

PTM 535 / PTM 535U / PTM 535J

EnOcean Transmitter Module

29.04.2021



Observe precautions! Electrostatic sensitive devices!

Patent protected:

WO98/36395, DE 100 25 561, DE 101 50 128,
WO 2004/051591, DE 103 01 678 A1, DE 10309334,
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REVISION HISTORY

The following major modifications and improvements have been made to this document:

Version	Author	Reviewer	Date	Major Changes
1.0	MKA	MKA	23 May 2018	Initial Release
1.1	MK/CB	CB	02 Aug 2018	Configuration set and functional block diagram updated, additional minor changes e.g. ARIB ID added, Tx range free field 300m
1.2	MK/CB	CB	14 Sep 2018	Renamed Pad 13 from VCC to VCC_MODE, V+ for configuration only, hint for PTM Config help
1.3	MK/CB	CB	21 Nov 2018	4.4 added strict sequence and tool requirements for configuration change, 2.3 added CFG test pin
1.4	MK/CB	CB	27 May 2019	Document branding changed, 2.2 pin out image corrected
1.5	MKA	MKA	21 Sep 2020	FCC / ISED added
1.6	MK	MKA	29 Apr 2021	Added additional soldering information, 1.3 EEP overview update, 3.4 1BS mode, 6.1 CE/RED PTM 535 as component

**Published by EnOcean GmbH, Kolpingring 18a, 82041 Oberhaching, Germany
www.enocean.com, info@enocean.com, phone +49 (89) 6734 6890**

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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.

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1 General description

1.1 Product description

The radio transmitter module PTM 535, PTM 535U and PTM 535J from EnOcean enable the implementation of wireless sensors and switches without batteries.

Key applications are handheld remote controls or industrial switches.

1.2 Product variants

The following product variants are offered:

- PTM 535
Operating frequency 868.300 MHz
- PTM 535U
Operating frequency 902.875 MHz
- PTM 535J
Operating frequency 928.350 MHz



All three variants contain a pre-installed whip antenna, support enhanced security and are delivered in a cardboard box. The term "PTM 535" is subsequently used to describe all three product variants unless otherwise noted.

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1.3 Technical data

Power supply	ECO 200 or equivalent energy pulse
Antenna	Pre-installed whip antenna
Frequency / Modulation / Transmission power	
PTM 535	868.300 MHz / ASK / +5 dBm
PTM 535U	902.875 MHz / FSK / +4 dBm
PTM 535J	928.350 MHz / FSK / +0 dBm
Data rate	125 kbps
Telegram types (EEP)	F6-01-01 (RPS, push button, default) F6-05-01 (RPS 868 only, water leakage sensor, config.) D2-B0-51 (VLD 902 only, water leakage sensor, config.) D5-00-01 (1BS 868 only, single input contact, config.)
Digital inputs	4 (2 of those also usable via meander contacts)
Mode selection (standard / enhanced security)	3 pins / LRN Button
Transmission range	up to 300 m free field, up to 30 m indoor

1.4 Maximum ratings for input signals

Symbol	Parameter	Min	Max	Units
AC1, AC2	Supply voltage operation	0	6.0	V
V+	Supply voltage configuration	0	5.5	V
GND	Voltage on GND pin	0	0	V
A0, A1, B0, B1, SECURE, STANDARD, CFG	Voltage on digital input pins	0	3.6	V

1.5 Physical dimensions

PCB dimensions	26.2 x 21.15 x 3.5 mm
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1.6 Device drawing

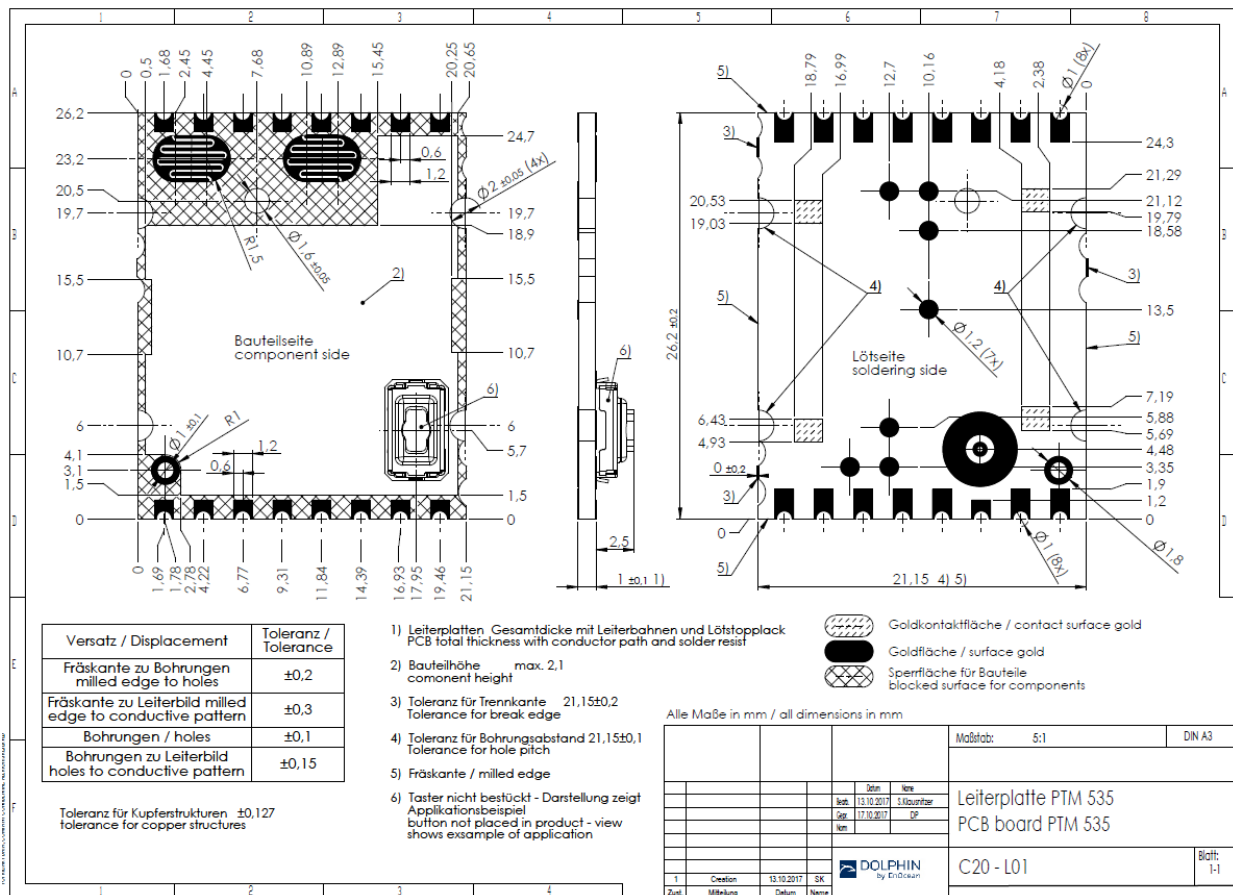


Figure 1 – PTM 535 outline

1.7 Environmental conditions

Operating temperature	-25 °C ... +65 °C
Storage temperature	-40 °C ... +85 °C
Storage temperature in Tape & Reel	-20 °C ... +50 °C
Humidity	0% ... 93% r.h., non-condensing

