EnOcean UP Kits

SMART HOME KIT

&

KINETIC DESIGN KIT

User Manual

Version 0.1

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1 Introduction

This user guide shows how to integrate the EnOcean Design Kits with the UP-Board and the EnOcean-Hat add-on board. The example is based around a home automation system but it can form the basis of many other IoT projects. It uses FHEM http://fhem.de/fhem.html as the basis of the server but other open systems are also available, such as openHAB www.openhab.org

Wireless, energy autonomous sensors and switches are ideal for automation projects as no cabling is required. Sensors and actuators can directly communicate with each other or they can be controlled by an intelligent automation server. This allows users to set up automation for remote sensing and remote control via e.g. smart phone or tablet PC. Up-Board is the ideal platform to setup an automation server where the EnOcean-Hat acts as a bridge (Gateway-Controller) to the EnOcean radio world.

1.1 Topics **Covered**

- Kits Content

- Installation of Up-Board and preparation for automation projects

- Connection of an EnOcean-Hat to Up-Board

- Installation of the FHEM server software for home automation

- Configuration of FHEM for EnOcean switches and sensors contained in the Kits

1.2 **Necessary Components**

- Laptop/PC with internet browser
- "Smart Home Kit" or "Kinetic Design Kit", both including EnOcean-Hat
- Up-Board board
- Up-Board accessories:
    - USB micro power supply
    - HDMI cable
    - SD card (e.g. 4GB)
    - Ethernet cable or USB WLAN stick

2 SMART HOME KIT

2.1 What is SMART HOME KIT for?

Up-Board used e.g. with FHEM server freeware becomes a home automation server. The server can be used to automate common tasks such as switching lamps, scene illuminations or closing blinds, measurement and visualization of power consumption, temperature and humidity.

The server receives and sends EnOcean radio telegrams via the EnOcean-hat. Self-powered switches and FHEM send on/off or dim commands to actuators or to a relay board (if connected). The solar powered radio sensors periodically send values which will be interpreted and displayed via the FHEM web interface.

Actors and other Sensors are not included in the kit, but can be easily purchased from e.g. www.amazon.com (search for "enocean"), or e.g. from www.greenelectric.com .

2.2 Kit Content

The Smart Home Kit contains the following parts:

P/n		Description
#1		PTM 210 Rocker Switch Module Electrodynamic push-button transmitter 4 channel
#2,3		2 ROCKERS for PTM 210 (with medial position)
#4		STM 329 Wireless Magnet Window Contact Module (incl. reed contact, solar cell, energy store, helix antenna)

#5		STM 330 Wireless Temperature Sensor Module (incl. on-board temp sensor, solar cell, energy store, whip antenna, pin connector)
#6		FTKE Wireless Contact Switch, finished product
#7		ENOCEAN HAT Adapter Board for UP GPIO

3 KINETIC DESIGN KIT

3.1 What is KINETIC DESIGN KIT for?
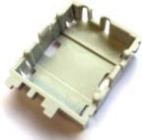
The "KINETIC DESIGN KIT" offers two ready to go switches: A handheld remote pushbutton and also a dual rocker switch. Furthermore the provided design data enables you to realise a bespoke switch housing with 3D printing, based on given housing design data. Key Benefits:

1. Cutting edge: **Combines 3D Printing & IoT**
2. Plug & Play: All required parts included
3. Parts easy to reproduce: Printer data and spare parts list provided
4. Easy to customize: 3D plastic design data enclosed
5. Simple housing design: No battery compartment necessary
6. Maintenance free: Batteryless
7. Cool & Green: Self-powered by using kinetic energy

3.2 Kit Content

The Kinetic Design Kit contains the following parts:

P/n		Description
#1		PTM330 Transmitter module for ECO 200 (pre-installed whip antenna)
#2		ECO200 Energy converter for motion energy harvesting
#3		CLAMP SWITCH HOUSING Wireless Energy Harvesting Pushbutton-Switch 1 channel (3D printed housing for ECO200/PTM330)
#4		PTM 210 Rocker Switch Module Electrodynamic push-button transmitter 4 channel

