USER MANUAL

DOLPHIN
Self-powered IoT by EnOcean

PTM 330 / PTM 335 / PTM 330U / PTM 430J
Sub GHz Transmitter Modules

Patent protected:
WO98/36395, DE 100 25 561, DE 101 50 128,
WO 2004/051591, DE 103 01 678 A1, DE 10309334,
WO 04/109236, WO 05/096482, WO 02/095707,
US 6,747,573, US 7,019,241

REVISION HISTORY

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

No	Major Changes
0.81	CFG Pin: For test purposes only
0.85	Antenna length 868 MHz changed to 86 mm; upper limit of operating temperature reduced to 65 °C
0.90	Equivalent energy pulse definition added
1.00	Max. supply voltage for programming interface added in 2.4. Digital input parameters added in 2.3. FCC / IC grants added in 4.2 and 4.3.
1.01	TX power increased to 3 dBm at antenna input; Chapter Related Documents added; misleading table removed in 3.3
1.02	Figure corrected in 3.4
1.03	3.4 modified
1.1	Meander structures increased; PTM 330U added
1.2	PTM 335 added
1.3	Telegram of PTM 332 changed to EEP F6-10-00 (window handle)
1.4	Delete PTM 332 (customer specific SMD variant), chapter 1. general documents deleted, 3.6 deleted since PTM 33x not recommended for SMD soldering, 4. CE label customer application specific, added comment on RE-D, approval documents and drawings/3D-data -> available at product websites, replaced ECO 200 by ECO 2xy with ECO 250 introduction, added/merged PTM 430J
1.5	Added comment about operating rate
1.6	Added 3.4 EMC and module handling (IEC 61000-6-2)
1.7	R&TTE -> RED: updated 2.2 technical data , 4.2 antenna and 5.1 RED for EU, IC (CA) -> ISED
1.8	Added warnings: no magnet or ferromagnetic near ECO 200, none-conductive material for good radio performance

Important!

This information describes the type of component and shall not be considered as assured 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 essential requirements of the local legal authorities.

The modules must not be used in any relation with equipment that supports, directly or indirectly, human health or life or with applications that can result in danger for people, animals or real value.

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.

TABLE OF CONTENT
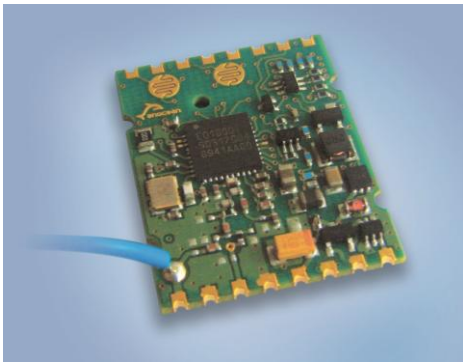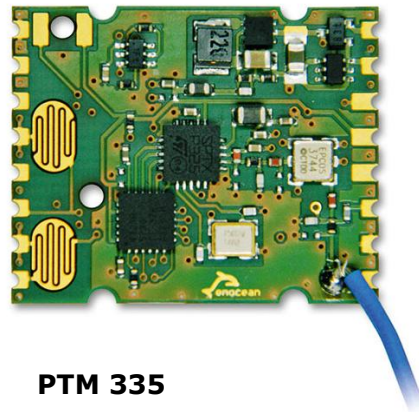
1   GENERAL DESCRIPTION

1.1   Basic Functionality

The radio transmitter module PTM 33x / PTM 330U / 430J (PTM radio module) from EnOcean enables the implementation of wireless sensors and switches without batteries.

Key applications are handheld remote controls or industrial switches.

PTM 330 / PTM 330U / PTM 430J   **PTM 335**

Functional Principle

When an energy pulse is supplied (e.g. by ECO 200 or ECO 250 from EnOcean) an RF telegram is transmitted including a unique 32-bit module ID (PTM 430J 32 or 48bit), the polarity of the energy pulse, and the operating status of 4 digital inputs. The RPS telegram content can be configured if other content is needed.

PTM transmitter modules have all the same mechanical dimensions and can be connected to EnOcean energy generators (e.g. ECO 250 / ECO 200) via two appropriate contact springs. There are two meander structures on the PCB which allow usage of a rubber pad to set the level of two digital inputs. Alternatively PTM transmitter module can be mounted as an SMD component onto a host PCB. In this case energy supply pins and digital input pins are accessible via contact pads.

PTM 335 can additionally protect its outgoing communication with enhanced security features.

Product variants

- PTM 330:   868 MHz variant, pre-installed whip antenna (PTM 332 w/o antenna)
- PTM 335:   868 MHz variant, pre-installed whip antenna, supports enhanced security
- PTM 330U: 902 MHz variant, pre-installed whip antenna
- PTM 430J: 928 MHz variant, pre-installed whip antenna

1.2   Technical Data

Power supply	ECO 2x0 or equivalent energy pulse
Antenna	pre-installed whip antenna
Frequency	PTM 33x: 868.300 MHz (ASK) PTM 330U: 902.875 MHz (FSK) PTM 430J: 928.350 MHz (FSK)
Transmission power (at antenna base)	PTM 33x: typ. 3 dBm PTM 330U: typ. 1 dBm PTM 430J: typ. 0 dBm
Data rate	125 kBit/s
EnOcean Equipment Profile	PTM 330: EEP F6-02-xx, F6-04-xx PTM 335: EEP F6-02-xx, F6-04-xx or secure D2-03-00 PTM 430J: F6-02-04
On-board button interface	2 meander contacts
Digital inputs	4
Mode switch (standard and enhanced security)	3 pins PTM 335 only
Max. transmission range (free field/indoor)	PTM 33x: 300m/30m PTM 330U: 300m/30m PTM 430J: 200m/20m
Module dimensions	26.2 x 21.15 x 3.5 mm
Operating temperature	-25 up to +65 °C
Storage temperature	-40 °C … +85 °C
Humidity	0% … 93% r.h., non-condensing
Radio approvals	PTM 33x: RED (EU) PTM 330U: FCC (US) / ISED (CA) PTM 430J: ARIB (Japan)

Engineering drawings and 3D-data available for download at product web website e.g.
https://www.enocean.com/en/enocean_modules/ptm-330/

1.3   Ordering Information

Type	Ordering Code	Frequency	Note
PTM 330	S3001-A330	868.300 MHz	whip antenna
PTM 332	Custom variant	868.300 MHz	w/o antenna for SMD soldering
PTM 335	S3001-A335	868.300 MHz	whip antenna / enhanced security
PTM 330U	S3051-A330	902.875 MHz	whip antenna
PTM 430J	S3061-A430	928.350 MHz	whip antenna

