

PTM 535Z (DB) – ZIGBEE GREEN POWER PUSHBUTTON TRANSMITTER

PTM 535Z (DB)

Zigbee Green Power Pushbutton Transmitter

01.12.2022



Observe precautions! Electrostatic sensitive devices!

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PTM 535Z (DB) – ZIGBEE GREEN POWER PUSHBUTTON TRANSMITTER

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1 General description

1.1 Basic functionality

PTM 535Z (DB) enables the realization of energy harvesting wireless switches for lighting, building or industrial automation control systems using Zigbee Green Power (ZGP) technology.

PTM 535Z (DB) is mechanically compatible with the established PTM 330 / PTM 430J / PTM 535 form factor enabling quick integration into existing designs for these products. Key applications are wall-mounted or portable pushbutton or position switches.

PTM 535Z (DB) pushbutton transmitters are intended for operation together with the ECO 200 kinetic harvester which generates the required energy based on an external action (such as a button press). The combination of ECO 200 with PTM 535Z (DB) enables the implementation of self-powered (no batteries) and fully maintenance-free products. They can therefore be used in all environments including locations that are difficult to reach or within hermetically sealed housings.

When the ECO 200 kinetic energy harvester is actuated (pressed or released), electrical energy is generated and a ZGP radio telegram is transmitted. This radio telegram transmits the action of the energy generator (press or release) and the status of the two external inputs. PTM 535Z (DB) radio telegrams are protected with AES-128 security based on a device-unique private key.

Figure 1 below shows the top side of PTM 535Z (DB) (on the left side) and the bottom side of PTM 535Z (DB) (on the right side).

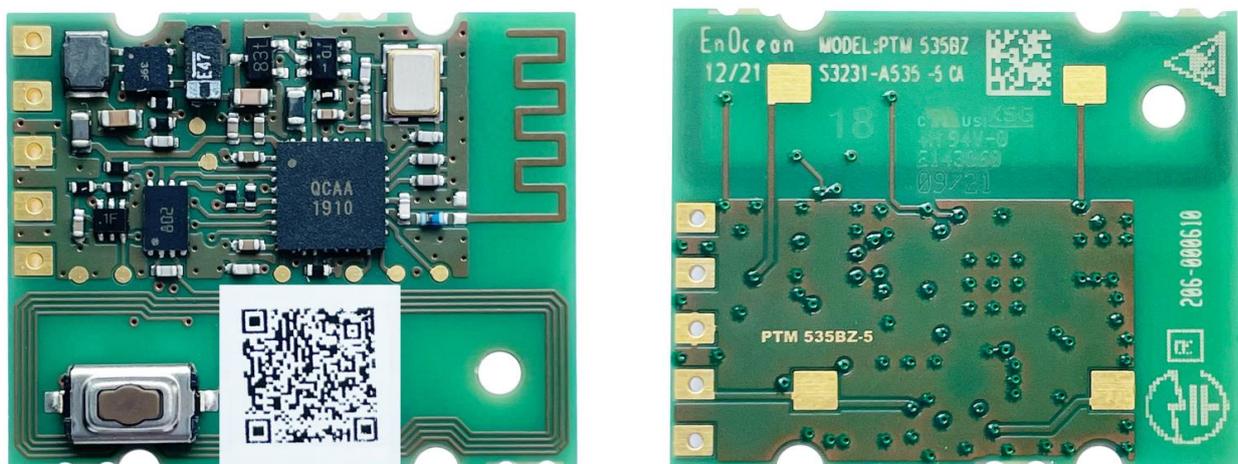


Figure 1 – PTM 535Z (DB) top and bottom view

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1.2 Technical data

Radio Standards	2.4 GHz Zigbee Green Power
Zigbee Radio Channels	Default: Zigbee Channel 11 Selectable via LRN button: Zigbee Channel 11 ... 26
Data Encoding	Zigbee Green Power ON / OFF Switch Model (Device ID 0x02)
Security	AES128 (CBC) authentication with sequence counter
Transmission Power	+4 dBm
Transmission Range (typ.)	30 m line of sight / 10 m indoor environment
Antenna	Integrated antenna
Power Supply	Kinetic harvester (ECO 200)
User Interface	Learn button
Operating Conditions	-25°C ... +65°C / 0 ... 90 % r.h. Indoor use in dry rooms only
Dimensions	26.2 mm x 21.15 mm (same as PTM 535)

1.3 Environmental conditions

Operating Temperature	-25°C ... 65°C
Storage Temperature	-25°C ... 65°C
Humidity	0% to 95% r.h. (non-condensing)

1.4 Packaging information

Packaging Unit	100 units
Packaging Method	Tray / Box (10 units per tray, 10 trays per box)

1.5 Ordering information

Type	Ordering Code	Description
PTM 535Z (DB)	S3071-A535:DB	PTM 535Z (DB) transmitter module
ECO 200	S3016-N200	ECO 200 kinetic energy generator

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2 Functional information

2.1 Product overview

The transmitter module PTM 535Z (DB) from EnOcean enables the implementation of wireless buttons and switches without batteries. It transmits Zigbee Green Power (ZGP) data telegrams where the required energy is provided by an external electro-dynamic energy generator such as the kinetic harvester ECO 200.

2.2 Basic functionality

PTM 535Z (DB) works in conjunction with an electro-dynamic energy converter (e.g. ECO 200) which is actuated (pressed and released) by external action such as a button press. The term "ECO 200" will be used throughout this document to describe a suitable energy converter.