#5,6		2 ROCKERS for PTM 210 (with medial position)
#7		FIXATION HOUSING for ECO200/PTM330
#8,#9		2 RESTORING SPRINGS (small one for Clamp Switch, large one for contact switch)
#10		ENOCEAN HAT Adapter Board for UP GPIO

3.3 Switch Assembly

3.3.1 Rocker Switch
Simply plug the two rockers on the PTM 210 module.

Clip both rockers onto the PTM module

Figure 10: Rocker Switch – Assembly/Disassembly

3.3.2 Clamp Switch

1. Insert Restore Spring   2. Insert Transmitter Module   3. Insert Energy Generator

4. Ready To Use   5. Disassembly

Figure 11: Clamp Switch – Assembly/Disassembly

Notes: Contact springs of ECO energy generator have to contact the unpopulated PCB side (white ECO rubber mat on the opposite). When inserting the generator move its black plastic nose around the PCB antenna soldering point. The housing inside has a small antenna slot in which the module antenna can be pressed in with a screwdriver and thus fixed.

3.3.3 ECO Fixation Housing

1. Insert Energy Generator   2. Insert Transmitter Module

1. Release PCB Holder Flap   2. Release ECO holder front mounting bracket while pushing ECO spring   3. Release rear mounting bracket
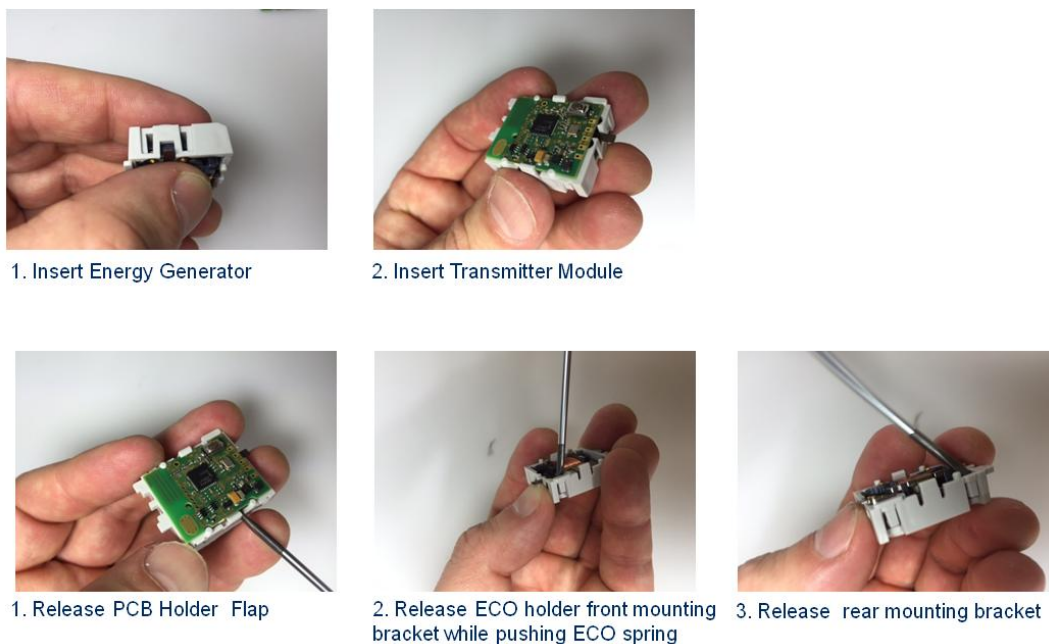
Figure 12: ECO Fixation Housing – Assembly/Disassembly

Note: Contact springs of ECO energy generator have to touch the contacts on the unpopulated PCB side (direct the ECO side with white rubber mat onto the bottom of the housing).