2 FUNCTIONAL DESCRIPTION

2.1 Block diagram

At power-up by an energy pulse at AC1, AC2 a DC voltage is provided to the internal micro controller. The microcontroller reads the polarity of the supply voltage pulse and the status of the digital inputs A0, A1, B0, B1. After that 3 identical radio telegrams calculated from the status of these inputs are transmitted.
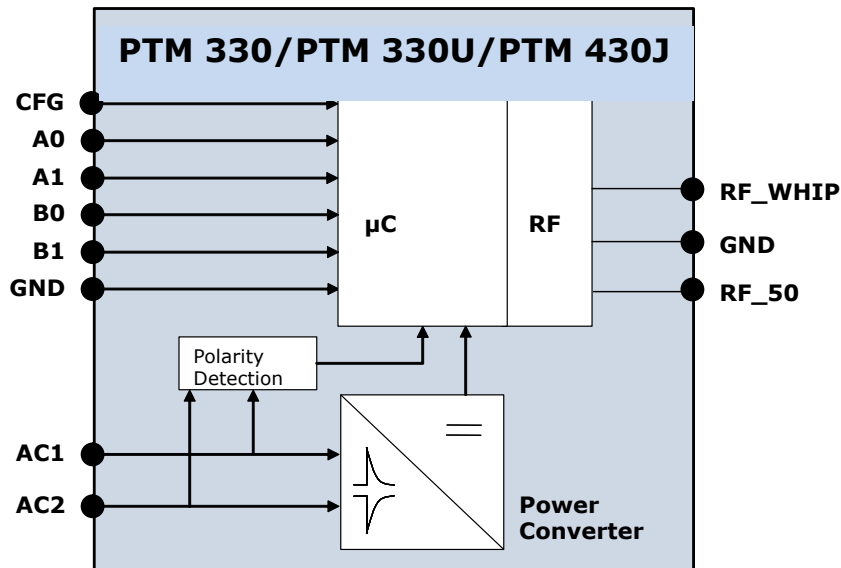
PTM 335 has additionally SECURE and STANDARD input pins, which enable to switch between enhanced security communication and standard communication.
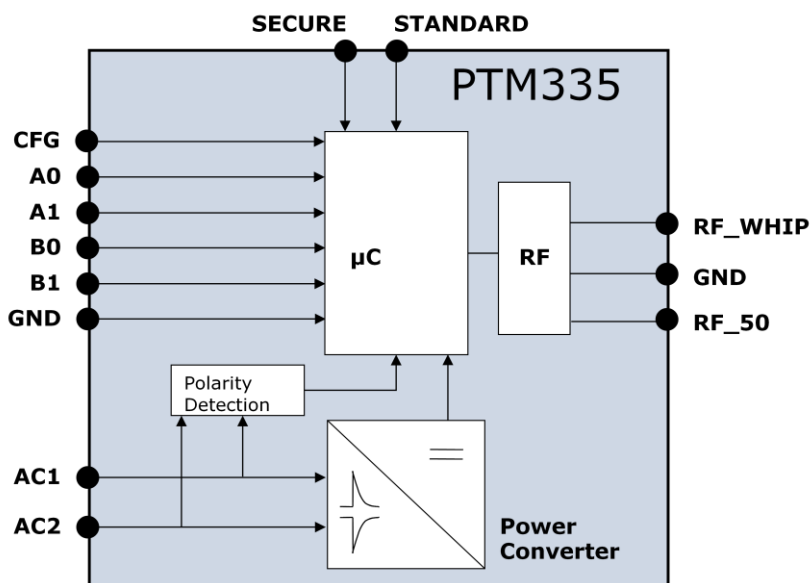
2.2　　Pin out

PTM 330 / PTM 330U / PTM 430J bottom:

On back side of PCB

PTM 335 bottom:

DOLPHIN
Self-powered IoT by EnOcean

PTM 330 / PTM 335 / PTM 330U / PTM 430J

Sub GHz Transmitter Modules

2.3 Pin Description and operational characteristics

PTM 330 / PTM 330U / PTM 430J

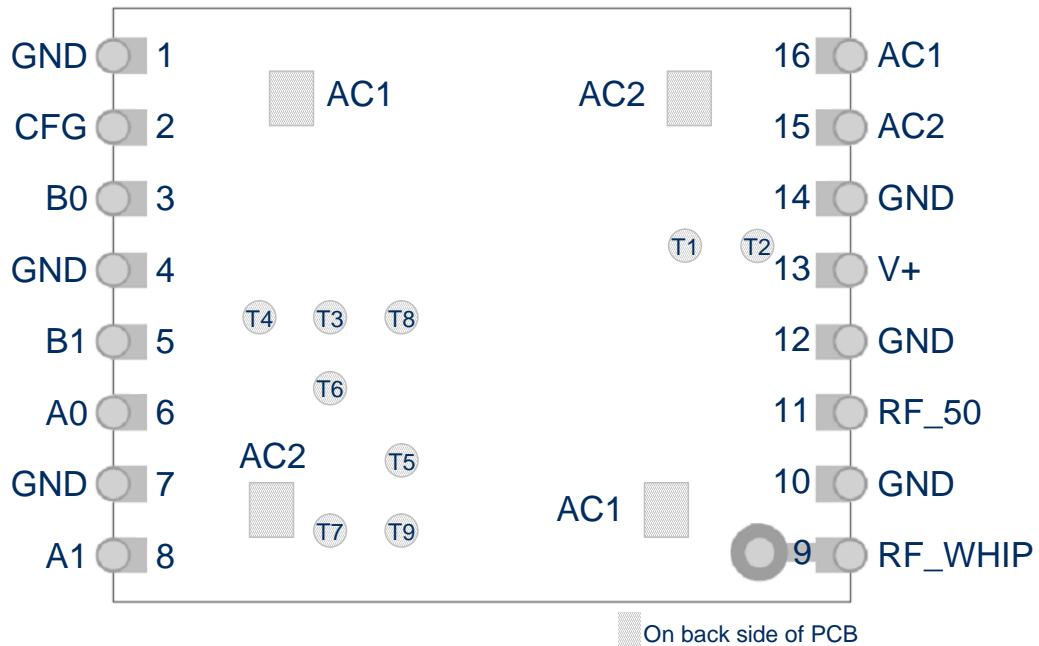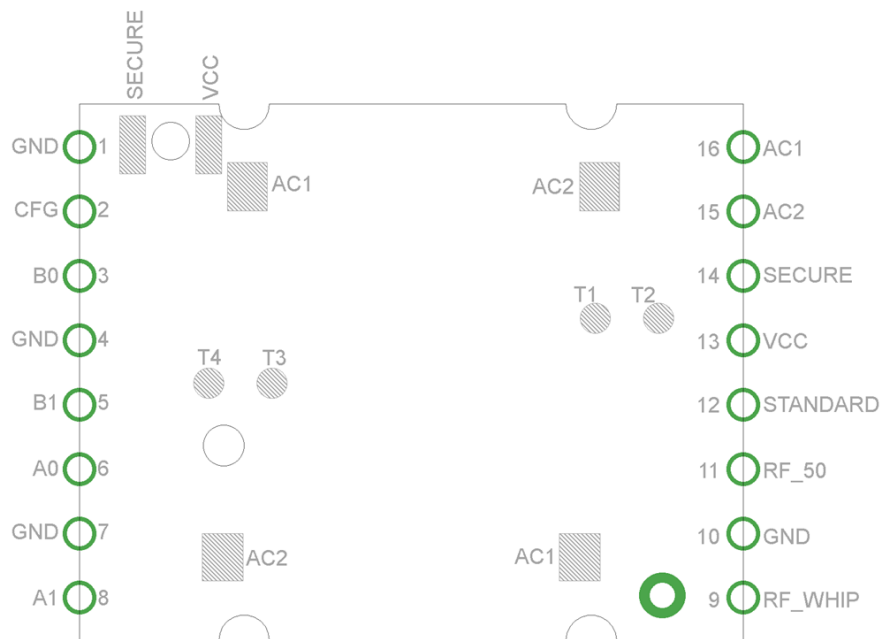| Symbol	Function	Characteristics
GND	Ground connection	Must be connected to GND
V+	For test purposes only	Do not connect
B0	O-Button Rocker B	Digital input, leave open or connect to GND Internal pull-up
B1	I-Button Rocker B	Digital input, leave open or connect to GND Internal pull-up
A0	O-Button Rocker A	Digital input, leave open or connect to GND Internal pull-up
A1	I-Button Rocker A	Digital input, leave open or connect to GND Internal pull-up
CFG	For test purposes only	Internal pull-up
AC1	Input for ECO 2xy	ECO 2xy or equivalent energy pulse
AC2	Input for ECO 2xy	ECO 2xy or equivalent energy pulse
RF_WHIP	RF output	Output for whip antenna
RF_50	RF output	50 Ohm output for external antenna (not recommended for PTM 330U and PTM 430J due to radio approval reasons)
T1-9	Configuration Interface	See 0