When ECO 200 is actuated (pressed / pushed or released / pulled), electrical energy is generated and a ZGP radio telegram is transmitted which identifies the action (pressed or released) and the status of the two external input contacts.

When ECO 200 is actuated in the opposite direction (restored to its original position), it similarly generates energy which is used to transmit a different radio telegram. It is therefore possible to distinguish between radio telegrams sent when ECO 200 was pressed and radio telegrams sent when ECO 200 was released.

By identifying these different telegram types and measuring the time between pressing and releasing of the energy generator, it is possible to distinguish between "Long" and "Short" presses if required.

2.3 Functional block diagram

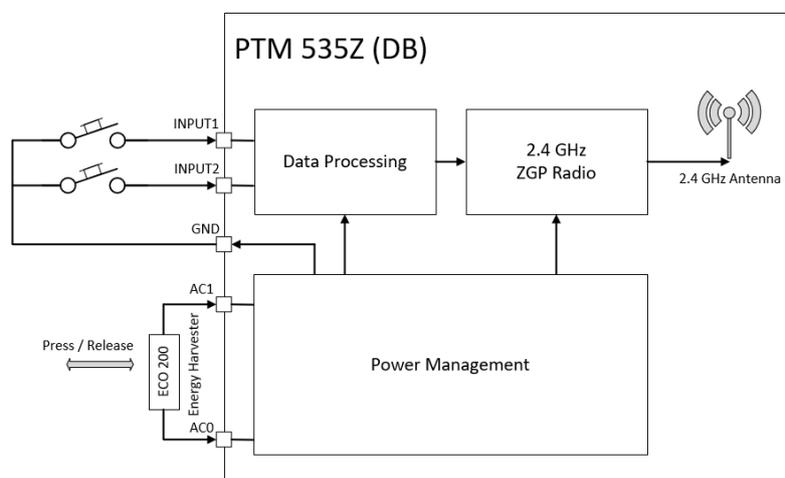


Figure 2 – Functional block diagram of PTM 535Z (DB) working with ECO 200

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2.3.1 Key components

PTM 535Z (DB) uses the following main components to achieve the desired product functionality:

ECO 200 energy harvester

Converts the kinetic energy (press / release) into electrical energy and is used to power PTM 535Z (DB) in self-powered applications. Alternatively, a power supply might be used.

Power management

Converts the energy of the power generator into a stable supply voltage suitable to power the device electronics. It also determines the polarity of the input voltage which allows identifying the direction of the ECO 200 action (press or release).

Data processing

Determines the status of the external inputs and the ECO 200 action, encodes this status into a data word, calculates the unique security signature, generates the proper radio telegram structure and sends it to the 2.4 GHz BLE / Zigbee radio transmitter

2.4 GHz Zigbee radio transmitter

Transmits the data in the form of a series of short 2.4 GHz Zigbee Green Power (ZGP) radio telegrams using the integrated antenna

2.4 Product interface

Figure 3 below shows the product interface of PTM 535Z (DB) seen from the top side (shown on the left) and the bottom side (shown on the right).

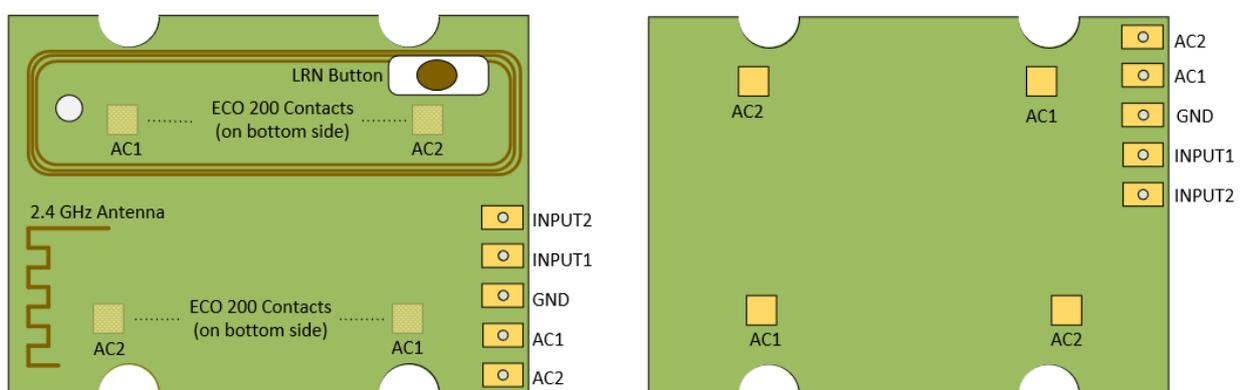


Figure 3 – PTM 535Z (DB) product interface

The following chapters describe the key components of this product interface.

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2.4.1 Energy harvester interface

PTM 535Z (DB) is designed to operate based on the energy supplied by a kinetic energy harvester such as ECO 200. Refer to [1] for a description of ECO 200.

ECO 200 provides the harvested energy to PTM 535Z (DB) using its AC1 and AC2 output pins. The polarity of the voltage identifies the direction of the ECO 200 action (press or release) which is transmitted by PTM 535Z (DB) as part of data telegrams. For press actions, the voltage difference $V(AC2) - V(AC1)$ is positive; for release actions this difference is negative.

PTM 535Z (DB) provides the AC1 and AC2 supply input signals which have to be connected to the AC1 and AC2 supply output signals of the ECO 200 harvester or another suitable power source. Connection between PTM 535Z (DB) and ECO 200 can either be made mechanically (direct connection between the ECO 200 contacts and the PTM 535Z (DB) contacts) or by wiring.