3.4 Switch Housing Design Process

1.) Select your appropriate Switch Design from the User Manual "EnOcean Design Data" that can be downloaded from www.enocean.com/design-data
2.) Download the corresponding design data from www.enocean.com/design-data
3.) Load the 3D data with an IGS compatible CAD tool (e.g. for FreeCAD lot of tutorials are available on the internet). Export the design to a STL file.
4.) If you have an own 3D printer simply print the/your design. Alternatively there are a lot of low-cost printing services available on the internet. Examples you will find in the "EnOcean Design Data" User Manual.

Figure: Design of individual switch applications

4 Step by step installation of the Up-Board

4.1 Installing ubilinux

4.1.1 Preparing the installation media

- Get the latest ubilinux image from the ubilinux download section.
- Burn the image to a USB drive. After plugging the drive, the way of doing it depends on the OS that it is being burned from:

4.1.2 Burning from Linux / OSX

- As root, run:
  ```
  dd if=/path/to/ubilinux-3.0.iso of=/dev/sdX
  ```

Here, /dev/sdX is the device node assigned to your drive: /dev/sdb, /dev/sdc... Please ensure you are selecting the right device before proceeding.

4.1.3 Burning from Windows

There are many applications that can do this. unetbootin is known to cause problems when creating Debian-based installations, so it is not recommended (in fact, the installer will display a warning if it detects the image was created with this tool). We recommend Rufus.

- Execute Rufus and select the image to copy clicking on the cdrom icon
- Select `ubilinux-3.0.iso`
- Ensure `Partition scheme and target system type` option is set to `MBR partition scheme for UEFI`.
- Press `Start` and select `DD write mode`
- Once the process is complete, press `Close` and eject your drive before disconnecting it.

4.1.4 Installation

Note: release candidate installations, from 3.0RC1 to 3.0RC3, can't be upgraded to 3.0 through APT. A reinstall is required to upgrade.

- Plug the drive to your UP board.
- Connect the power supply.
- When you see the UP logo, press F7 to open the boot menu.
- Select your USB stick as the boot disk.
- Select `Install` to begin the installation.
  `Install (serial console)` allows you to install through serial console.
  (~1A)
- The installer will ask a few questions:
  - language, location and keymap
  - hostname and domain
  - username and password
  - preferred Debian mirror
- After installation is complete, the system will reboot.

That's it! You can now log in using your chosen username and password.

4.1.5 Post-install tips

- If the installation was performed while offline, it is recommended to run an update whenever the board is connected to the internet:
  ```
  sudo apt update && sudo apt dist-upgrade
  ```
- If you're having trouble with wireless dongle connectivity with Realtek dongles, visit Wireless for possible fixes.

No matter how the installation was performed, a serial console is always available on the 10-pin connector UART (including BIOS and bootloader stages).

4.2 Connecting Up-Board and the EnOcean-Hat

Connect the EnOcean-Hat via its connector on top of Up-Board
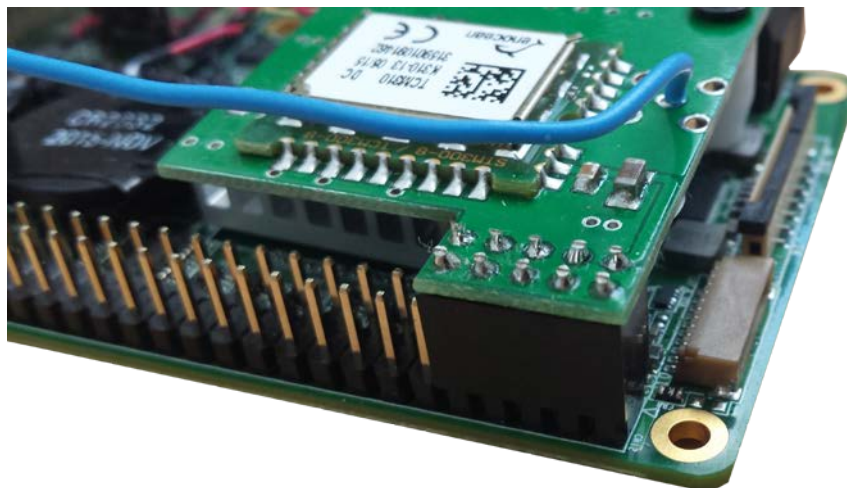
4.3 Disable Linux using the serial port

NOTE:
As default the serial port of the GPIO interface is used for console debug outputs. In order to use this port for EnOcean-Pi, this feature has to be disabled.