PTM 335

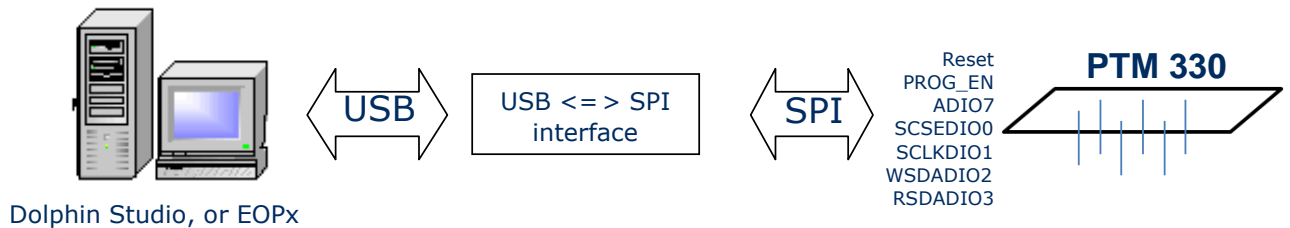| Symbol	Function	Characteristics
GND	Ground connection	Must be connected to GND
VCC	Operating voltage	Connect to SECURE or STANDARD to change modes
SECURE	Mode change pin	Connect to VCC and press ECO (energy generator) to change mode - secure. Disconnect after mode change.
STANDARD	Mode change pin	Connect to VCC and press ECO (energy generator) to change mode - standard. Disconnect after mode change.
B0	O-Button Rocker B	Digital input, leave open (int pull-up) or connect to GND
B1	I-Button Rocker B	Digital input, leave open (int pull-up) or connect to GND
A0	O-Button Rocker A	Digital input, leave open (int pull-up) or connect to GND
A1	I-Button Rocker A	Digital input, leave open (int pull-up) or connect to GND
AC1	Input for ECO 2xy	ECO 2xy or equivalent energy pulse
AC2	Input for ECO 2xy	ECO 2xy or equivalent energy pulse
RF_WHIP	RF output	Output for whip antenna
RF_50	RF output	50 Ohm output for external antenna
T1-4	Config. Interface	See 0

2.4 Configuration Interface

2.4.1 PTM 330 / PTM 330U Configuration

Telegram content can be configured by via EnOcean Developer Kit (EDK 350). PTM 330 needs to be connected via bed of needle to the EnOcean programmer board (EOP 350). **DolphinStudio** or EOPx command line program is used to set configurations. Following figure shows basic principle:

Pad	Symbol	Function	Characteristics
T1	VDD	Supply voltage	Interface to programmer; Max. 3.3 V
T2	GND	Ground connection	Interface to programmer
T3	SCSEDIO0	SPI chip select	Interface to programmer
T4	SCLKDIO1	SPI serial clock	Interface to programmer
T5	WSDADIO2	SPI input	Interface to programmer
T6	RSDADIO3	SPI output	Interface to programmer
T7	RESET	Reset	Interface to programmer, internal pull down
T8	ADIO7	Sync output	
T9	PROG_EN	Enable programming mode	Interface to programmer HIGH: programming mode active LOW: operating mode Internal pull-down

DolphinStudio for PTM 330 and PTM 330U configuration is available for download at the EnOcean website.
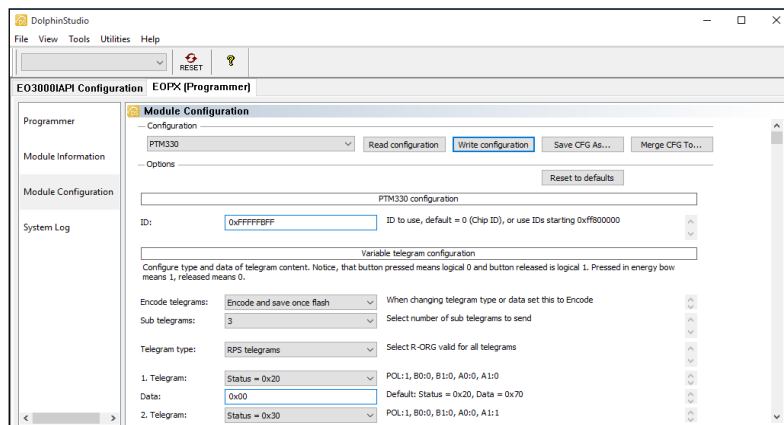
2.4.2 PTM 430J Configuration

Telegram content can be configured by via EnOcean Developer Kit (EDK 400J). PTM 430J needs to be connected via bed of needle to the EnOcean programmer board (EOP 350). **Dolphin Module Configurator** (part of DolphinSuite) is used to set configurations. Connecting to SPI programming interface is done like PTM 330 via a bed of needle and the EnOcean developer kit. Following figure shows basic principle:
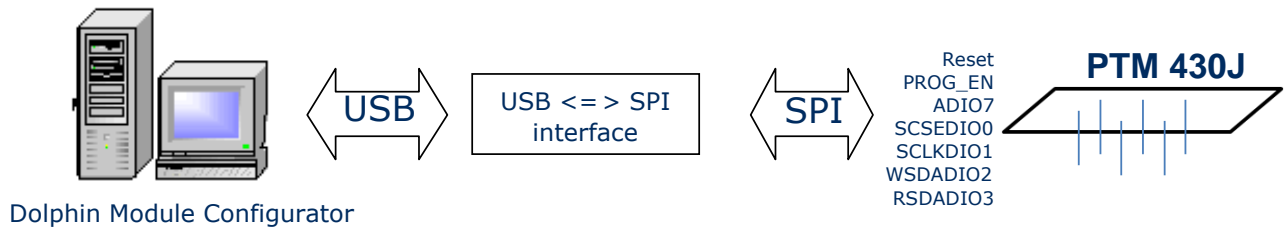
Use Dolphin Module Configurator to change telegram coding and/or module ID length 32/48 bit to customer specific needs. Default configuration of the outgoing telegram coding is corresponding to the profile definition of the EEP F6-02-04. Please see chapter 3.7.
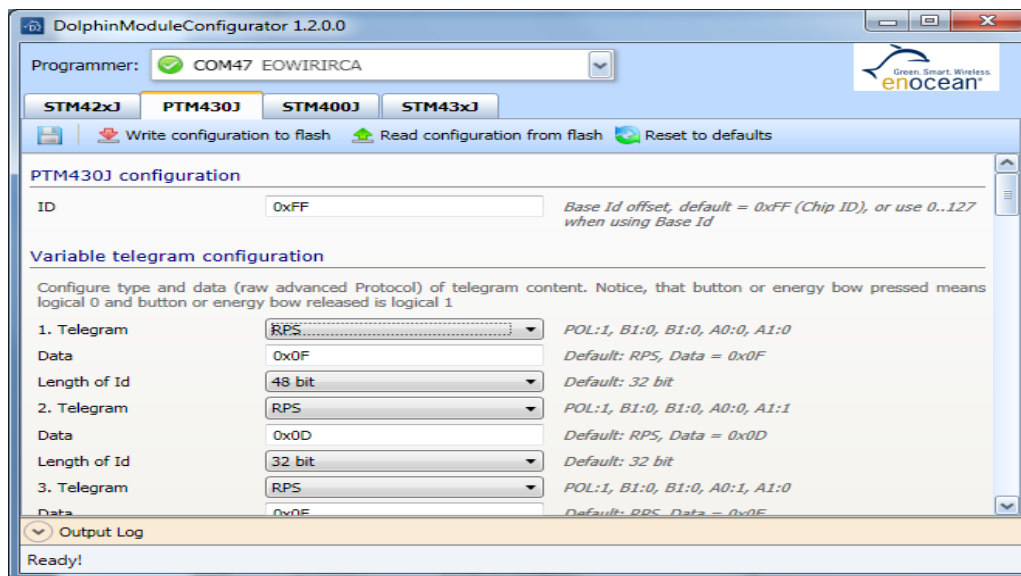
2.4.3 PTM 335 Configuration

To configure PTM 335, **PTM 335 Suite** must be used. Please see here for latest version - http://www.enocean.com/en/download/