For a mechanical connection, PTM 535Z (DB) provides two pairs of AC1 and AC2 contact pads on the bottom of the PCB. Having two pairs of contacts enables the user to select the orientation of the ECO 200 harvester according to the mechanical design needs of the application. The AC1 and AC2 contact pads of PTM 535Z (DB) can be mechanically connected to the AC1 and AC2 outputs of an ECO 200 kinetic harvester using a suitable fixation housing for ECO 200 and PTM 535Z (DB) such as the one shown on the right in Figure 4.

For a wired connection, PTM 535Z (DB) provides two boundary contact signals AC1 and AC2 (shown on the right side of Figure 3) which can be used for a wired connection to the AC1 and AC2 outputs of ECO 200.

Figure 4 below shows the ECO 200 harvester (on the left side) and an example for a mechanical integration with PTM 535Z (DB) (on the right side). This figure also indicates the direction of movement which is a "Press" or "Release" action.

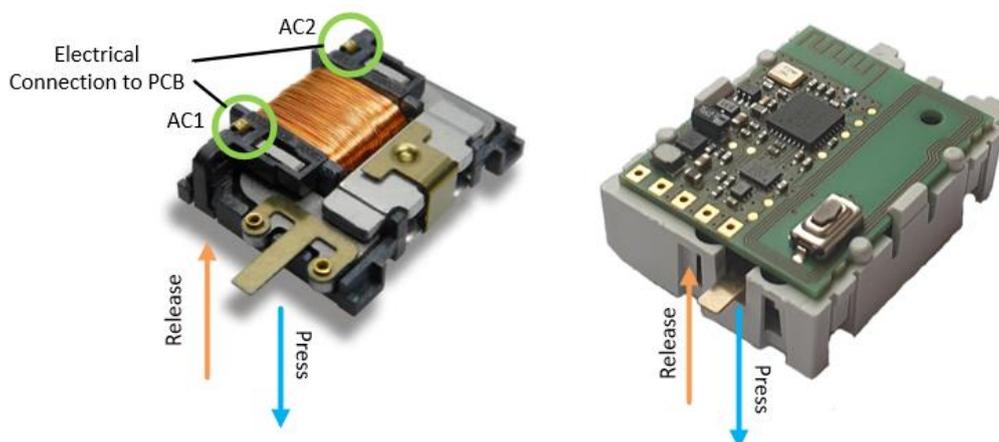


Figure 4 – ECO 200 kinetic harvester

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2.4.2 External inputs

PTM 535Z (DB) provides two electrical inputs called INPUT1 and INPUT2 and will report the status of these input pins as part of each data telegram. These signals can for instance be used for external contacts or switches.

INPUT1 and INPUT2 are active low, meaning that they will be considered to be active (connected) if they are connected to the GND signal of the PTM 535Z (DB) product interface and inactive (not connected) if they are left open.



INPUT1 and INPUT2 must either be connected to the GND signal of the PTM 535Z (DB) product interface or be left open. Do not connect these signals to a supply voltage!

2.4.3 LRN button

PTM 535Z (DB) provides an LRN button which can be used to trigger the transmission of a commissioning (LRN) telegram and to execute the channel selection process in Zigbee Green Power.

2.4.4 Radio subsystem

PTM 535Z (DB) integrates a radio transceiver including a 2.4 GHz antenna for the transmission of Zigbee Green Power (ZGP) radio telegrams as described in chapter 3.

2.4.5 Installation QR code

PTM 535Z (DB) provides an Installation QR code to identify key parameters. [Figure 5](#) shows the position of the Installation QR code on the PTM 535Z (DB) module.

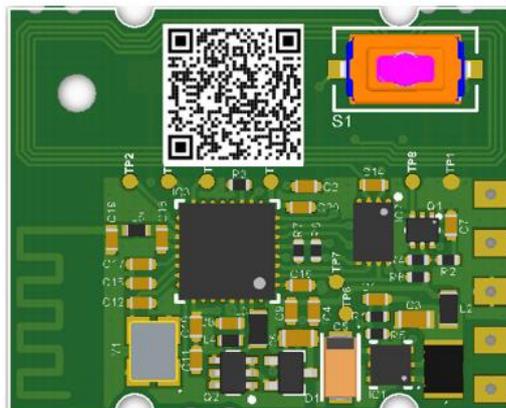


Figure 5 – Installation QR code position

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2.4.5.1 QR code fields

The Installation QR code encodes product parameters according to the ANSI/MH10.8.2-2013 industry standard. [Figure 6](#) shows an example of a PTM 535Z Installation QR code.



Figure 6 – Installation QR code example

The installation QR code shown in [Figure 6](#) above encodes the following string:

30PS3071-A535+2PCB06+20S01541234+Z01020304050607080910111213141516

[Table 1](#) below describes the ANSI/MH10.8.2 data identifiers used by the PTM 535Z (DB) device label and shows the interpretation of the data therein.

Identifier	Length of data (excl. identifier)	Content
30P	10 characters	Product Order Code (S3071-A535)
2P	4 characters	Product Revision (CB-06)
30S	8 characters	ZGP Source Address (4 byte, hexadecimal format)
Z	32 characters	Security Key (16 byte, hexadecimal format)
S	14 characters	Product Serial Number (14 digits, decimal format)

Table 1 – QR code format

2.5 Security key

PTM 535Z (DB) authenticates ZGP data telegrams based on an authentication signature as described in chapter [3.4.3](#).