1.8 Ordering information

Type	Ordering Code	Frequency	Note
PTM 535	S3001-A535	868.300 MHz	Whip antenna, Delivered in cardboard box
PTM 535U	S3051-A535	902.875 MHz	Whip antenna, Delivered in cardboard box
PTM 535J	S3061-A535	928.350 MHz	Whip antenna, Delivered in cardboard box

2 Functional description

2.1 Functional Principle

PTM 535 is designed to be powered by an ECO 200 kinetic energy harvester from EnOcean. PTM 535 can be mechanically connected to the contact springs of ECO 200 by means of its integrated PCB contacts.

PTM 535 provides 4 digital input pads and two PCB meander structures allowing the implementation of push button functions either via external connection or via conductive rubber pads.

When the ECO 200 harvester generates an energy pulse or when power is supplied by another source then PTM 535 determines the polarity of the energy pulse (push or release direction), and the operating status of the digital inputs and encodes this information in an RF telegram.

The communication mode (enhanced security communication or standard communication) can be selected using the SECURE and STANDARD input pins or the LRN button (which is not mounted by default). Default communication mode is STANDARD.

2.2 Block diagram

Figure 2 below shows the block diagram of PTM 535.

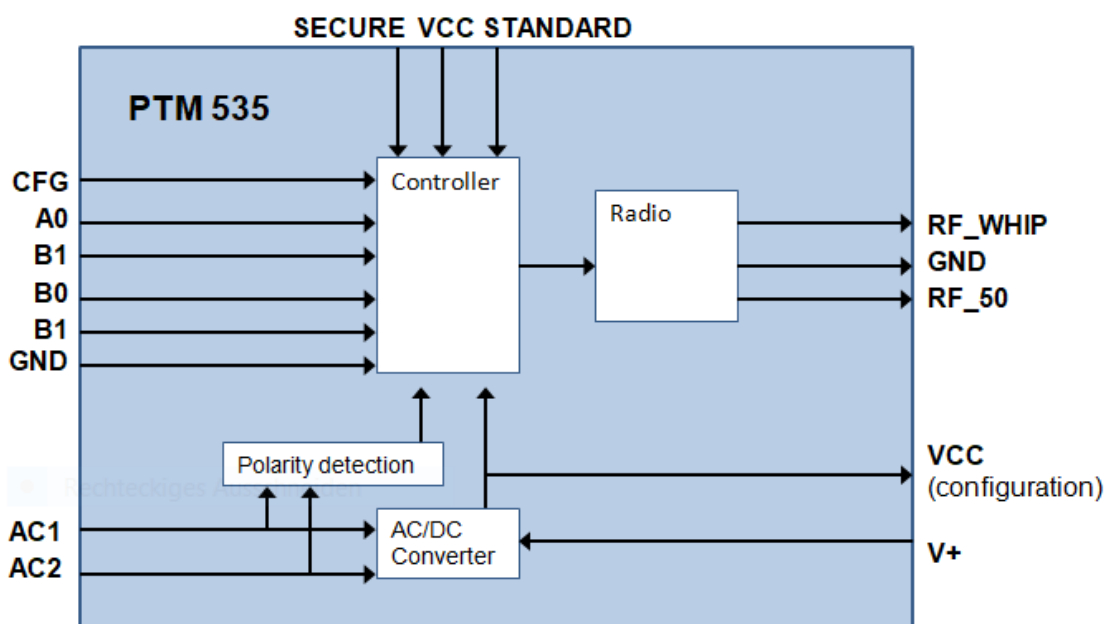


Figure 2 – PTM 535 functional block diagram

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2.3 Interface pin layout

Figure 3 below shows the pin out and external interfaces of PTM 535 as seen from the top (component side). Items marked in green are on the component side while items in grey are on the bottom side.

In addition to the 16 boundary contacts, PTM 535 provides the following contact points:

- Meander contact A0
- Meander contact A1
- Connection for whip antenna RF_WHIP
- Footprint for LEARN button (connecting VCC and SEC)
- AC1 / AC2 power supply connection to ECO 200 harvester (two contact pairs at the PCB bottom side to support different ECO 200 orientation)

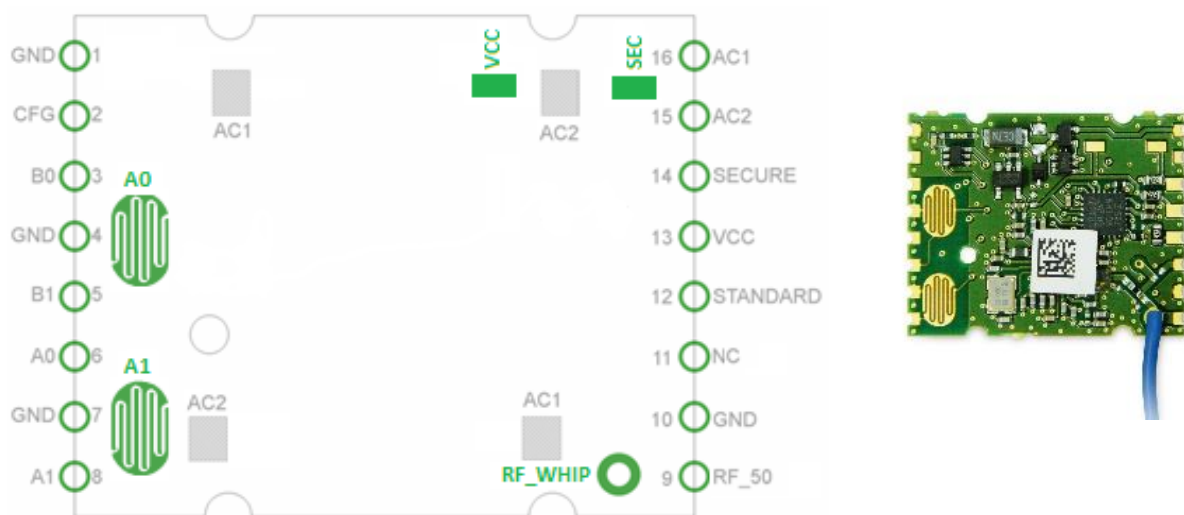


Figure 3 – PTM 535 pin-out and external interfaces

2.4 Interface pin functionality

Table 1 below describes the PTM 535 interface pin functionality.