Additional Programmer for MSP 430 is required (e.g. MSP-FET430UIF - http://www.ti.com/tool/msp-fet430uif).
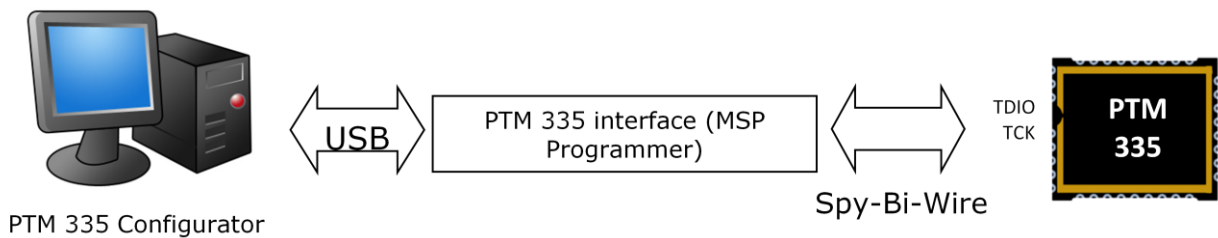
Pin adapter which were used to program PTM 330 can be reused to program PTM 335 too.
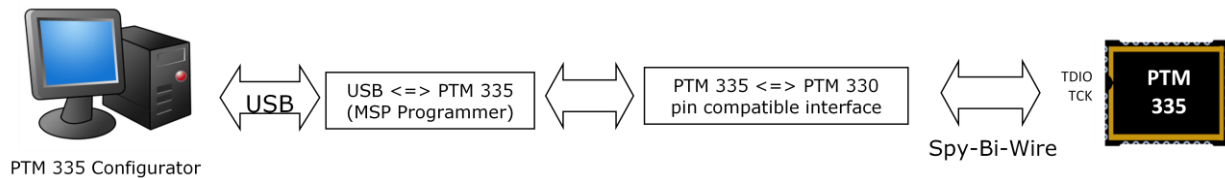
To re-use the PTM 330 a convertor is required please see here the layout of such convertor PTM 330 interface.
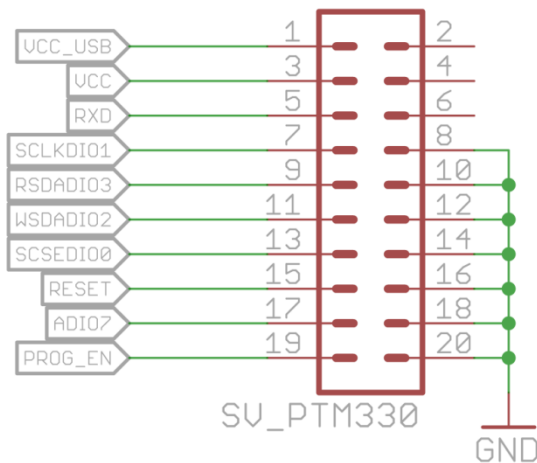
PTM 335 Interface – PL1 is corresponding to the interface of MSP-FET430UIF programmer.
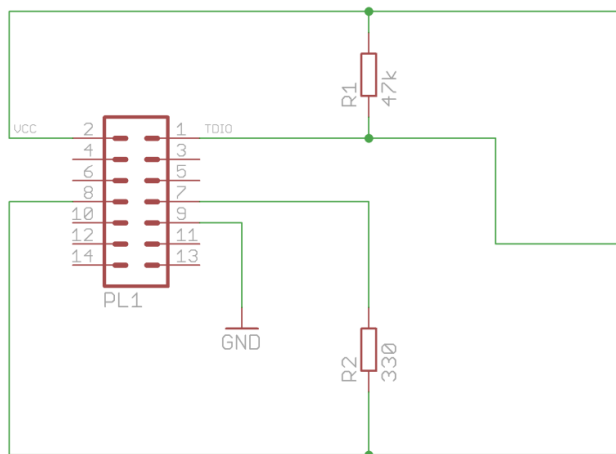
JTAG interface   PTM 335 interface
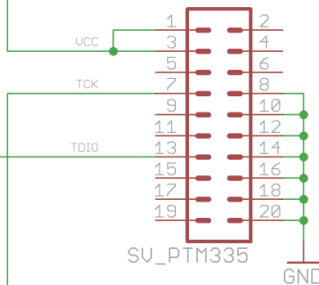
Not all pins are required for programming. Please refer to the table below to see an overview which PINs are still required.

Pad	Symbol PTM 330	Symbol PTM 335	Characteristics
T1	VDD	VCC	Programming interface. Spy-Bi-Wire
T2	GND	GND	Programming interface. Spy-Bi-Wire
T3	SCSEDIO0	TDIO	Programming interface. Spy-Bi-Wire
T4	SCLKDIO1	TCK	Programming interface. Spy-Bi-Wire

The configuration of PTM 335 is executed via „2-wire Spy-Bi-Wire".
The programming interface consists of the PINS: TCK, TDIO, GND and VCC.
Following is the „2-wire Spy-Bi-Wire"-interface of MSP430FRxxxx.
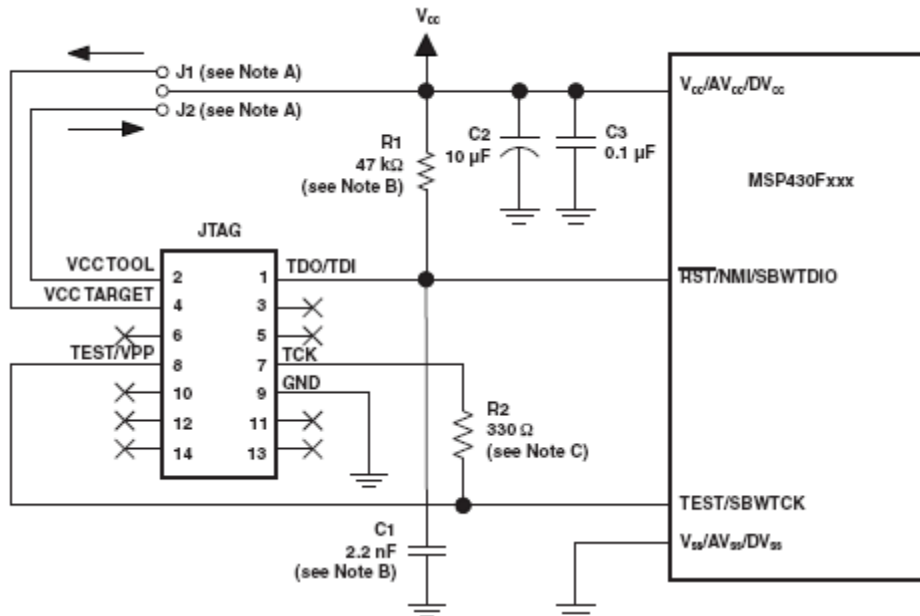
A   Make either connection J1 (if a local target power supply is used) or connection J2 (if powering the from the debug/programming adapter).

B   Note that the device RST/NMI/SBWTDIO pin is used in 2-wire Spy-Bi-Wire mode for bi-directional debug communication with the device and that any capacitance attached to this signal may affect the ability to establish a connection with the device. The upper limit for C1 is 2.2 nF when using current TI FET Interface modules (USB FET).

C   R2 is used to protect the JTAG debug interface TCK signal against the JTAG security fuse blow voltage that is supplied by the TEST/VPP pin during the fuse blow process. In the case that fuse blow functionality is not needed, R2 is not required (becomes 0 Ω) and the connection TEST/VPP must not be made.

Figure 3-2. Signal Connections for 2-Wire Spy-Bi-Wire Communication

.

Picture Source - http://www.ti.com/tool/msp-fet430uif (20.6.2014)

The Parts R1, C2 und C3 must be included in the programming adapter / converter from MSP 430 interface to PTM 330. R1 is already included in the layout above.