The authentication and obfuscation functionalities are based on a device-specific random key which is programmed at manufacturing. This key is provided by the Installation QR code on the device described in chapter [2.4.5](#) and transmitted as part of the Commissioning telegram as described in chapter [3.4.2](#).

2.6 Related products

Consider PTM 535BZ [\[U1\]\[2\]](#) if configuration via NFC or dual mode (Zigbee Green Power or Bluetooth Low Energy) is required.

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3 Zigbee Green Power (ZGP) radio

PTM 535Z (DB) communicates using the Zigbee Green Power (ZGP) protocol. PTM 535Z (DB) can transmit two types of ZGP telegrams:

- Data telegrams
Data telegrams report the button status of PTM 535Z (DB)
- Commissioning telegrams
Commissioning telegrams provide PTM 535Z (DB) device parameters necessary for the receiver to interpret and authenticate data telegrams

PTM 535Z (DB) transmits ZGP data telegrams during normal operation to inform the receiver about the action (press or release) of the connected ECO 200 harvester and the state of the two input signals

PTM 535Z (DB) transmits ZGP commissioning telegrams if the ECO 200 harvester is actuated and the LRN button is pressed.

If the LRN button remains pressed, then commissioning telegrams will be transmitted whenever the same ECO action (press or release) is executed as when the LRN button became pressed and ECO 200 was actuated. For the other direction (release or press), no telegram will be transmitted.

If for instance the LRN button is pressed by the user and ECO 200 is then actuated into “press” direction, then PTM 535Z (DB) will transmit commissioning telegrams as long as the LRN button remains pressed and ECO 200 is moved into the press direction. No telegrams will be transmitted as long as the LRN button remains pressed and ECO 200 is moved into the release direction.

Both telegram types share the same high-level telegram format and differ only in the payload as described in subsequent chapters.

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3.1 Radio channels

PTM 535Z (DB) transmits ZGP telegrams on one of the sixteen IEEE 802.15.4 radio channel within the 2.4 GHz radio frequency band (2402MHz ... 2480MHz). The IEEE 802.15.4 radio channel assignment is shown in [Table 2](#) below.

Primary channels (marked bold) are specified as preferred channels for the transmission of ZGP telegrams. When a ZGP network is formed, those primary channels will be evaluated first when selecting the radio channel used by the ZGP network. Most ZGP systems therefore operate on one of the primary channels.

Channel Number	Channel Type	Center Frequency
11 (default)	Primary Channel	2405 MHz
12	Standard Channel	2410 MHz
13	Standard Channel	2415 MHz
14	Standard Channel	2420 MHz
15	Primary Channel	2425 MHz
16	Standard Channel	2430 MHz
17	Standard Channel	2435 MHz
18	Standard Channel	2440 MHz
19	Standard Channel	2445 MHz
20	Primary Channel	2450 MHz
21	Standard Channel	2455 MHz
22	Standard Channel	2460 MHz
23	Standard Channel	2465 MHz
24	Standard Channel	2470 MHz
25	Primary Channel	2475 MHz
26	Standard Channel	2480 MHz

Table 2 – IEEE 802.15.4 radio channels

By default, PTM 535Z (DB) uses IEEE 802.15.4 radio channel 11 (which is a primary channel) when transmitting ZGP telegrams. Other channels can be selected using the LRN button as part of the commissioning process as described in chapter [3.5](#).

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3.2 Radio transmission sequence

PTM 535Z (DB) transmits ZGP data telegrams as a set of redundant transmissions where the same data telegram is transmitted 3 times. The timing interval between the start of two consecutive redundant data telegrams is approximately 2.5 ms and varies by some random timing offset.

Figure 7 below shows the ZGP radio transmission sequence used by PTM 535Z (DB) for data telegrams.

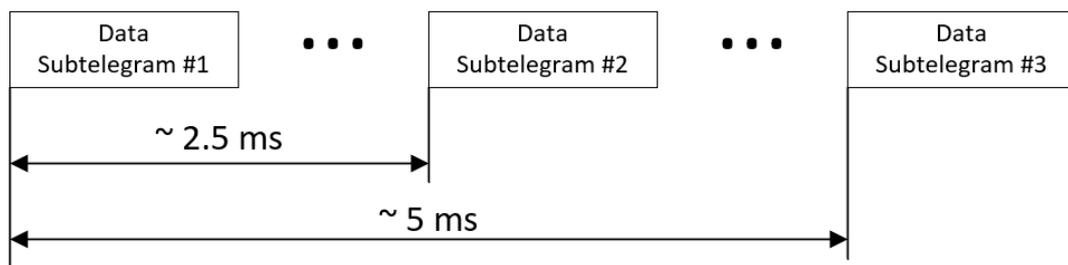


Figure 7 – ZGP radio transmission sequence for data telegrams

PTM 535Z (DB) transmits ZGP commissioning telegrams (which are much longer than ZGP data telegrams) as a set of redundant transmissions where the same data telegram is transmitted 2 times. The timing interval between the start of the two consecutive redundant commissioning telegrams is approximately 2.5 ms and varies by some random timing offset.

Figure 8 below shows the ZGP radio transmission sequence used by PTM 535Z (DB) for commissioning telegrams.