Pin	Function	Characteristics
GND	Ground connection	Must be connected to GND
VCC_MODE	Internal Operating voltage with 1k	Connect externally to SECURE or STANDARD pin to change operation mode. Also connected to LEARN button pad.
SECURE	Mode change pin	Connect this pin to VCC_MODE and press the ECO 200 harvester to change operation mode to enhanced security. Then disconnect. Also connected to LEARN button footprint.
STANDARD	Mode change pin	Connect this pin to VCC_MODE and press the ECO 200 harvester to change operation mode to standard. Then disconnect.
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, Connected to meander contact
A1	I-Button Rocker A	Digital input, leave open or connect to GND Internal pull-up, Connected to meander contact
AC1	ECO 200 Input 1	ECO 200 or equivalent energy pulse
AC2	ECO 200 Input 2	ECO 200 or equivalent energy pulse
RF_WHIP	RF output	Output for whip antenna
RF_50	RF output	50 Ohm output for external antenna
CFG	Test pin	Do not connect

Table 1 – PTM 535 interface pin functionality

3 Radio telegram format

3.1 RPS standard mode

In standard configuration, PTM 535 transmits the same telegram type as the PTM 210 pushbutton module. The telegram information is encoded within a 7 byte RPS telegram as shown in Figure 4 below.

Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
RORG	DATA	EURID				STATUS
0xF6 (RPS)	SWITCH_DATA	32 BIT ENOCEAN RADIO ID				SWITCH_STATUS

Figure 4 – PTM 535 telegram format

This telegram format uses the following fields:

- Telegram type (RORG, 1 byte)
The telegram type is always 0xF6 indicating an RPS telegram
- Switch data (DATA, 1 byte)
This field encodes the buttons that have been pressed. The encoding depends on the number of buttons that have been pressed.
- EnOcean Unique Radio IO (EURID, 4 byte)
This field contains the ID which uniquely identifies each EnOcean products
- Switch status (STATUS)
This field encodes certain properties of the telegram as shown in below.

The STATUS field identifies the message type (U-Message or N-Message) as well as the repeater level (original telegram, 1 hop repeated, 2 hop repeated) as shown in Figure 5 below.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
RESERVED		TYPE	MESSAGE	REPEATER_LEVEL			
		0b0: TYPE 1 (deprecated) 0b1: TYPE 2	0b0: U Message 0b1: N Message	0b0000: Original Message 0b0001: Level 1 (Single Hop Repeated) Message 0b0010: Level 2 (Dual Hop Repeated) Message Others: Unused			

Figure 5 – STATUS field encoding

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If one or two buttons are pressed, then the button status is transmitted using a so-called N-Message. The DATA field format of such N-Message is shown in Figure 6 below.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
ACTION_1_TYPE			POLARITY	ACTION_2_TYPE			ACTION_2_VALID
0b000: A1 0b001: A0 0b010: B1 0b011: B0 Others: Unused			0b0: AC1 positive, AC2 negative 0b1: AC1 negative, AC2 positive	0b000: A1 0b001: A0 0b010: B1 0b011: B0 Others: Unused			0b0: No second action detected 0b1: Second action detected

Figure 6 – DATA field encoding for N-Messages (one or two button presses)

If either no button is pressed (only the ECO 200 is actuated), three buttons are pressed or four buttons are pressed then the button status is transmitted using a so-called U-Message. The DATA field format of such N-Message is shown in Figure 7 below.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
BUTTON_NUMBER			POLARITY	RESERVED			
0b000: No button pressed (ECO 200 actuation only) 0b001: Not possible (N Message) 0b010: Not possible (N Message) 0b011: 3 or 4 buttons pressed simultaneously Others: Unused			0b0: AC1 positive, AC2 negative 0b1: AC1 negative, AC2 positive				

Figure 7 – DATA field format for U-Messages (no, three or four button pressed)

3.2 RPS enhanced security mode

While operating in enhanced security mode, PTM 535 sends secure telegrams in accordance to EEP D2-03-00 as specified in EnOcean Equipment Profiles. For more details refer to <http://www.enocean-alliance.org/eep/>.

These telegrams include a rolling code based on an incrementing counter which guarantees that identical message content will be encrypted differently for each telegram thus preventing replay attacks.

The initial counter value is transmitted from PTM 535 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.

When telegrams are not received by the receiver this may lead to a de-synchronization of transmitter and receiver counters, i.e. the transmitter counter will have a greater value than the receiver counter.

In order to prevent failure, 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, non-received telegrams does not exceed the size of this window. For more details please refer to <http://www.enocean.com/en/security-specification/>.



The rolling code 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 535 in secure mode only in fixed installations with safe radio distance to avoid de-synchronization of sender and receiver. De-synchronization will occur if PTM 535 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.

3.3 Switching between RPS operation modes

PTM 535 can be switched from standard mode (default) to enhanced security mode by connecting SECURE with VCC_MODE (see chapter 3 for details) and triggering the ECO 200. Upon entry into enhanced security mode, a teach-in telegram is sent by PTM 535. The type of the teach-in telegram (`Teach_In_Info : Type`) is: 1-PTM.

PTM 535 will continue to transmit secure teach-in telegrams until the SECURE pin is disconnected from the VCC_MODE pin.

The secure teach-in message has to be transmitted as two consecutive telegrams due to its payload size. Therefore, the ECO generator has to be triggered twice in order to transmit a complete secure teach-in message. It is not required that the two contacts (SECURE and VCC_MODE) remain connected throughout the transmission of both messages. It is sufficient to connect them while actuating the ECO energy generator the first time.

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 535 can be switched from secure mode to normal mode by connecting STANDARD with VCC_MODE and triggering the ECO 200. Then disconnect the pins.



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.

3.4 1BS single input contact (standard mode) for 868 MHz only

PTM 535 can be configured to send 1BS telegrams, this feature can be used to implement a single input contact device with the EnOcean Equipment Profile D5-00-01.

This radio telegram uses the following fields:

- Telegram type (RORG, 1 byte)
The telegram type is always 0xD5 indicating an 1BS telegram.
- Switch data (DATA, 1 byte)
This field encodes the learn button and contact status:
DB0.3: 0 = pressed / 1 = not pressed
DB0.0: 0 = open / 1 = closed
- EnOcean Unique Radio IO (EURID, 4 byte)
This field contains the ID which uniquely identifies each EnOcean products
- Status field (STATUS)
Only repeater status is used.

For details see EnOcean Alliance EEP specification:

<http://tools.enocean-alliance.org/EEPViewer/#2>

PTM 535 will be delivered in RPS standard mode. Radio module can be changed to 1BS standard mode by using a programmer, a bed of needle adapter and a configuration script. For HW details see chapter 4.2. A customer specific configuration script will be provided by the EnOcean support team. Please contact: support@enocean.com



Since PTM 535 is ECO 200 powered it will not send regular status updates like the solar powered magnet contact transmitter module STM 320.