Configuring Values in PTM 335 Configurator

PTM 335 Configurator provides additional configuration option than Dolphin Studio does. Additionally the secure telegrams content relevant parameters can be configured.

Parameter	Configuration via programming interface
Number of secure sub-telegrams.	When ECO 2xy is connected in secure mode only 2 tele-grams can be transmitted due to longer telegrams and energy reasons. In case of sufficient power source is secured you can change this parameter to 3. Default value: 2
Secure teach-in starts when	To operate in secure mode the PTM 335 sends a secure teach-in telegram. This event can be triggered by con-necting SECURE with VCC and either: • pressing the energy bow only • releasing the energy bow only • pressing or releasing the energy bow Default value: •pressing or releasing the energy bow
PTM 335 secure telegrams content	The content of the 32 possible data telegrams with en-hanced security can be configured. Please see PTM 335 Configurator for details.
PTM 335 standard telegram content	The content of the 32 possible data telegrams can be configured. Please see PTM 335 Configurator for details.

Configuring PTM 335 in production with command line tool

During PTM 335 Configuration a command line programmer tool is installed – MSP 430 Flasher:
http://processors.wiki.ti.com/index.php/MSP430_Flasher_-_Command_Line_Programmer

This command line tool can be also used without PTM 335 Configuration – similar to EOPX. The command line tool is most valuable during production, where no GUI is needed for con-figuration and the configuration must be performed without user involvement.

For this purpose first create the required configuration in PTM 335 Configurator and save it. The stored file can be then used to configure a PTM 335. This command must be used:

```
MSP430Flasher.exe -i COM59 -n MSP430FR5730 -w ptm335_config.txt -u -e ERASE_SEGMENT -s -z [VCC]
```

The COMXX must be specified according your COM Port representing the MSP 430 Pro-gramming interface.

⚠ Be sure not programming previously read-out configuration files or other files into the PTM 335. By programming other than the specified cells the module configura-tion will become corrupted and the PTM 335 fails to operate according to specifica-tion.

2.5 Absolute maximum ratings (non operating)

Symbol	Parameter	Min	Max	Units
AC1 AC2	Supply voltage	0	6.4	V
GND	Ground connection	0	0	V
A0 A1 B0 B1	Voltage digital input pins	0	0	V

2.6 Maximum Ratings (operating)

Symbol	Parameter	Min	Max	Units
AC1 AC2	Supply voltage	0	6.0	V
GND	Ground connection	0	0	V
A0 A1 B0 B1	Voltage digital input pins	0	0	V

2.7 Radio telegram

2.7.1 PTM 330, PTM 330U and PTM 335 Normal operation

In default configuration PTM 33x transmits the same telegrams as a PTM 210 radio switch:

- Telegram type RPS:
  There are two message types depending on how many contacts (A0, A1, B0, B1) have been connected to GND (button pressed)
  - o N-message: Only one or two buttons have been pressed simultaneously
  - o U-message: No pushbutton was pressed when activating the energy generator, or more than two pushbuttons have been pressed simultaneously.
- Unique factory programmed 32 bit device ID
- DATA_BYTE2, DATA_BYTE1, DATA_BYTE0=0
- DATA_BYTE3 and STATUS as follows:

N-message:

DATA_BYTE3:

7					0
RID	UD	PR	SRID	SUD	SA

RID	(2 bit)	Rocker ID, A=0, B=1
UD	(1 bit)	UD=1 → O-button, UD=0 → I-button
PO	(1 bit)	Polarity, see table below
SRID	(2 bit)	Second Rocker ID
SUD	(1 bit)	(Second) SUD=1 → O-button, SUD=0 → I-button
SA	(1 bit)	SA=1 → Second action (2 buttons pressed simultaneously), SA=0 → No second action

STATUS:

7			0
Reserved	T21	NU	RP_COUNTER

Reserved	(2 bit)	For future use
T21	(1 bit)	1
NU	(1 bit)	NU=1 → N-message.
RP_COUNTER	(4 bit)	Repeater level: 0 is original message (not repeated)

U-message:

DATA_BYTE3:

7			0
BUTTONS	**PR**	**Reserved**	

BUTTONS   (3 bit)   Number of simultaneously pressed buttons, as following:

> 0 = 0 Button
> 1 = not possible
> 2 = not possible
> 3 = 3 or 4 buttons
> 4 = not possible
> 5 = not possible
> 6 = not possible
> 7 = not possible

PO   (1 bit)   Polarity, see table below
Reserved   (4 bit)

STATUS:

7			0
Reserved	**T21**	**NU**	**RP_COUNTER**

Reserved   (2 bit)   For future use
T21   (1 bit)   1
NU   (1 bit)   NU=0 → U-message.
RP_COUNTER   (4 bit)   Repeater level: 0 is original message (not repeated)

The polarity PO is defined as follows:

AC1	AC2	PO
-	+	1
+	-	0

PTM 330 / PTM 335 / PTM 330U / PTM 430J

Sub GHz Transmitter Modules

2.7.2 PTM 430J Equipment Profile Examples

PTM 430J as two rocker switch

In default configuration PTM 430J transmits the same radio telegrams as a PTM 210J switch module:

R-ORG	:	F6	(RPS Telegram)
FUNC	:	02	(Two Rocker Switch)
TYPE	:	04	(Light and Blind Control, EnOcean Radio Protocol 2)

Reserved is required to be 0.

Telegram definitions:

Offset	Size	Bit-range	Data	Short-cut	Description	Valid Range	Scale	Unit
0	1	DB0.7	Energy bow	EBO	State of the energy bow.	Enumeration: 1: pressed 0: released		
1	1	DB0.6	Button coding	EBO	Signalize button coding..	Enumeration: 0: button		
2	2	DB0.5-DB0.4	Reserved					
0	1	DB0.3	BI	RBI	State I of the rocker B.	Enumeration: 1: pressed 0: not pressed		
0	1	DB0.2	B0	RB0	State 0 of the rocker B.	Enumeration: 1: pressed 0: not pressed		
0	1	DB0.1	AI	RAI	State I of the rocker A.	Enumeration: 1: pressed 0: not pressed		
0	1	DB0.0	A0	RA0	State 0 of the rocker A.	Enumeration: 1: pressed 0: not pressed		

PTM 430J as key card switch

R-ORG   :   F6   (RPS Telegram)
FUNC   :   04   (Position Switch, Home and Office Applications)
TYPE   :   02   (Key Card Activated Switch, EnOcean Radio Protocol 2)

Reserved is required to be 0.

Telegram Definition:

Offset	Size	Bit-range	Data	Short-cut	Description	Valid Range	Scale	Unit
0	1	DB0.7	Energy bow	EBO	State of the energy bow.	Enumeration: 1: card inserted 0: taken out		
1	1	DB0.6	Button coding	EBO	Signalize button cod-ing..	Enumeration: 0: button		
2	3	DB0.5 - DB0.3	Reserved					
5	1	DB0.2	State of card	SOC	State of the card.	Enumeration: 1: card inserted 0: taken out		
6	2	DB0.1 - DB0.0	Reserved					

When card is inserted field EBO and SOC are both having value 1. When take out, both are having value 0. This coding is required to have a context-less translation of RPS profiles between ERP 1 and ERP 2.

2.7.3 PTM 335 Secured Radio Message

While operating in secure mode, PTM 335 sends secure telegrams in accordance to EEP D2-03-00 as specified in EnOcean Equipment Profiles. More details see: http://www.enocean-alliance.org/eep/.

Secure telegrams include a **rolling code** based on an incrementing counter which guarantees that identical message content will be encrypted differently for each telegram in order to prevent replay attacks.

The initial counter value is transmitted from PTM 335 to the receiver as part of the teach-in telegram when entering secure mode. Subsequent secure telegrams do not specify this counter value, therefore sender and receiver have to automatically increment their respective counters for each secure telegram to keep them synchronized.