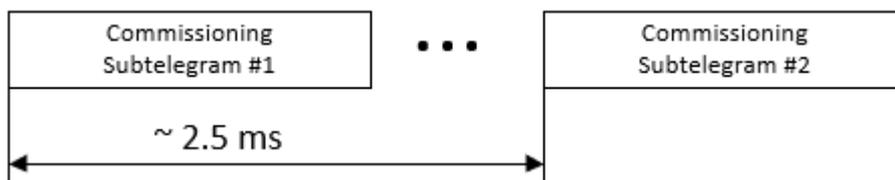


Figure 8 – ZGP radio transmission sequence for commissioning telegrams

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3.3 Telegram format

PTM 535Z (DB) transmits ZGP radio telegrams in the 2.4 GHz band according to the Zigbee Green Power specification [3] which uses IEEE 802.15.4 [4] as lower layer standard. Please refer to these specifications for detailed, up to date information.

Figure 9 below summarizes the high-level IEEE 802.15.4 / Zigbee Green Power frame structure. The content of these fields is described in more detail in the next chapters.

IEEE 802.15.4 PHY Header	IEEE 802.15.4 MAC Header	IEEE 802.15.4 MAC Payload			IEEE 802.15.4 MAC Trailer
		ZGP Network Header	ZGP Application Payload	ZGP Network Trailer	

Figure 9 – IEEE 802.15.4 / Zigbee Green Power frame structure

3.3.1 Data integrity

Correct reception of the IEEE 802.15.4 frame is ensured using a 2-byte Cyclic Redundancy Check (CRC16) which forms the IEEE 802.15.4 MAC Trailer field.

3.3.2 Byte order

ZGP uses little endian byte order meaning that if a data structure (e.g. Source Address, Frame Control or Sequence Number) is bigger than 1 byte then the least significant byte is transmitted first. Considering the case of the 4-byte Source Address 0x01501234, these 4 bytes will be transmitted (and received) in the order 0x34 first, 0x12 second, 0x50 third and 0x01 last.

3.3.3 IEEE 802.15.4 PHY Header

The IEEE 802.15.4 PHY header consists of the following fields:

- Preamble (4 byte long, always 0x0000:0000)
- Start of Frame (1 byte long, always 0xA7)
- Length of Frame (1 byte long, length depending on ZGP payload length)

The structure of the IEEE 802.15.4 PHY header is shown in Figure 10 below.

IEEE 802.15.4 PHY Header		
Preamble	Start of Frame	Frame Length
4 Byte	1 Byte	1 Byte
0x00000000	0xA7	Variable

Figure 10 – IEEE 802.15.4 PHY header structure

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3.3.3.1 Frame Length

The *Frame Length* of the 802.15.4 frame depends on the telegram type (data telegram or commissioning telegram). [Table 3](#) below lists the telegram length for the supported telegram types.

Telegramm Type	Device ID	Length
Data Telegram	0x02	24 byte (0x18)
Commissioning Telegram	0x02	42 byte (0x2A)

Table 3 – Telegram length for supported telegram types

3.3.4 IEEE 802.15.4 MAC Header

The IEEE 802.15.4 MAC Header contains the following fields:

- IEEE 802.15.4 Frame Control Field (1 byte)
The *Frame Control Field* is 0x0801 for all ZGP telegram types supported by PTM 535Z (DB)
- Sequence Number (1 byte)
The *Sequence Number* is an incremental number used to identify the order of telegrams
- Address Field (4 byte)
The *Address Field* is set to 0xFFFF:FFFF for all PTM 535Z (DB) ZGP telegrams

[Figure 11](#) below shows the IEEE 802.15.4 MAC header structure.

IEEE 802.15.4 MAC Header		
IEEE 802.15.4 Frame Control	Sequence Number	Destination Addr 16 PAN 16 Bit Addr
2 Byte	1 Byte	4 Byte
0x0801	Variable	0xFFFFFFFF

Figure 11 – IEEE 802.15.4 MAC header structure

3.4 IEEE 802.15.4 MAC payload (ZGP telegram)

The IEEE 802.15.4 MAC payload contains the ZGP telegram data. [Figure 12](#) below shows the ZGP telegram format.

ZGP Network Header				ZGP Application Payload	ZGP Network Trailer
Frame Control	<i>Extended Frame Control</i>	Source Address	<i>Sequence Counter</i>	Content depends on Telegram Type	<i>Authentication Signature</i>
1 Byte	0 or 1 Byte	4 Byte	0 or 4 Byte	Size depends on Telegram Type	0 or 4 Byte

Figure 12 – ZGP telegram format

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The content of the ZGP telegram data field depends on the telegram type (ZGP data telegram or ZGP commissioning telegram). Some of the fields shown in [Figure 12](#) above are not used in all telegram types. These fields are marked in *italics*. The structure of data and commissioning telegrams is described in the subsequent chapters.

3.4.1 Data telegram structure

By default, PTM 535Z (DB) transmits data telegrams. The payload of data telegrams is 12 byte long. [Figure 13](#) below shows the telegram structure for ZGP data telegrams.

ZGP Network Header				ZGP Application Data	ZGP Network Trailer
Frame Control	Extended Control	ZGP Source Address	ZGP Sequence Counter	ZGP Command	Authentication Signature
1 Byte	1 Byte	4 Byte	4 Byte	1 Byte	4 Byte
0x8C	0x30	0x015x:xxxx	Variable	Variable	Variable

Figure 13 – Structure of ZGP data telegrams

ZGP data telegrams contain the following fields:

- **Frame Control (1 byte)**
The *Frame Control* field is set to 0x8C
- **Extended Frame Control (1 byte)**
The *Extended Frame Control* field is set to 0x30
- **Source Address (4 byte)**
The *Source Address* uniquely identifies the originator (sender) of ZGP telegrams. This Source ID is assigned by Zigbee Alliance and cannot be changed by the user.
- **Sequence Counter (4 byte)**
The *Sequence Counter* is a continuously incrementing counter used for security processing. It is initialized to 0 at the time of production and incremented for each telegram (data telegram or commissioning telegram) sent. The least significant byte of the Sequence Counter is used as Sequence Number in the IEEE 802.15.4 MAC Header.
- **ZGP command (1 byte)**
The ZGP command identifies the switch action as described in the next chapter.
- **Security Signature (4 byte)**
The Security Signature is used to authenticate PTM 535Z (DB) ZGP radio telegrams as described in chapter 3.4.3

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3.4.1.1 ZGP command

PTM 535Z (DB) uses a command table with eight entries corresponding to each of the eight possible combinations of ECO 200 action (Press or Release), INPUT1 and INPUT2 status (Connected or Not Connected) to determine which ZGP command will be sent upon the corresponding input status.

Table 4 below shows the ZGP command that is transmitted for each of the eight possible combinations of ECO 200 action, INPUT1 and INPUT2 status.

Table Index	INPUT2 Status	INPUT1 Status	ECO 200 Action	ZGP Command
ZGP_COMMAND_0	Not connected	Not connected	Press action	0x22
ZGP_COMMAND_1	Not connected	Not connected	Release action	0x23
ZGP_COMMAND_2	Not connected	Connected	Press action	0x12
ZGP_COMMAND_3	Not connected	Connected	Release action	0x13
ZGP_COMMAND_4	Connected	Not connected	Press action	0x14
ZGP_COMMAND_5	Connected	Not connected	Release action	0x15
ZGP_COMMAND_6	Connected	Connected	Press action	0x16
ZGP_COMMAND_7	Connected	Connected	Release action	0x17

Table 4 – ZGP command table

3.4.2 Commissioning telegram

Transmission of a commissioning telegram can be selected either by pressing the LRN button. The commissioning telegram payload is shown in Figure 14 below.

ZGP Network Header		ZGP Application Data (Commissioning Telegram)						
Frame Control	Source Address	Command	Device ID	Options	Extended Options	Encrypted Key	Key MIC	Sequence Counter
1 Byte	4 Byte	1 Byte	1 Byte	1 Byte	1 Byte	16 Byte	4 Byte	4 Byte
0x0C	0x015x:xxxx	0xE0	0x02	0x81	0xF2	Variable	Variable	Variable

Figure 14 – ZGP payload structure for commissioning telegrams

The commissioning telegram contains the following fields that are common to all Device ID:

- ZGP Network Header (6 byte)
The ZGP Network Header is similar to that of data telegrams; the Sequence Counter field is omitted in the ZGP Network Header as it is part of the Application Payload
- Command (1 byte)
The ZGP Command field is set to 0xE0 to identify a commissioning telegram
- Device ID (1 byte)
The Device Type identifies the Device ID used by PTM 535Z (DB) which is 0x02 (ON / OFF switch).

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- Options (1 byte)
The Option field provides information about the structure of the commissioning telegram. It is always set to 0x81.
- Extended Options (1 byte)
The Extended Option field provides information about the security model. It is always set to 0xF2.
- Encrypted Security Key (16 byte)
The Encrypted Security Key field contains an encrypted representation of the 16 byte security key used by PTM 535Z (DB) to authenticate its data telegrams.
- Key Hash (4 byte)
The Key Hash can be used to verify if the security key was correctly decrypted
- Sequence Counter (4 byte)
The Sequence Counter is a continuously incrementing counter used for security processing. It is initialized to 0 at the time of production and incremented for each telegram (data telegram or commissioning telegram) sent.

3.4.3 Data telegram authentication

PTM 535Z (DB) implements telegram authentication for transmitted ZGP data telegrams as specified by the ZGP specification. This ensures that only telegrams from transmitters using a previously exchanged security key will be accepted by the receiver. Refer to the ZGP specification [3] for details about ZGP data telegram authentication.

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3.5 Channel selection

ZGP uses the IEEE 802.15.4 radio standard [4] for telegram transmissions which defines 16 radio channels (designated as Channel 11 ... Channel 26) as described in chapter 3.1.

The radio channel used for communication is selected when a ZGP network is formed and usually remains the same throughout the lifetime of the network. The channel selection process is designed to ensure that a certain channel quality (low disturbances) is achieved.

Devices within a ZGP network can receive radio telegrams from PTM 535Z (DB) only if PTM 535Z (DB) uses the same radio channel as the ZGP network. PTM 535Z (DB) therefore has to be configured to use the right radio channel. This process is called channel selection.

Channel selection can be executed via the LRN button where PTM 535Z (DB) will announce its identity (Source Address, Device ID, Application Information, Security Material) sequentially on different radio channels.

If a ZGP network operates on the currently used radio channel and is configured to accept new devices (for instance by pressing a dedicated button on the receiver) then it can signal to the installer (for instance by blinking the controlled light) that PTM 535Z (DB) is now operating on the right radio channel, that its Commissioning Telegram has been received and that PTM 535Z (DB) is now part of the ZGP network.

At this point, the installer has to release the LRN button to complete the channel selection sequence of PTM 535Z (DB) and trigger a data telegram (by actuating the connected ECO 200 harvester after the LRN button has been released) to signal to the receiver that the configuration has been completed.

PTM 535Z (DB) will continue to operate on the selected channel until the channel selection process is started again (for instance because the product using PTM 535Z (DB) has been moved to a different room and should now be part of a different ZGP network).

Note that PTM 535Z (DB) will change to a different channel if the LRN button is pressed during at least three consecutive ECO 200 actions (e.g. press - release - press).



Therefore, it is strongly recommended to transmit a data telegram after completion of the channel selection sequence to avoid unintentional channel reconfiguration when the LRN button is pressed the next time.

The channel selection sequence will always start with the radio channel that is currently used by PTM 535Z (DB). This allows to communicate the identify of PTM 535Z (DB) to additional devices in the same ZGP network (for instance to newly added devices or to devices that did not receive the initial Commissioning Telegram).

After that, PTM 535Z (DB) will sequentially transmit commissioning telegrams on channels 11, 12, 13 ... 25, 26. If channel 26 has been reached then the sequence will be restarted at channel 11.

PTM 535Z (DB) – ZIGBEE GREEN POWER PUSHBUTTON TRANSMITTER

4 Mechanical interface

PTM 535Z (DB) uses the same mechanical outline as the existing PTM 535 / PTM 535Z / PTM 535J and PTM 535Z products. Existing mechanical designs combining one of the existing variants with an ECO 200 harvester can therefore also be used with PTM 535Z (DB).

Note also that the five boundary contacts (AC1, AC2, INPUT1, INPUT2, GND) are located at different positions in PTM 535Z Revision DB compared to PTM 535Z Revision DA.

4.1 Product dimensions

Figure 15 below provides a product drawing of PTM 535Z (DB). Refer to the PTM 535Z (DB) product webpage for additional details.

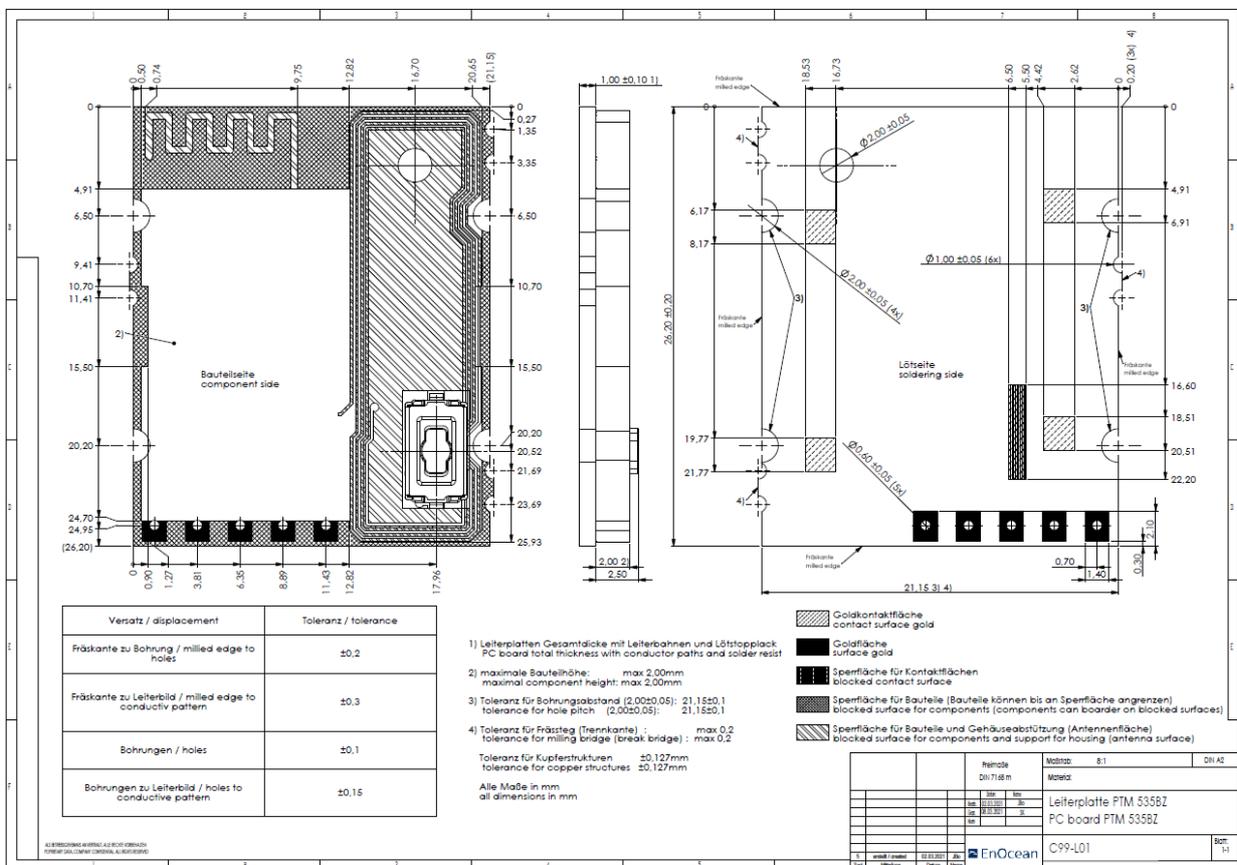


Figure 15 – PTM 535Z (DB) product drawing

PTM 535Z (DB) – ZIGBEE GREEN POWER PUSHBUTTON TRANSMITTER

5 Application information

5.1 Transmission range

The main factors that influence the system transmission range are:

- Type and location of the antennas of receiver and transmitter
- Type of terrain and degree of obstruction of the link path
- Sources of interference affecting the receiver
- “Dead spots” caused by signal reflections from nearby conductive objects.

Since the expected transmission range strongly depends on this system conditions, range tests should always be performed to determine the reliably achievable range under the given conditions. The following figures should be treated as a rough guide only:

- Line-of-sight connections
Typically 10 m range in corridors, up to 30 m in halls
- Plasterboard walls / dry wood
Typically 10 m range, through max. 2 walls
- Ferro concrete walls / ceilings
Typically 5 m range, through max. 1 ceiling (depending on thickness)
- Fire-safety walls, elevator shafts, staircases and similar areas should be considered as shielded

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 mounting 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 fibre
- Lead glass or glass with metal coating, steel furniture

The distance between the receiver and other transmitting devices such as computers, audio and video equipment that also emit high-frequency signals should be at least 0.5 m. Note that interference from other radio equipment operating in the 2.4 GHz band (WiFi routers, smartphones, wireless audio and video systems, etc.) can have major impact on radio performance.

5.2 Device operation



PTM radio modules are designed for manual button operation with an actuation rate of 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.

6 Regulatory approvals

6.1 European Union

6.1.1 Declaration of conformity

Hereby, EnOcean GmbH, declares that this radio equipment is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU. A copy of the Declaration of Conformity can be obtained from the product webpage at www.enocean.com

6.1.2 Waste treatment

WEEE Directive Statement of the European Union

The marking below indicates that this product should not be disposed with other household wastes throughout the EU. To prevent possible harm to the environment or human health from uncontrolled waste disposal, recycle it responsibly to promote the sustainable reuse of material resources.

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6.2 FCC (United States)

6.2.1 Certificate

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: 08/10/2022
Application Dated: 08/10/2022

EnOcean GmbH
Kolpingring 18a
Oberhaching, 82041
Germany

Attention: Armin Anders , Director Product Marketing

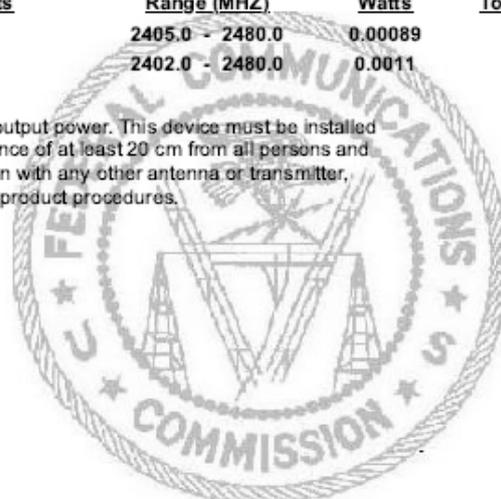
NOT TRANSFERABLE

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-PTM535BZ
Name of Grantee: EnOcean GmbH
Equipment Class: Digital Transmission System
Notes: Energy Harvesting Wireless Switch

<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>
	15C	2405.0 - 2480.0	0.00089		
	15C	2402.0 - 2480.0	0.0011		

Output Power listed is the maximum conducted output power. This device must be installed and operated so as 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, except in accordance with FCC multi-transmitter product procedures.



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6.2.2 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.

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6.3 ISED (former Industry Canada)

6.3.1 Certificate



**CANADIAN CERTIFICATION
TECHNICAL ACCEPTANCE CERTIFICATE**

Certification No. ➤ IC: 5713A-PTM535BZ

Issued To ➤ EnOcean GmbH
Kolpingring 18A
Oberhaching 82041
Germany

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

Type of Equipment ➤ Other

Type of Service ➤ Modifications (C3PC)

Hardware Version Id Number (HVIN) ➤ PTM 535Z (DB)

Firmware Version Id Number (FVIN) ➤ PTM 535Z (DB)

Product Marketing Name: (PMN) ➤ PTM 535Z (DB)

Host Marketing (HMN) ➤ N/A

FREQUENCY RANGE	EMISSION DESIGNATIONS <small>NECESSARY BANDWIDTH & EMISSION CLASSIFICATION</small>	R.F. POWER	ANTENNA INFO	SPECIFICATION/ ISSUE & DATE
2405 – 2480 MHz	2M30F1D	0.0012 W	Trace, 1.2dBi	RSS-247 Issue 2; Feb. 2017

Note 1: This equipment also complies with RSS-102, Issue 5 (March 2015) and RSS-Gen, Issue 5 (April 2018).

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: November 28, 2022

Bruno Clavier
Bruno Clavier, General Manager

PTM 535Z (DB) – ZIGBEE GREEN POWER PUSHBUTTON TRANSMITTER

6.3.2 Regulatory Statement

6.4 English version

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

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

PTM 535Z (DB) – ZIGBEE GREEN POWER PUSHBUTTON TRANSMITTER

6.5 French version

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

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.

Cet équipement a été testé et déclaré conforme aux limites d'un appareil numérique de classe B, conformément à la norme ICES-003. 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

PTM 535Z (DB) – ZIGBEE GREEN POWER PUSHBUTTON TRANSMITTER

7 Product history

Table 5 below lists the product history of PTM 535Z (DB).

Revision	Release date	Key changes versus previous revision
CB-01	July 2022	Product preview (lead customers only)

Table 5 – Product History

8 References

- [1] [ECO 200 Product Website](#)
- [2] [PTM 535BZ Product Website](#)
- [3] [Zigbee Green Power Specification](#)
- [4] [IEEE 802.15.4](#)