3.5 Transmission timing

The setup of the transmission timing allows avoiding possible collisions with data packages of other EnOcean transmitters as well as disturbances from the environment. With each transmission cycle, 3 identical subtelegrams are transmitted within 40 ms.

The transmission of a subtelegram lasts approximately 0.7 ms. The delay between the three transmission bursts is affected at random.

PTM 535 transmits in secured mode 2 identical subtelegrams with length of ~ 1.3 ms



PTM radio modules are designed for manual button operation. The actuation rate should therefore be limited to no more than 5 actuations per second. For higher actuation rates, PTM radio modules might temporarily stop operation and will restart operation after a period of 2 seconds without operation.

4 PTM 535 configuration

PTM 535 provides a configuration interface that can be used to configure certain device parameters.



Note that configuration is currently only supported for PTM 535 (868.300 MHz). Configuration of PTM 535U (902.875 MHz) and PTM 535J (928.350 MHz) is currently not supported.

4.1 PTM 535 configuration parameters

The following parameters can be configured for PTM 535 (868.300 MHz):

- **RPS: Content of the radio telegrams**
This can be configured for each of the 32 possible input combination (A0, A1, B0, B1, direction of ECO movement)
- **RPS: Default operation mode**
This can be standard (default) or enhanced security. Changing the mode is still possible using the HW mechanism described in chapter 3.3
- **RPS: Secure teach-in telegram transmission**
The secure teach-in telegram transmission can start only when the ECO 200 is pressed, only when the ECO 200 is released or at any ECO 200 action (press or release)
- **RPS: Number of secure subtelegrams**
If PTM 535 is powered by an ECO 200 harvester and operating in enhanced security mode then it will always transmit 2 subtelegrams.
If PTM 535 is powered by another energy source such as a battery and operating in enhanced security mode, then it can be selected if it should transmit 2 or 3 subtelegrams.
- **1BS: Content of the radio telegrams**
This can be configured for each of the 32 possible input combination (A0, A1, B0, B1, direction of ECO movement)

For other frequency variants, please check with support team: support@enocean.com

4.2 PTM 535 configuration interface

The PTM 535 configuration interface consists of test points MP1- MP6. The function of these test points is summarized in Table 2 below.

Pad	Signal Name	Characteristics	Segger J-Link Signal	Segger J-Link Pin
MP1	VCC	Configuration interface (Supply voltage)	VTref	1
MP2	GND	Configuration interface (Ground)	GND	4/6/8/10 /12
MP3	TDIO	Configuration interface (Data)	TMS	7
MP4	TCK	Configuration interface (Clock)	TCK	9
MP5	V+	Power supply (from Segger)	5V-Supply	19
MP6	RESET	Optional	RESET	15

Table 2 – PTM 535 configuration interface

4.3 PTM 535 test point location

Figure 8 below shows the location of the test points MP1 ... MP6. For the exact location refer to the product drawing in chapter 1.6.

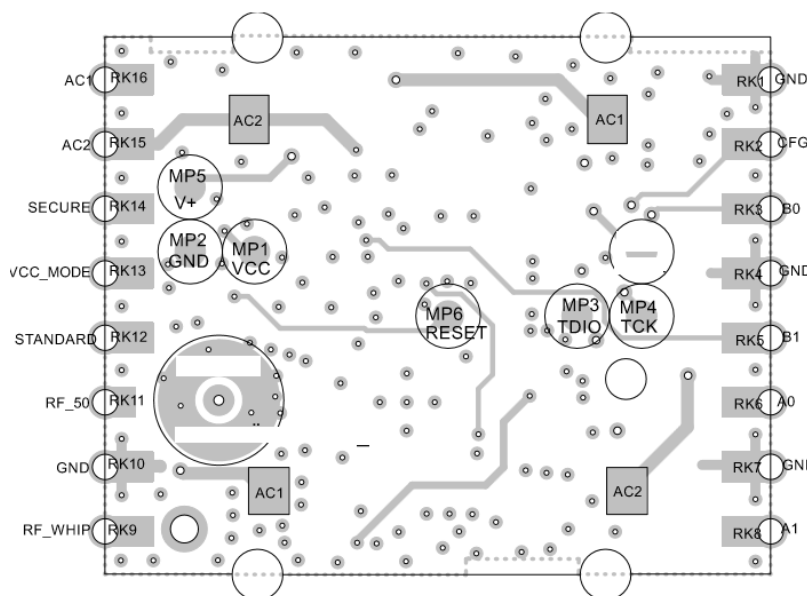


Figure 8 – PTM 535 test point location

4.4 Connection between Segger J-Link and PTM 535

PTM 535 has to be connected to the Segger J-Link connector for configuration. Figure 9 below shows the pin-out of the Segger J-Link connector.

VTref	1 ●	● 2	NC
nTRST	3 ●	● 4	GND
TDI	5 ●	● 6	GND
TMS	7 ●	● 8	GND
TCK	9 ●	● 10	GND
RTCK	11 ●	● 12	GND
TDO	13 ●	● 14	GND*
RESET	15 ●	● 16	GND*
DBG RQ	17 ●	● 18	GND*
5V-Supply	19 ●	● 20	GND*

Figure 9 – Segger J-Link connector pin-out

Two approaches can be used to connect Segger J-Link and PTM 535 depending on the power supply of PTM 535 during configuration. Both approaches are described below.

4.4.1 Segger power supply (6-Pin interface)

Supplying power by Segger J-Link to PTM 535 is the recommended approach. It requires a 6 pin test interface.

In this case, power is supplied by Segger J-Link to PTM 535 via PTM 535 MP5 (V+) connected to Segger Pin 19. The "5V Target Power Supply" option has to be activated at the Segger user interface. We recommend checking available voltage supply.

The required connections are shown in Figure 10 below.

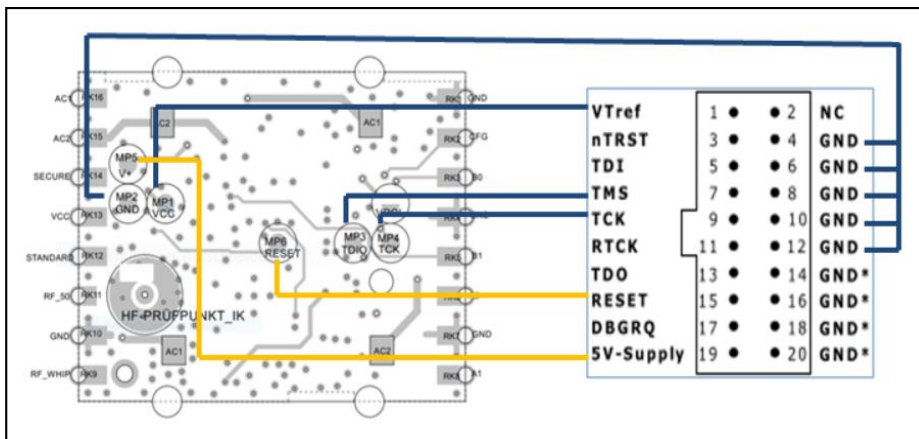


Figure 10 – 6-Pin configuration interface (Power supplied by Segger)

4.4.2 External power supply (4 pin configuration interface)

This approach allows you to use a 4 needle test adapter instead of a 6 needle adapter. Existing 4 needle adapters built for PTM 335 can be reused.