1. To check the configuration for Serial Port 1 (have to disable) in Bios.
   a. [Advanced]->[Serial Port Console Redirection]
2. Restart System and open Console (LXTerminal) window for testing the connection

3. Change the Configuration of ttyAMA0
   a. sudo stty -F /dev/ttyAMA0 57600

   (configure the COM port to 57600 Baud)

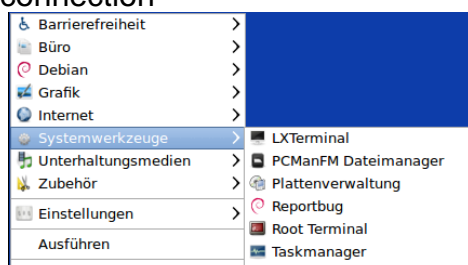   b. sudo hexdump < /dev/ttyAMA0

   Now, send some enocean radiosignals.
   After some secounds, the hexdump command show the raw data of
   EnOcean Signals.
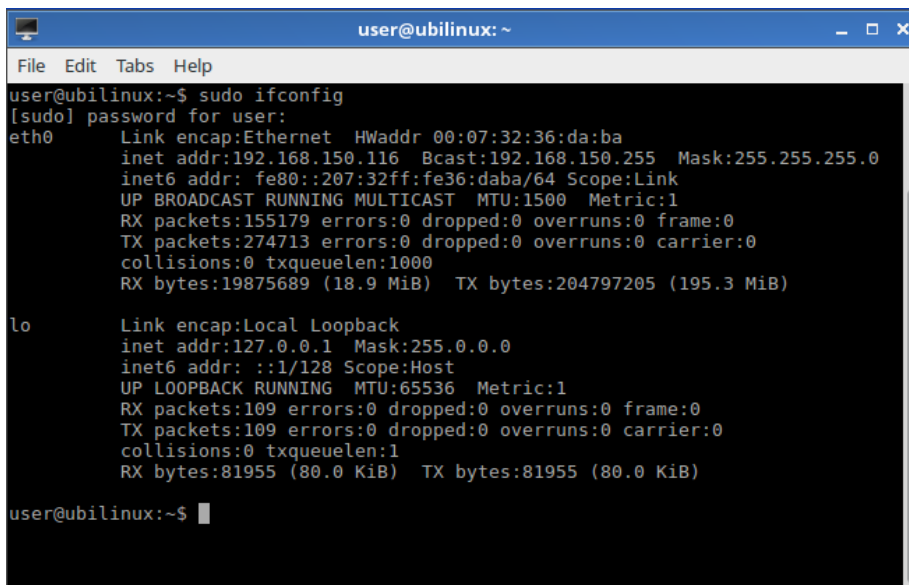
   ```
   0000000 0055 5d0a 00f4 ff01 ffff 5cff 3000 0055
   0000010 070a eb01 00d1 21b0 0001 db8a 002e ff01
   0000020 ffff 36ff 7e00 0055 070a eb01 00d1 21b0
   0000030 0000 db8a 002e ff01 ffff 34ff c000 0055
   0000040 070a eb01 00d1 21b0 0001 db8a 002e ff01
   ```

You can test the connection via the FHEM event monitor

4.4 Discover the IP address of your Up-Board

In most cases the IP address is provided via the DHCP server. For remote
control via ssh (e.g. via PuTTY) or HTML server connections (FHEM server) the IP
address of Up Board is required.

You can discover the allocated (by the DHCP server) IP address by typing in the
following command:

Example output:
You can see that in this example output text the IP address 192.167.150.116.

4.5 Installation of the building automation server

This example project uses the FHEM server available under a GPL license.
More details can be found on the FHEM website: http://fhem.de/fhem.html

4.5.1   Installation of the Perl environment including libraries for FHEM

FHEM runs as a server on a Perl interpreter, which needs to be installed.

