressly approved by manufacturer could void the user's authority to operate the equipment.

IMPORTANT! Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

IMPORTANT! Tous les changements ou modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner cet équipement.

10.8 PTM 210U FCC and Industry Canada Regulatory Statements

| | |
|---------|---------------|
| FCC ID: | SZV-PTM210U |
| IC: | 5713A-PTM210U |

This device complies with part 15 of the FCC rules and Industry Canada ICES- 003. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Any changes or modifications not expressly approved by manufacturer could void the user's authority to operate the equipment.

IMPORTANT! Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

IMPORTANT! Tous les changements ou modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner cet équipement.