It requires to supply PTM 535 by an external power supply (2.0 - 3.3 V) connected to PTM 535 MP1 and to Segger VTref (IO voltage reference). The external power supply ground has to be connected to PTM 535 MP2 (GND) and Segger GND.

The required connections are shown in Figure 11 below.

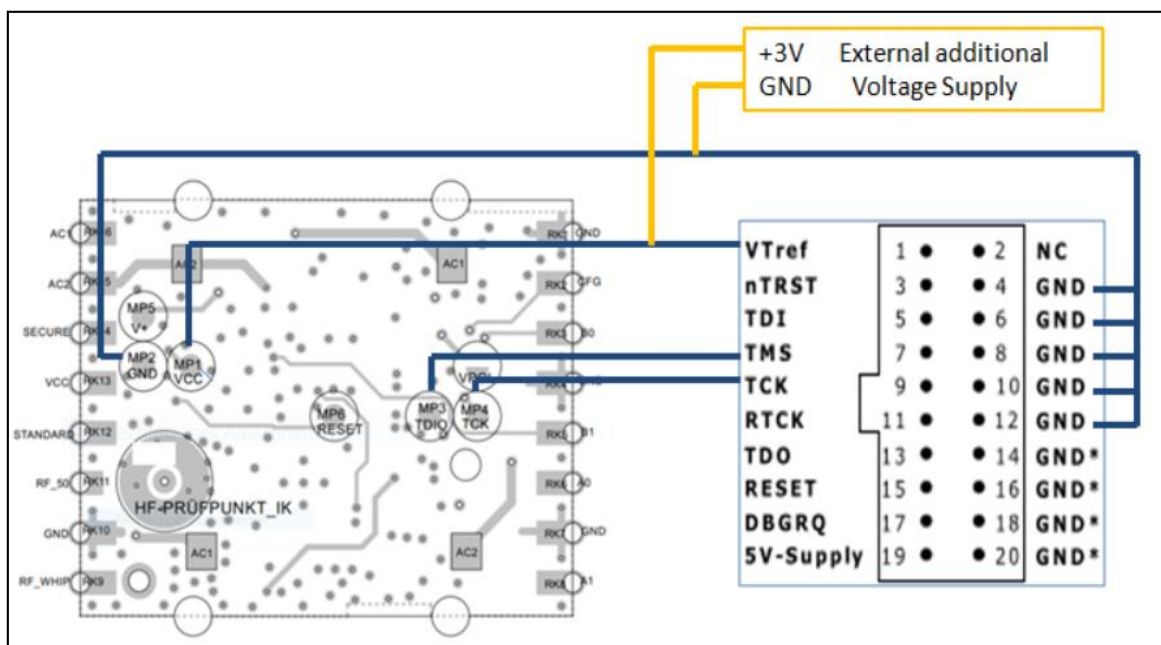


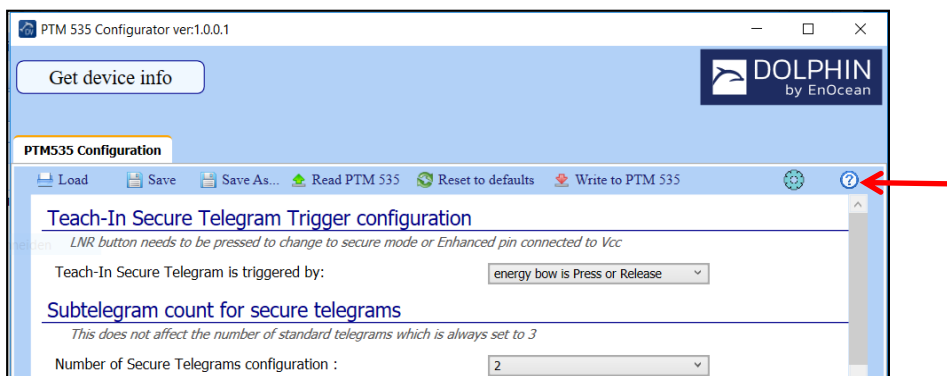
Figure 11 – 4-Pin configuration interface (external power supply)

4.5 Required tools

The following tools are required to configure PTM 535:

- **Needle adapter**
 Suitable adapter to contact test points as described in the previous chapter. EnOcean can provide a mechanical design example upon request.
- **Debugger / Programmer**
 J-Link Plus or higher from Segger is required, see:
<https://www.segger.com/products/debug-probes/j-link/models/j-link-plus/>
- **J-Link Software and Documentation Pack**
<https://www.segger.com/downloads/jlink/#J-LinkSoftwareAndDocumentationPack>
- **PTM 535 Configuration Suite**
<http://www.enocean.com/en/download/>

Please check PTM 535 Config help for a detailed description of the program usage.



PTM 535 Configurator uses Segger tools to communicate with the radio chip. If a window pops up “to unlock” the device you must select NO (details see PTM 535 Config help). Due to radio approval requirements a wrong configuration will lead the module to stop radio transmission.



Radio module configuration is only possible with the EnOcean PTM 535 Configurator tool. Follow exactly the below written sequence to change PTM 535 configuration. Due to radio approval requirements, a wrong configuration will lead the module to stop radio transmission.



Additional care has to be taken to configure correct values for DATA and STATUS fields. Otherwise PTM 535 might not work properly together with repeaters or receivers.

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4.6 Configuration setup

Figure 12 below shows the setup required to configure PTM 535.

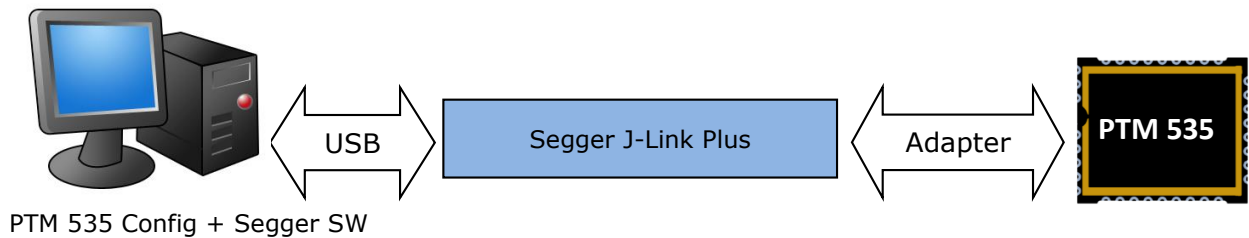


Figure 12 – Setup for PTM 535 configuration

4.7 User Interface

Figure 13 below shows the user interface of the PTM 535 Configurator.