- Install prerequisits:

```
apt-get -y install perl-base libdevice-serialport-perl libwww-
perl libio-socket-ssl-perl libcgi-pm-perl libjson-perl sqlite3
libdbd-sqlite3-perl libtext-diff-perl libtimedate-perl libmail-
imapclient-perl libgd-graph-perl libtext-csv-perl libxml-
simple-perl liblist-moreutils-perl ttf-liberation libimage-
librsvg-perl libgd-text-perl libsocket6-perl libio-socket-
inet6-perl libmime-base64-perl libimage-info-perl libusb-1.0-0-
dev libnet-server-perl
```

- Download latest stable package:

```
wget https://debian.fhem.de/fhem.deb
```

- Install package:

```
dpkg -i fhem.deb
```

- You can find the init-script as /opt/fhem/contrib/init-scripts/fhem.3 and copy this to /etc/init.d/fhem

```
sudo cp /opt/fhem/contrib/init-scripts/fhem.3 /etc/init.d/fhem
sudo chmod a+x /etc/init.d/fhem
sudo update-rc.d fhem defaults
```

Note:
Check the FHEM website for updates and any path changes in new versions.

4.5.2   Display of the FHEM Web Interface

Start your chosen internet browser and type the following to the address bar:

http://<Raspberry_Pi_IP>:8083/fhem

You will get the following user interface on the screen:
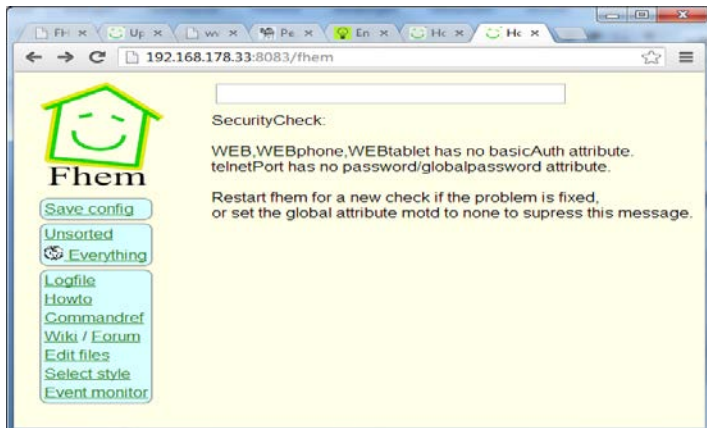
FHEM automatically recognizes the EnOcean-Pi and receives radio telegrams from EnOcean devices. Additionally, it generates by default device entities for each new received EnOcean ID. With the user interface you can visualize and configure graphical user elements to visualize events and send control telegrams to actuators.

A small "how to" guide can be found at:

 http://fhem.de/HOWTO.html

For German users there is an additional forum available:
http://forum.fhem.de/

4.5.3   Configuring the FHEM Server

FHEM server is configured via the configuration file `fhem.cfg`.
Start the configuration file editor via the FHEM menu item "Edit files".
A reference of FHEM commands for EnOcean can be found at:

http://fhem.de/commandref.html#EnOcean

4.5.4   Configure the EnOcean-Pi

FHEM might not recognize the EnOcean-Hat as an EnOcean Gateway-Controller. To fix this you can manually enter following definition:

```
define TCM310_0 TCM 310 /dev/ttyAMA0@57600
```
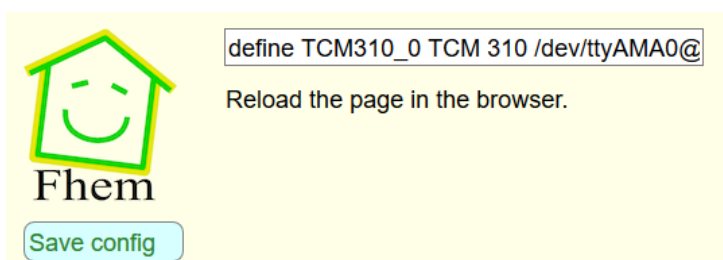

and save Config.