Not received telegrams lead to a de-synchronization of transmitter and receiver counter. In order to prevent failure during normal operations the receiver will usually test the received rolling code against a defined window of future expected rolling codes and – if successful - resynchronize its counter automatically. The size of this rolling code window is defined on the receiver side. It is important that the amount of consecutive, not (correct) received telegrams does not exceed the side of this window. For more details please refer to http://www.enocean.com/en/security-specification/.

⚠ The rolling code itself is not transmitted with every telegram. It is only transmitted during teach-in. Afterwards the receiver has to increase the counter autonomously for each received message.

⚠ It is strongly recommended to use PTM 335 in secure mode only in fixed installations with safe radio communication to avoid de-synchronization of sender and receiver. De-synchronization will occur if PTM 335 is operated outside the range of the receiver consecutively more often than the size of the rolling code window defined on the receiver. The same may apply if consecutive telegrams are lost on the receiver side due to power interruptions. In these cases it is necessary to set the receiver in LRN mode and teach-in the device again.

2.7.4 PTM 335 Switching to Secure Mode and send Teach-In Telegrams

1. Connect SECURE pin with VCC to enter
2. Power transmitter module via ECO 2xy (push spring)
   -> PTM 335 will change to secure mode and first part of teach-in will be sent
3. Power transmitter module via ECO 2xy (push spring)
   -> PTM 335 will send second part of teach-in telegram
4. Disconnect SECURE from VCC

The complete secure teach-in message consists of two subsequent telegrams. Therefore to transmit a complete message the ECO generator has to be triggered twice. The two contacts must not remain connected during the sequence of transmitting the teach-in telegram. The connection is only required to trigger the process.

For more information on the structure of the teach-in telegram please refer to chapter 4.2 of http://www.enocean.com/en/security-specification/.

PTM 335 can be switched from secure mode to normal mode by connecting STANDARD with VCC, and triggering the ECO 2xy. Please disconnect STANDARD after mode change.

Before changing the operating mode please make sure to clear the device from all receivers which have been taught to work with this device before. Otherwise the receiver will ignore the telegrams and the application will not work.

2.7.5 User defined operation

Via the configuration interface it is possible to define different content of DATA_BYTE3 and define if a N-message or U-message shall be sent. This allows for example to transmit other RORG=F6 telegrams, e.g. "Mechanical handle", as described in the EnOcean Equipment Profiles defined by EnOcean Alliance.

For details please refer to the EnOcean Equipment Profiles specification- http://www.enocean-alliance.org/en/enocean_standard/.

2.8   Transmit timing and operating rate

Optimized transmission timing according to the EnOcean standard helps to avoiding collisions with data packages of other EnOcean transmitters as well as disturbances from the environment. With each transmission cycle, multiple identical sub-telegrams are transmitted within 40 ms. The transmission of a sub-telegram lasts approximately 0.7 – 1.3ms. The delay between the three transmission bursts is affected at random.

PTM 330 / PTM 330U:
3 sub-telegrams each approx. 0.7ms within 40ms

PTM 335 in secure mode:
2 sub-telegrams each approx. 1.3ms within 40ms

PTM 430J:
2 sub-telegrams each 0.7ms within 40ms
After sending of two sub telegrams there will be a pause of 50ms to be conform to the duty cycle rules of ARIP. Pushing the button during this pause will be ignored.

PTM radio modules are designed for manual button operation. The operations rate is limited to max. 5 actuations per second. Faster operation could lead to a short freeze (no operation) for about 2 seconds.

3 APPLICATIONS INFORMATION

3.1 How to connect an energy harvester

PTM transmitter module can be connected to ECO 2xy without soldering. ECO 2xy provides contact springs which can directly be connected to contact pads of PTM. The contact pads on the bottom of the PCB are shown below (left). A second orientation where PTM transmitter module is rotated 180° with respect to ECO 2xy is also possible as shown with dashed lines.
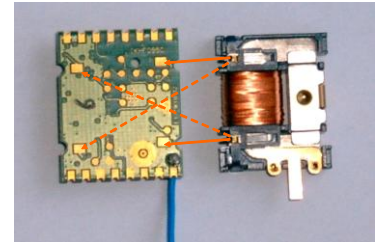
For CAD system development support, 3D construction data is available from EnOcean (IGS data). Using this data, the mechanical interface is fixed, and the shape and surface of the rocker(s) can be changed according to requirements.

Polycarbonate is recommended as rocker material since it is both buckling resistant and wear-proof. It is also recommended to apply Teflon varnish in the areas of actuation.

⚠️ It is required to use non-conductive material (no metal or plastic with metal or graphite elements) in order to get good radio performance.

⚠️ For proper function there has to be a keep out zone of 60mm for magnets or ferromagnetic materials around the center of ECO 200.

3.2 How to generate an equivalent energy pulse

PTM transmitter module can also be operated from an external equivalent energy pulse. As the source impedance is not known a procedure is defined how to find the needed duration of the pulse. The pulse must provide a voltage between 5 V and 6 V for maximum 10 ms time.
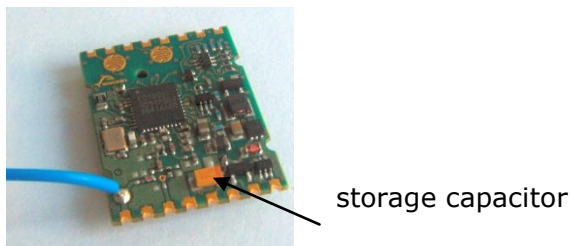
storage capacitor

The length of this supply pulse needs to be defined by measuring the remaining voltage on the storage capacitor after the 3rd sub-telegram, according to the following procedure:

1) Discharge the storage capacitor (see photo) completely
2) Apply a short pulse, voltage between 5 V to 6 V which charges the capacitor
3) Measure the voltage drop at the storage capacitor to ground (between pin 13 and pin 12) while the sub-telegrams are being transmitted with an oscilloscope
4) The remaining voltage shortly after the 3rd sub-telegram should be 2.5 to 3.0 V
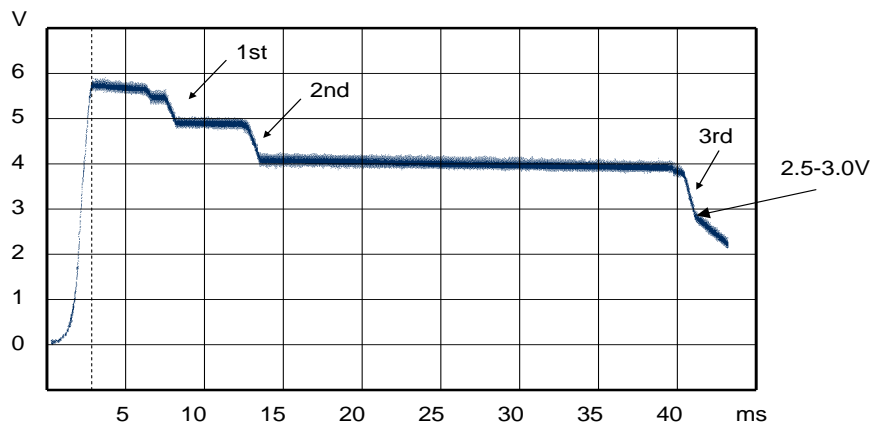
3.3 How to solder additional teach-in button (PTM 335 only)

On PTM 335 there is are not populated pads – SECURE and VCC. By mounting a push button on them the PTM 335 can have a teach-in button. By pressing the button and triggering the ECO the secure teach-in process is triggered and the module switches to secure mode.

By repeated pressing the button will retransmit the secure message. To switch to the standard mode the STANDARD and VCC pin must be connected. There is no push button option available for this step.

A drilling is positioned between the pads. This enables the possibility to mount also push buttons which have pressing point deeper then the PCB (better tactile handling) or are operated from the bottom.