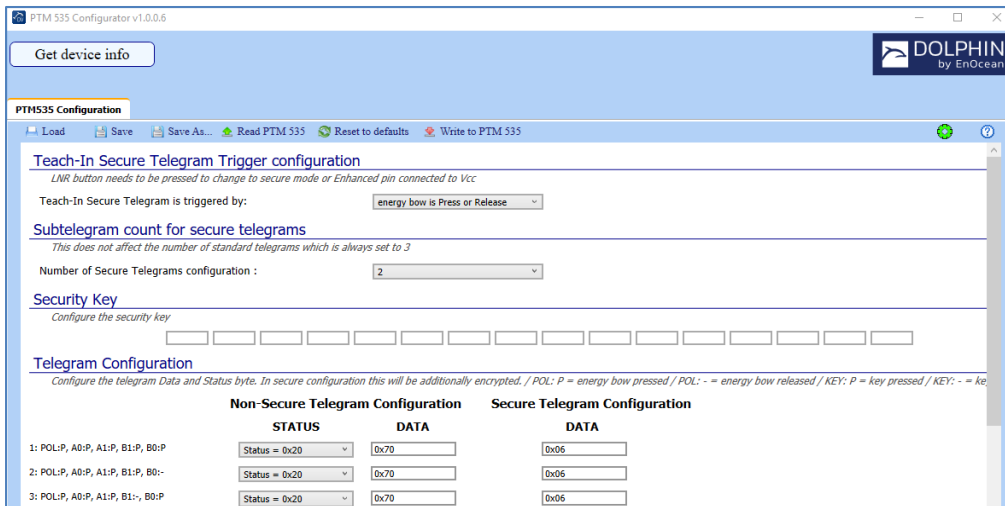


Figure 13 – User interface of PTM 535 Configurator

4.8 Execution sequence

The following steps have to be executed exactly in the below given order:

1. "Get the device info" (show device info)
2. "Read PTM 535" the current configuration (show config and do a backup)
3. Modify the configuration fields (security key, telegram data, etc.)
4. "Write to PTM 535" the modified configuration
Quit Segger info window with no (details see PTM Config help)!
5. Save configuration to file (if you want to configure additional PTM 535)
6. Load configuration from file
7. "Write to PTM 535" the modified configuration to additional module
Quit Segger info window with no (details see PTM Config help)!



PTM 535 Configurator uses Segger tools to communicate with the radio chip. If a window pops up "to unlock" the device, **you must select NO** (for details, see PTM 535 Config help). Due to radio approval requirements, trying to unlock the device will cause the module to stop radio transmission.



Radio module configuration is only possible with the EnOcean PTM 535 Configurator tool. Follow exactly the above written sequence to chance PTM 535 configuration. Due to radio approval requirements, trying to use an incorrect configuration will lead the module to stop radio transmission.



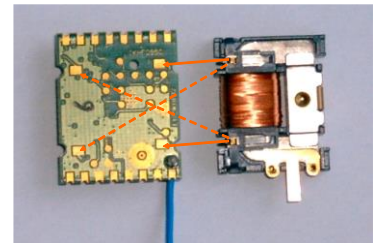
Additional care has to be taken to configure correct values for DATA and STATUS fields. Otherwise PTM 535 might not work properly together with repeaters or receivers.

5 Application information

5.1 Connection to ECO 200 energy harvester

PTM 535 can be connected to ECO 200 without soldering. ECO 200 provides contact springs which can directly be connected to the corresponding contact pads of PTM 535.

The contact pads on the bottom of the PCB are shown below (left). A second orientation where PTM 535 is rotated 180° with respect to ECO 200 is also possible as shown with dashed lines.



5.2 How to populate a teach-in button (for enhanced security mode)

PTM 535 provides two landing pads for a LRN button called SECURE and VCC_MODE. If a pushbutton is mounted, then this will act as secure teach-in button. By pressing the button and triggering the ECO 200, the secure teach-in process is triggered, the module switches to secure mode and transmits a secure teach-in telegram.

To switch operation back to standard mode, the STANDARD and VCC_MODE 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 than the PCB (better tactile handling) or are operated from the bottom.

Please see drawings of PTM 535 for detailed information and position of pads. The design of the pads was optimized for Compact High-speed Mounting Type (Surface Mount) SKQY Series switch from ALPS.

Soldering has to be done manually according to the common IPC / JEDEC standards: J-STD-001, IPC/JEDEC-J-STD-020C, DIN EN 61192-5, IPC-7711/7721. The maximum peak temperature should be 340°C with a max. time of 2s.



Figure 14 – LEARN button example for PTM 535 ⁽¹⁾

¹ Picture Source: https://www.alps.com/prod/info/E/HTML/Tact/Surface-Mount/SKQY/SKQY_list.html

PTM 535 / PTM 535U / PTM 535J – ENOCEAN TRANSMITTER MODULE

5.3 Antenna specification

PTM 535 provides two antenna options:

- 86 mm whip (wire) antenna (PTM 535 only), connected to RF_WHIP
This is populated by default, see Figure 15 for the mechanical dimensions
- 64 mm whip (wire) antenna (PTM 535U and PTM 535J only), connected to RF_WHIP
This is populated by default, see Figure 15 for the mechanical dimensions
- 50 Ω antenna connected to RF_50
If this shall be used then the whip antenna has to be removed. Only the approved antenna shown below may be used.

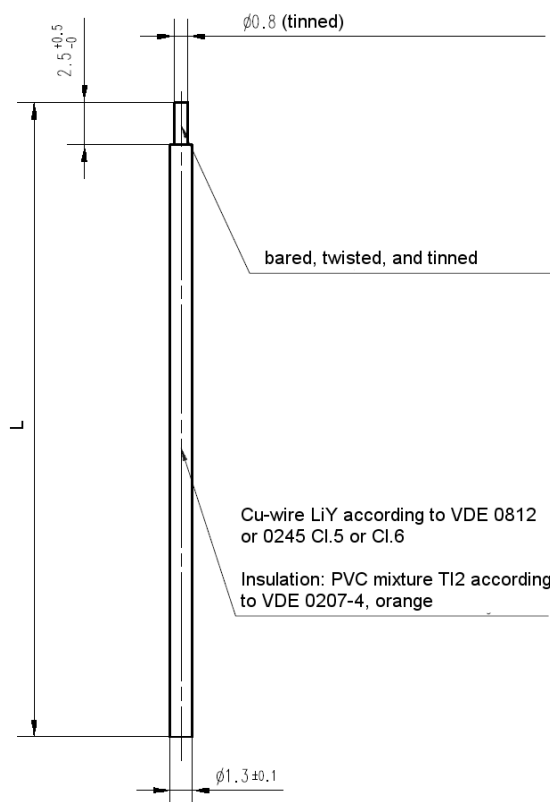


Figure 15 – Whip antenna specification
PTM 535: L=86 mm, PTM 535U / PTM 535J: L = 64 mm

5.4 Layout and soldering recommendations

PTM 535 can be soldered onto a host PCB. Soldering has to be done manually according to the common IPC / JEDEC standards: J-STD-001, IPC/JEDEC-J-STD-020C, DIN EN 61192-5, IPC-7711/7721. The maximum peak temperature should be 340°C with a max. time of 2s. Figure 16 below shows the required footprint shape. EnOcean can provides Gerber data if required.