4.5.5 Visualization

(german)

4.5.6 Configure the PTM switch

PTM 210 – Push button multi-channel switch module

EEP: F6-02-xx

Set FHEM in the learning Mode (`set <IODev> teach <time/s>`), entering the following command

set TCM_ESP3_0 teach 600

Then press any button of the modul. When pressing the button a message is sent, which is received from the FHEM. After that FHEM defines the button automatically, and the button is trained. For this purpose FHEM adds the following code to the configuration:

- excerpt oft the configuration

```
define EnO_switch_FFC54500 EnOcean FFC54500                        <--
"FFC54500" is the 8-digit Hex-transmitterID of the button
attr EnO_switch_FFC54500 IODev TCM_ESP3_0
attr EnO_switch_FFC54500 room EnOcean
attr EnO_switch_FFC54500 subType switch                           <-- if it
refers to a button
# attr EnO_switch_FFC54500 eventMap AI:off A0:on BI:an B0:aus  <-- if
required ... the defined values (here: off, on, an, aus) should be explicit
define FileLog_EnO_switch_FFC54500 FileLog ./log/EnO_switch_FFC54500-%Y.log
EnO_switch_FFC54500
attr FileLog_EnO_switch_FFC54500 logtype text
```

4.5.7 Configure the STM Sensor

STM 320 energy harvesting magnetic contact transmitter module (Datenblatt)

EEP: D5-00-01

Set FHEM in the learning Mode (`set <IODev> teach <time/s>`), entering the following command

set TCM_ESP3_0 teach 600

Send train telegram according to manual or open and close magnetic contact.

The contact is automatically defined in FHEM and is trained.

- excerpt oft he configuration

```
define EnO_contact_0000FF53 EnOcean 0000FF53
attr EnO_contact_0000FF53 IODev TCM_ESP3_0
attr EnO_contact_0000FF53 room EnOcean
attr EnO_contact_0000FF53 subType contact
define FileLog_EnO_contact_0000FF53 FileLog ./log/EnO_contact_0000FF53-
%Y.log EnO_contact_0000FF53
attr FileLog_EnO_contact_0000FF53 logtype text
attr FileLog_EnO_contact_0000FF53 room EnOcean
```

4BS-Teach-In

Set FHEM in the learning Mode (`set <IODev> teach <time/s>`), entering the following command

```
set TCM_ESP3_0 teach 600
```

Release train telegram at the sensor according to manual.. The sensor is automatically defined in FHEM and is trained. When the device is detected a process graph is generated in the „room" „plots"
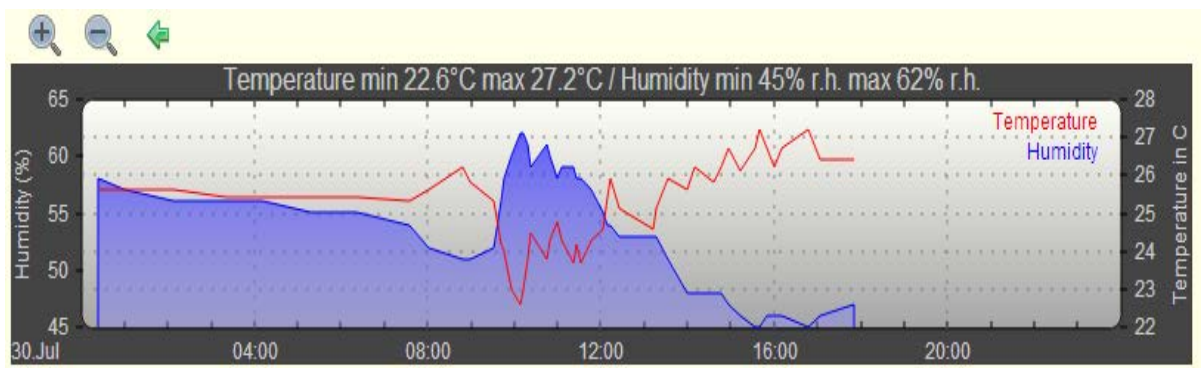
5 Useful Links