Please see drawings of PTM 335 for detailed information and position of pads. (please see chapter 2.4 and 3.2)

Following push buttons have been evaluated as acceptable for the above defined use case: Ultra-small Tactile Switch (SMT) B3U – from Omron

http://www.omron.com/ecb/products/pdf/en-b3u.pdf

3.4 EMC and module handling

Observe precautions for electrostatic devices!
Module fulfils IEC 61000-6-2

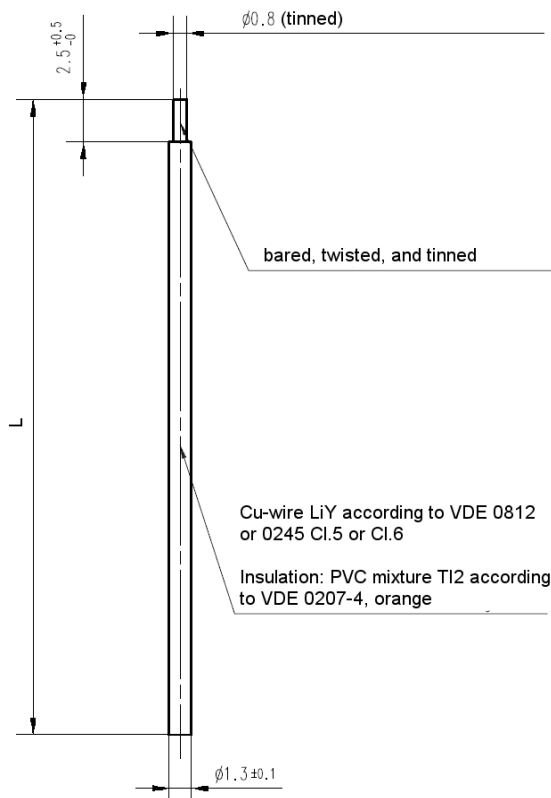## 3.5   Antenna

868.300 MHz

Option 1: 86 mm wire, connect to RF_WHIP
Option 2: A 50 Ω antenna can be connected to RF_50

902.875 MHz
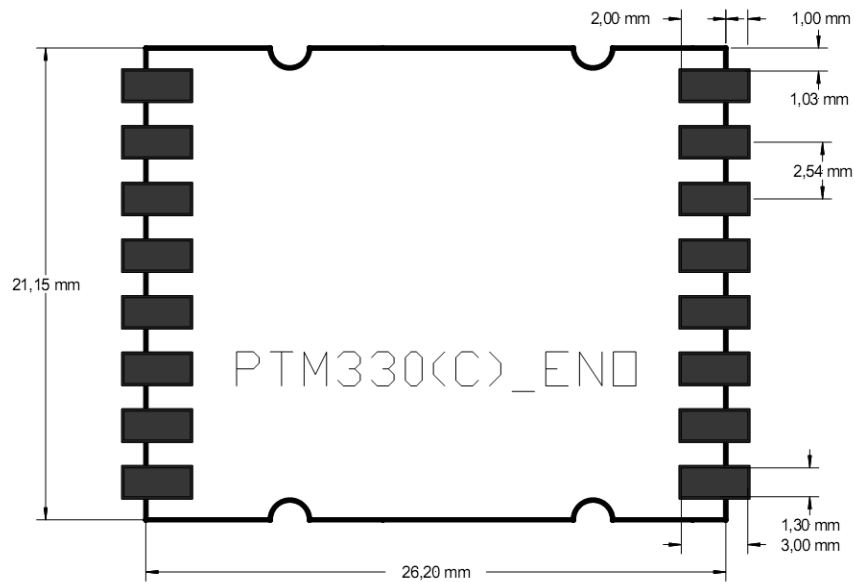
64 mm wire, connect to RF_WHIP

928.350 MHz
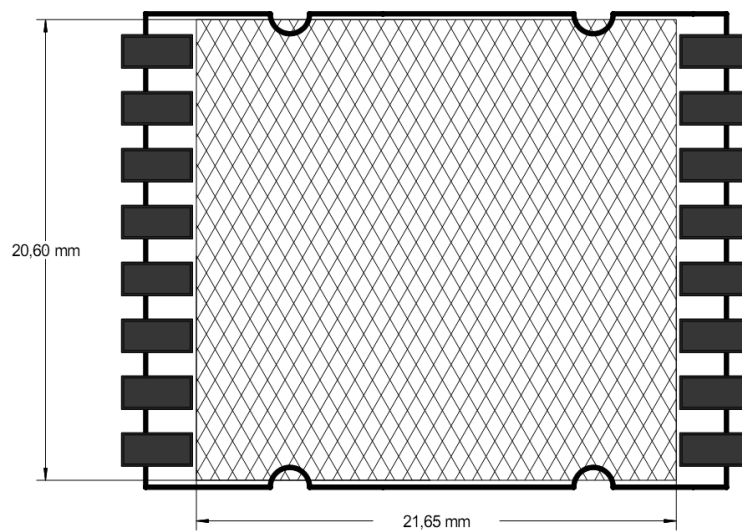
64 mm wire, connect to RF_WHIP

**Specification of the whip antenna;
L=86 mm @ 868 MHz, L=64 mm @ 902 MHz / 928MHz**

3.6 Layout recommendations

Proposal for foot print on host PCB

Keep out area on host PCB. No copper surface area allowed!

DOLPHIN
Self-powered IoT by EnOcean

PTM 330 / PTM 335 / PTM 330U / PTM 430J

Sub GHz Transmitter Modules

3.7 Device Integration

PTM transmitter module is designed for integration with ECO 2xy kinetic energy harvesters. EnOcean will provide mechanical reference designs upon request. The 2D mechanical outline of PTM 330 is shown below as an example. Detailed engineering drawings are available on PTM and ECO product websites.
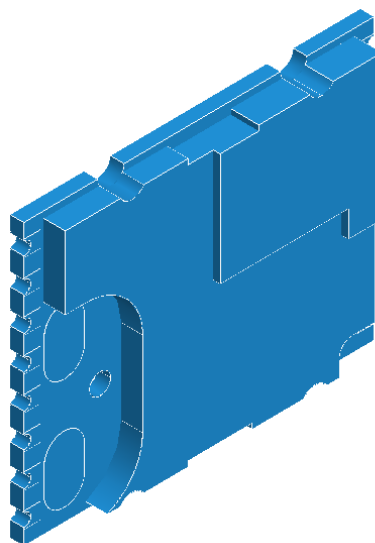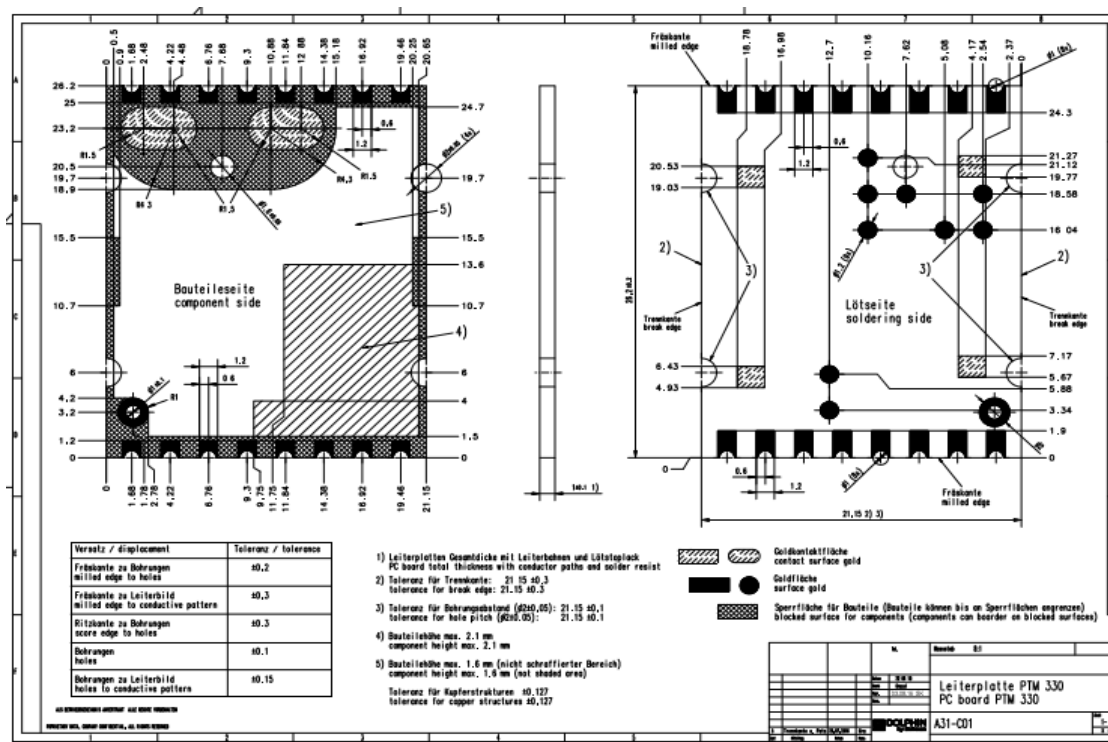
3.8 Transmission range

The main factors that influence the system transmission range are type and location of the antennas of the receiver and the transmitter, type of terrain and degree of obstruction of the link path, sources of interference affecting the receiver, and "Dead" spots caused by signal reflections from nearby conductive objects. Since the expected transmission range strongly depends on this system conditions, range tests should categorically be performed before notification of a particular range that will be attainable by a certain application.

The following figures for expected transmission range are considered by using a PTM, a STM or a TCM radio transmitter device and the TCM radio receiver device with preinstalled whip antenna and may be used as a rough guide only:

868 MHz (EU) / 902 MHz (US/CA):

- Line-of-sight connections: Typically 30 m range in corridors, up to 100 m in halls
- Plasterboard walls / dry wood: Typically 30 m range, through max. 5 walls
- Line-of-sight connections: Typically 30 m range in corridors, up to 100 m in halls
- Ferroconcrete walls / ceilings: Typically 10 m range, through max. 1 ceiling
- Fire-safety walls, elevator shafts, staircases and supply areas should be considered as screening.

928 MHz (Japan):

- Line-of-sight connections: Typically 20 m range in corridors, up to 70 m in halls
- Plasterboard walls / dry wood: Typically 20 m range, through max. 4 walls
- Line-of-sight connections: Typically 30 m range in corridors, up to 100 m in halls
- Ferroconcrete walls / ceilings: Typically 7 m range, through max. 1 ceiling
- Fire-safety walls, elevator shafts, staircases and supply areas should be considered as screening.

The angle at which the transmitted signal hits the wall is very important. The effective wall thickness – and with it the signal attenuation – varies according to this angle. Signals should be transmitted as directly as possible through the wall. Wall niches should be avoided. Other factors restricting transmission range:

- Switch mounted on metal surfaces (up to 30% loss of transmission range)
- Hollow lightweight walls filled with insulating wool on metal foil
- False ceilings with panels of metal or carbon fiber
- Lead glass or glass with metal coating, steel furniture

The distance between EnOcean receivers and other transmitting devices such as computers, audio and video equipment that also emit high-frequency signals should be at least 0.5 m

A summarized application note to determine the transmission range within buildings is available as download from www.enocean.com.

4 AGENCY CERTIFICATIONS

The modules have been tested to fulfil the approval requirements for RED (PTM 33x) and FCC/ISED (PTM 330U) based on the built-in firmware and described antenna.

4.1 Radio Equipment Directive (RED) for the European Union

The Radio Equipment Directive (2014/53/EU, typically referred to as RED) replaces the old R&TTE directive from 1999 as regulatory framework for radio products in the European Union. All products sold to final customers after 12th of June, 2017 have to be compliant to RED. At the time of writing, the text of the RED legislation was available from this link: http://eur-lex.europa.eu/eli/dir/2014/53/oj

Dolphin radio modules such as PTM 33x are components which are delivered to OEM manufacturers for their use in final or combined products.

It is the responsibility of the OEM manufacturer to demonstrate compliance to all applicable EU directives and standards. The attestation of conformity for PTM 33x serves as input to the declaration of conformity for the full product.

At the time of writing, guidance on the implementation of EU product rules – the so called "Blue Guide" – was available from this link: http://ec.europa.eu/DocsRoom/documents/18027/

Specifically within the new RED framework, all OEM manufacturers have for instance to fulfill the following additional requirements:

- Provide product branding (on the product) clearly identifying company name or brand and product name as well as type, charge or serial number for market surveillance

- Include (with the product) documentation containing full postal address of the manufacturer as well as radio frequency band and max. transmitting power

- Include (with the product) user manual, safety information and a declaration of conformity for the final product in local language

- Provide product development and test documentation upon request

Please contact an accredited test house for detailed guidance.

Additional requirements to meet RED:

- EnOcean RF modules must not be modified (change of HW or SW) or used outside their specification

- The final product incorporating EnOcean RF module must itself meet all necessary directives and requirements of the European Market

- If the transmitter is used according to the regulations of the 868.3 MHz band, a so-called "Duty Cycle" of 1% per hour must not be exceeded.

- 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

4.2   FCC (United States) Certification

4.2.1 PTM 330U FCC APPROVAL

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.

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

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:

PTM 330U

Contains FCC ID: SZV-PTM330U
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.

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 communica-

tions. 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.

4.3 ISED (former 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:

PTM 330U:

Contains IC: 5713A-PTM330U

■ OEM wishing to use PTM 330C / 332C under limited modular approval conditions must sign the OEM Limited Modular Approval Agreement with EnOcean

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:

PTM 330U:
Contains IC: 5713A-PTM330U
Contient le module d'émission IC: 5713A-PTM330U

■ L'OEM doit signer l'accord OEM limitée Approbation modulaire avec EnOcean pour utiliser PTM 330C / 332C.

4.3.1 ISED 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, meme 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 actioner cet équipment.

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

4.4 Radio Certification for the Japanese Market

PTM 430J has been designed and tested to fulfil the approval requirements for ARIB STD-T108 based on the built-in firmware.

When the product is placed on the Japanese market, it must carry the Specified Radio Equipment marking as shown below:
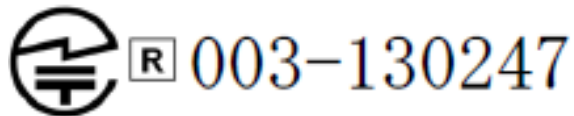
4.4.1 Label Information
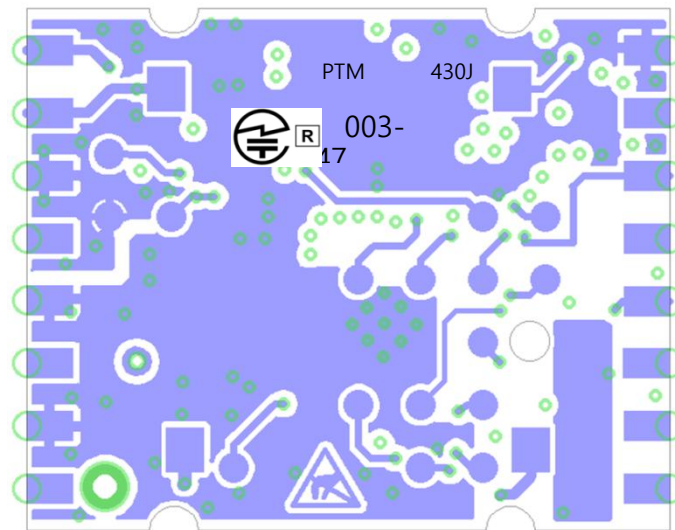
Field	Content	Comment
1	MOD: PTM 430J xy A430–z mm/jj	Step Code „xy" (e.g. CA) Revision „-z" (e.g. -1); Date Code "mm/jj" (e.g. 33/13)
2	ℝ 003–130247	ARIB Sign 3 mm min.