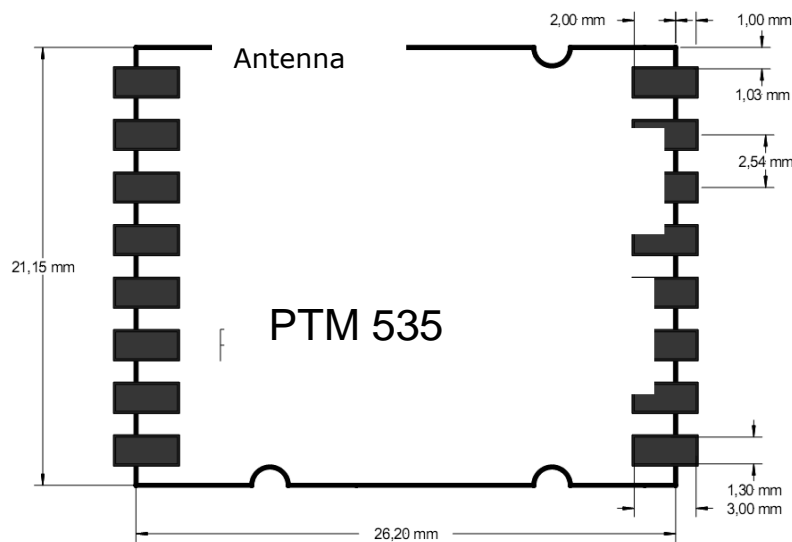


Figure 16 – PCB footprint for PTM 535

Figure 17 below shows the required keep out area on a host PCB form PTM 535. No copper surface area is allowed within this area.

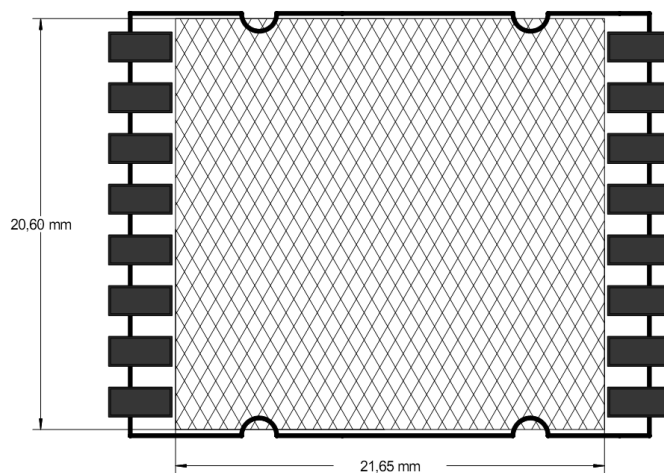


Figure 17 – Keep out area on host PCB for PTM 535

5.5 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 535 radio transmitter device and a TCM 310 / TCM 310U / TCM 410J radio receiver device with installed whip antenna and may be used as a rough guide only:

- 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.

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 include:

- 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.

6 Regulatory information

PTM 535 has been tested according to standards for RED (European Union), FCC (United States), ISED (Canada) and ARIB (Japan) certification.

6.1 Market Approval for the European Union (PTM 535, RED/CE)

The radio transmitter module PTM 535 is a component for integration into a final product. It has to be combined with a proper energy source e.g. ECO 200, mechanic and housing(s) to achieve the OEM customer specific product functionality.

EnOcean provides a list of test reports performed with the component PTM 535 based on a reference implementation. It is within the responsibility of the OEM manufacturer to demonstrate compliance with final product specific EU directives and standards. The customer can use the test reports provided by EnOcean where applicable. Additional details and conditions are described in the product-specific user manual. EnOcean GmbH strongly recommends the support of approval experts (e.g. test houses).

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.

The maximum transmitting power of PTM 535 using a whip antenna is +5 dBm.

PTM 535 / PTM 535U / PTM 535J – ENOCEAN TRANSMITTER MODULE

6.2 Market Approval for the USA (PTM 535U, FCC)

6.2.1 FCC grant of equipment authorization

TCB

GRANT OF EQUIPMENT
AUTHORIZATION

TCB

Certification
Issued Under the Authority of the
Federal Communications Commission
By:

Timco Engineering, Inc.
849 NW State Road 45
Newberry, FL 32669

Date of Grant: 09/18/2020
Application Dated: 09/18/2020

EnOcean GmbH
Kolpingring 18a
Oberhaching, 82041
Germany

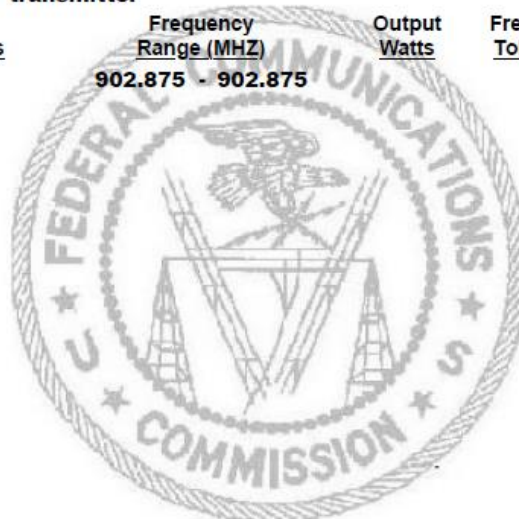
Attention: Armin Anders , Director Product Marketing

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER: SZV-PTM535U
Name of Grantee: EnOcean GmbH
Equipment Class: Part 15 Security/Remote Control Transmitter
Notes: Temperature and Humidity Sensor with transmitter

<u>Grant Notes</u>	<u>FCC Rule Parts</u>	<u>Frequency Range (MHZ)</u>	<u>Output Watts</u>	<u>Frequency Tolerance</u>	<u>Emission Designator</u>
	15.231	902.875 - 902.875			



6.2.2 FCC regulatory statement

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.

To comply with FCC/IC RF exposure limits for general population / uncontrolled exposure, the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter

Warning

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Interference

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 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.

6.3 Market Approval for the Canada (PTM 535U, ISED)

6.3.1 ISED technical acceptance certificate

TIMCO ENGINEERING, INC.

849 NW State Road 45
 Newberry, Florida 32669
www.timcoengr.com
 (352) 472-5500 CB@timcoengr.com

Job No. ➤ 3461-20

TECHNICAL ACCEPTANCE CERTIFICATE

Certification No.

➤ IC: 5713A-PTM535U

Issued To ➤ EnOcean GmbH
 Kolpingring 18A
 Oberhaching 82041
 Germany

Tested By ➤ VPI Laboratories, Inc
 Company No.: 2041B
 313 W 12800 S, STE 311
 Draper, UT 84020, US
 801-260-4050; jasons@vpitech.com

Type of Equipment ➤ Low Power Device (902–928 MHz)

Type of Service ➤ New Certification (Single)

Hardware Version Id Number (HVIN) ➤ PTM 535U

Firmware Version Id Number (FVIN) ➤ N/A

Product Marketing Name: (PMN) ➤ PTM 535U

Host Marketing (HMN) ➤ N/A

FREQUENCY RANGE	EMISSION DESIGNATIONS NECESSARY BANDWIDTH & EMISSION CLASSIFICATION	R.F. POWER	ANTENNA INFO	SPECIFICATION/ ISSUE & DATE
902.875 MHz	287KF1D	80.2 dBuV@3m	Wire, 0 dBi	RSS-210 Issue 10; Dec.2019

Note 1: This equipment also complies with RSS-102, Issue 5 (March 2015) and RSS-Gen, Issue 5 (March 2019)

Certification of equipment means only that the equipment has met the requirements of the above-noted specification. Licence applications, where applicable to use certified equipment, are acted on accordingly by the ISED issuing office and will depend on the existing radio environment, service and location of operation. This certificate is issued on condition that the holder complies and will continue to comply with the requirements and procedures issued by ISED. The equipment for which this certificate is issued shall not be manufactured, imported, distributed, leased, offered for sale or sold unless the equipment complies with the applicable technical specifications and procedures issued by ISED.

La certification de l'équipement signifie uniquement que l'équipement a satisfait aux exigences de la spécification susmentionnée. Les demandes de licence, le cas échéant pour utiliser un équipement certifié, sont traitées en conséquence par le bureau émetteur d'ISED et dépendront de l'environnement radio, du service et du lieu d'exploitation existants. Ce certificat est délivré à condition que le titulaire se conforme et continuera de se conformer aux exigences et procédures émises par ISED. L'équipement pour lequel ce certificat est délivré ne doit pas être fabriqué, importé, distribué, loué, mis en vente ou vendu à moins que l'équipement ne soit conforme aux spécifications et procédures techniques applicables émises par ISED.

I hereby attest that the subject equipment was tested and found in compliance with the above-noted specifications.

J'atteste par la présente que le matériel a fait l'objet d'essai et jugé conforme à la spécification ci-dessus.

ISSUED UNDER THE AUTHORITY OF MINISTER OF INDUSTRY
 DÉLIVRÉ AVEC L'AUTORISATION DU MINISTRE DES INDUSTRIES

DATE: September 18, 2020


 Bruno Clavier, General Manager

6.3.2 ISED regulatory statement

6.3.2.1 English version

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

This device complies with Industry Canada license-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.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to ICES-003. 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 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

6.3.2.2 French version

PRUDENCE: Changements ou modifications pourraient annuler le droit de l'utilisateur à utiliser l'équipement non autorisées.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

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.

Ces limites sont conçues pour fournir une protection raisonnable contre les interférences nuisibles dans une installation résidentielle. Cet équipement génère, utilise et peut émettre une énergie de radiofréquence et, s'il n'est pas installé et utilisé conformément aux instructions, il peut causer des interférences nuisibles aux communications radio. Cependant, il n'existe aucune garantie que des interférences ne se produiront pas dans une installation particulière.

Si cet équipement provoque des interférences nuisibles à la réception radio ou télévision, ce qui peut être déterminé en mettant l'équipement hors et sous tension, l'utilisateur est encouragé à essayer de corriger l'interférence par une ou plusieurs des mesures suivantes:

- Réorienter ou déplacer l'antenne de réception.
- Augmentez la distance entre l'équipement et le récepteur.
- Connecter l'équipement à une sortie sur un circuit différent de celui sur lequel le récepteur est branché.
- Consulter le revendeur ou un technicien radio / télévision expérimenté pour de l'aide

6.4 Market Approval for Japan (PTM 535J, ARIB)

6.4.1 ARIB (Japan) certificate

認 証 書

認証を受けた者	株式会社ルネサスイーストン
特定無線設備の種類別	第2条第1項第8号に掲げる無線設備 特定小電力機器 13GHz未満
電波の形式、 周波数及び 空中線電力	F1D 928.35MHz 0.001W
型式又は名称	PTM535J
販売業者	株式会社ルネサスイーストン
認証番号	003-180056
認証をした年月日	2018年4月24日
備考	No.18-0456 920MHz帯 テレコントロール、テレメーター、データ伝送用

上記のとおり、電波法第38条の24第1項の規定に基づく認証を行ったものであることを証する。

2018年4月24日

株式会社ディーエスピーリサーチ



6.4.2 ARIB (Japan) regulatory requirements

PTM 535J has been designed and tested to fulfil the approval requirements for ARIB STD-T108 based on the built-in firmware.

When products using PTM 535 are placed on the Japanese market, they must carry the Specified Radio Equipment marking.

PTM 535J will be laser marked on the bottom side of the PCB with the content shown in Table 3 below.


Field	Content	Description
1	MODEL: PTM 535J xy A535- z dc	Step Code „ xy “ (z.B. CA) State Code „ -z “ (z.B. -1); Date Code “ dc ” (z.B. 42/17)
2	 003-180056	ARIB ID with sign
3	DMC	Data Matrix Code

Table 3 – PTM 535J product marking

7 Product history

Table 4 below outlines the product history of PTM 535 and indicates key changes made between different revisions.

Revision	Introduction	Key features / changes
PTM 535 CA-02	Nov 2017	Prototypes for lead customer evaluation
PTM 535 DA-03	May 2018	First product release (868.300 MHz version)
PTM 535 DB-06	Aug 2019	Support for use of Base ID
PTM 535 DB-07	Jan 2020	HW optimization (alternative components)
PTM 535J DA-02	Feb 2020	First product release (928.350 MHz version)
PTM 535U DA-02	Oct 2020	First product release (902.875 MHz version)
PTM 535 DC-08	Mar 2021	1BS Support, HF optimization

Table 4 – PTM 535 product history