5.1 EnOcean radio modules

http://www.enocean.com/en/enocean_modules/

http://www.enocean.com/de/enocean-pi/

http://www.enocean.com/en/knowledge-base/

5.2   Element14 Raspberry Pi and accessories

http://www.element14.com/raspberrypi

http://www.element14.com/enocean_pi

5.3   Raspberry-Pi

http://www.debian.org/doc/manuals/refcard/refcard.en.pdf

http://www.danielspage.de/index.php/technik/raspberry-pi-blog/44-enocean-auf-dem-pi

http://developer-blog.net/hardware/raspberry-pi-backup/

http://www.datenreise.de/raspberry-pi-wlan-einrichten-edimax/

http://www.mikrocontroller.net/articles/Raspberry_Pi

http://pibeginners.com/ftp-server/

5.4   FHEM

http://fhem.de/fhem.html

http://forum.fhem.de/

http://fhem.de/Heimautomatisierung-mit-fhem.pdf

6   Regulatory Compliance and Safety Information

The **EnOcean UP Kits** are available in several frequency variants:
- SMART HOME KIT 868 MHz (for Europe) includes: STM 330, STM329, PTM 210, TCM 310 mounted on adaptor board
- SMART HOME KIT 902MHz (for US/Canada) includes: STM 330U, STM 320U, PTM 210U, TCM 310U mounted on adapter board
- KINETIC DESIGN KIT 868 MHz (for Europe) includes: PTM 210, PTM 330, TCM 310 mounted on adaptor board
- KINETIC DESIGN KIT 902MHz (for US/Canada) includes: PTM 210U, PTM 330U, TCM 310U mounted on adaptor board

WARNINGS:
- Devices or Modules containing RF components must meet the essential requirements of the local legal authorities.
- The modules must not be used in any relation with equipment that supports, directly or indirectly, any form of life or with applications that can endanger life or value.
- Any changes or modifications not expressly approved by the party responsible for compliance may 'void' the user's authority to operate this equipment
- These modules must not be modified or used outside of their specification limits
- These modules may only be used to transfer digital or digitized data; Analogue speech and/or music is not permitted
- The modules must not be used with gain antennas, otherwise resulting in exceeded ERP or spurious emission levels.

COMPLIANCE INFORMATION:

The **EnOcean UP Kits** complies with the relevant provisions of the RoHS Directive for the European Union.

WEEE Directive Statement for the European Union
- In common with all Electronic and Electrical products the Sensor Kit should not be disposed of in household waste within the European Union
- Components of the modules are considered and should be disposed of as hazardous waste.
- Alternative arrangements may apply to local jurisdictions.

EMC COMPLIANCE STATEMENTS:

European Union (EU) Electromagnetic Compatibility Directive Compliance Statement
- This product is in conformity with the protection requirements of EU Council Directive 2004/108/EC on the approximation of the laws of the Member States relating to electromagnetic compatibility.
- This product has been tested and found to comply with the limits for Class B Information Technology Equipment according to the European Standards EN 55022 & EN 55024.

FEDERAL COMMUNICATIONS COMMISSION (FCC) EMISSIONS COMPLIANCE STATEMENT

This equipment has been tested and complies with the limits f or a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a domestic environment.

Operation is subject to the following two conditions:

(1) this device might not cause harmful interference, and
(2) this device must accept any interference received, including interference that might cause undesired operation.

STM320U (902MHz) / STM330U (902MHz) – Scavenger Transmitter Modules:
These modules have been tested to fulfil the approval requirements and conform to the (CFR-47 Part 15) FCC based on the built-in firmware.

PTM210U (902MHz) / PTM330U (902 MHz) – Pushbutton Transmitter Devices:
These modules have been tested to fulfil the appropriate approval requirements and conform to FCC (CFR-47 Part 15).

INDUSTRY CANADA EMISSIONS COMPLIANCE STATEMENT
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

Compliant with: