

EMCSA / EMCSU / EMCSJ  
ENOCEAN MAGNET CONTACT SENSOR

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EMCSA / EMCSU / EMCSJ  
EnOcean Magnet Contact Sensor

(Stepcode DE and later)



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,  
WO 04/109236, WO 05/096482, WO 02/095707,  
US 6,747,573, US 7,019,241

## EMCSA / EMCSU / EMCSJ ENOCEAN MAGNET CONTACT SENSOR

### REVISION HISTORY

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

Version	Author	Reviewer	Date	Major Changes
1.0	AA	MK	22.01.2018	First release
1.1	AA	AA	26.02.2018	Light requirement details added, housing dimensions corrected, some more minor additions
1.2	AA	AA	29.05.2018	Chapter 4.4 added (Installing Supplemental Battery)
2.0	AA	AA	04.01.2019	Additional supplied Wall Mounting Plate added (in chapters 2.1, 2.5, 2.6)
2.1	AA	AA	01.02.2019	Tray packaging added (chapter 2.4, new chapter 2.7)
2.2	AA	AA	27.02.2019	EEP number corrected in Chapter 2.2
3.0	AA	MK	12.09.2019	New Step Code DE: Update with long-term energy storage replacement, additional transport mode for longer shelf storage & air cargo, optimized secure mode. Adding information about QR Code, new grey housing variant and new US Version. Update of Regulatory Notes inclusive European waste treatment.
3.1	AA	MHö	13.01.2020	EMCSJ version added (928 MHz)
3.2	AA	AA	25.02.2020	Battery lifetime calculation added (3.6.4)
3.3	MK		11.04.2022	UK market approval and UKCA added

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#### 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>.

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## 1 RELATED DOCUMENTS

This document describes setup and operation of the EMCSx unit. Related documents are as follows:

### 1.1 Installation Instructions

The installation instructions are content of the single unit packaging box

### 1.2 Range Planning

We recommend following our application notes, in particular AN001 "EnOcean Wireless Systems - Installation Notes" (PDF) available as download at:  
[www.enocean.com/en/support/application-notes/](http://www.enocean.com/en/support/application-notes/)

### 1.3 Radio Telegram Description

EMCSx transmits a radio telegram according to EnOcean Equipment Profile EEP D5-00-01 (contact state) and EEP SIGNAL 0x0E (Entering Transport Mode) as defined in the EnOcean Equipment Profiles specification:  
[www.enocean-alliance.org/eep/](http://www.enocean-alliance.org/eep/)

If the unit is operated in Secure Mode please refer to the EnOcean security specification:  
[www.enocean.com/security-specification](http://www.enocean.com/security-specification)

### 1.4 Declaration of Conformity

The Declaration of Conformity for EU and UK can be found at the EnOcean EMCSx product webpage.

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## 2 GENERAL INFORMATION

**This user manual specifies EMCSx units with Stepcode DE or later:**

- See chapter "2.8 Product Label and QR Code" to find out the module stepcode.
- For a detailed description of product change see Product Change Notification (PCN).
- The user manual for older modules can be downloaded from the product website (V2.2).

### 2.1 Basic Functionality

EMCSx is an energy-harvesting wireless magnet contact sensor for EnOcean systems.

Powered by a solar cell, EMCSx works absolutely maintenance-free. An integrated energy store allows operation for several days in total darkness. In dark surroundings, a coin cell battery can be retrofitted.

The small housing is easy to be mount on windows, on doorframes or on cabinets using the included double-sided adhesive pad or using the also included mounting plate. The ultra-slim magnet has a pre-assembled adhesive pad.

EMCSx supervises an integrated reed contact and reports every status change immediately (open<>closed). In addition, a sign of life signal is send at regular intervals. In addition to the cyclic wake-up, a wake up is triggered by pushing the LRN button.

EMCSx provides the option to use enhanced security mode with encrypted communication.

#### Key product features EMCSx

- Fully autonomous operation under sufficient lighting with pre-installed solar cell (Battery backup option for operation in dark surroundings)
- Very flat magnet with preinstalled adhesive for easy mounting
- Small housing for easy mounting with double-sided adhesive or mounting plate
  - Integrated reed contact
  - Integrated energy storage and charging circuit
  - Integrated LRN button and TX indicator LED



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### 2.2 Technical Data

<b>On-board power supply</b>	Solar with indoor light, min. 50 lx
<b>Auxiliary power supply</b>	Option for backup battery (CR1225, not included)
<b>Antenna</b>	Internal helix antenna
<b>Frequency</b>	EMCSA: 868,300 MHz (ASK) EMCSU: 902.875 MHz (FSK) EMCSJ: 928.230 MHz (FSK)
<b>Data rate / modulation type</b>	125 kbps
<b>Radiated output power</b>	EMCSA: max +6.4dBm (EIRP) EMCSU: +99 dB $\mu$ V/m $\pm$ 2 dB EMCSJ: typ. 0dBm
<b>Sustain condition for battery free operation</b>	min. 400 lx hours per day (signs-of-life only, 22°C)
<b>Start-up time with empty energy store</b>	typ. <2.5min @ 400 lx, 22°C <sup>1)</sup>
<b>Operation time in darkness</b>	>10 days (energy storage fully charged, signs-of-life only, 22°C) <sup>2)</sup>
<b>Operation time with backup battery</b>	5 years min. (total darkness, 22°C) <sup>3)</sup>
<b>Teach-in telegram trigger</b>	Pushbutton behind hole in side wall
<b>Teach-in telegram indicator</b>	LED shining through housing side wall
<b>Sign-of-life transmission</b>	Contact status update once every around 20...30 minutes
<b>EnOcean module integrated</b>	EMCSA: STM 320 for EU/UK with CE/UKCA EMCSU: STM 320U for US/CA with FCC/ISED EMCSJ: STM 420J for Japan with ARIB
<b>EnOcean Equipment Profile (EEP)</b>	D5-00-01, SIGNAL 0x0E (Transport Mode)

*Note 1:* Charging time from empty energy store until a teach-in telegram can be sent.

*Note 2:* Operation time from a fully charged energy store if telegrams sent on average every 17.5 minutes (signs-of-life). To maintain the performance, please refer to chapter 2.3!

*Note 3:* For details please see chapter 3.6.4

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### 2.3 Environmental Conditions

<b>Operating and storage temperature</b>	Absolute maximum: -20 °C ... +60 °C Recommended <sup>1)</sup> : +10 °C...+30 °C
<b>Operating and storage humidity</b>	Maximum: 0% ... 93% r.h., non-condensing Recommended: < 60% r.h.
<b>Shelf life (in absolute darkness)</b>	36 months after delivery in transport mode <sup>2</sup>

*Note 1:* Recommended for maximum life of energy storage capacitor. The following effects will lead to shorter dark time operation:

- a) Long time exposure of the unit to temperatures higher 30°C will gradually degrade the energy storage performance over lifetime.
- b) Lower temperatures than 10°C will noticeable reduce capacity of energy store, but temporarily only.

*Note 2:* Recharge energy storage after 36 months in total darkness. Deep discharge of the energy storage leads to degradation of performance. Therefore, the device must be put into operation after 36 months in transport mode.

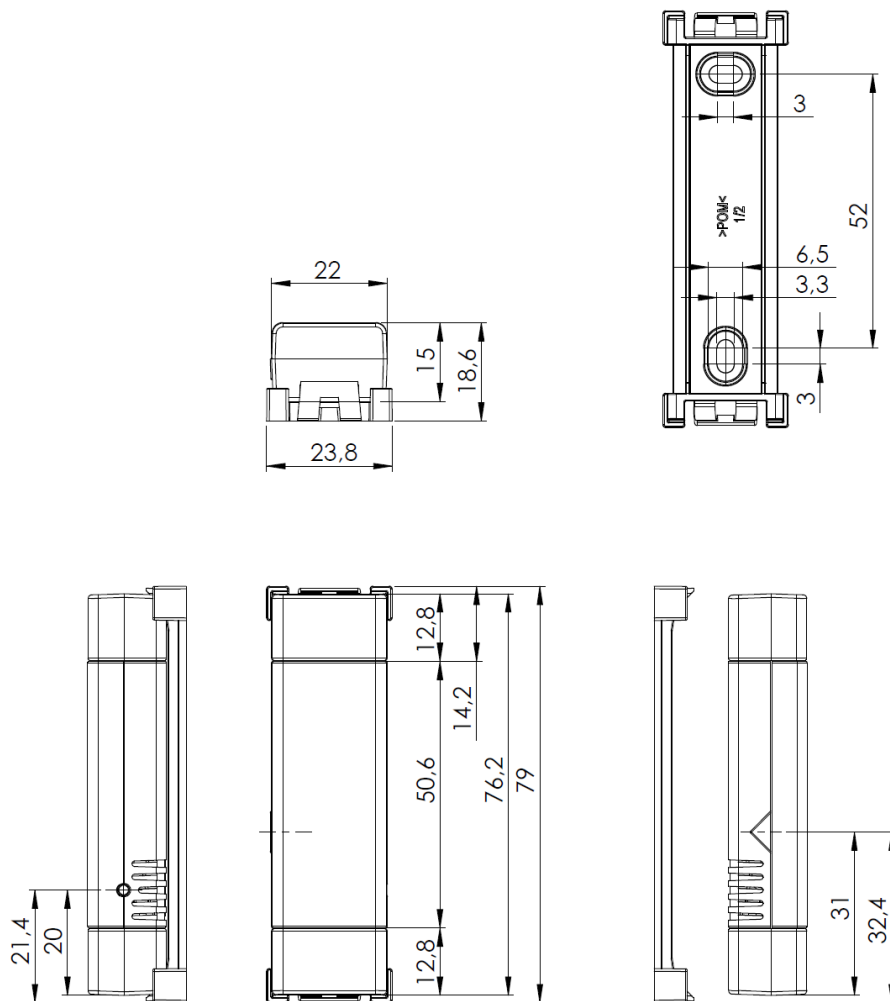
### 2.4 Ordering Information

Type	Ordering Code	Frequency	Packaging
EMCSA	S3001-C320	868.300MHz	Single Unit Packaging (chapter 2.6)
EMCSA	S3001-T320	868.300MHz	Tray Packaging (chapter 2.7)
EMCSA-G	S3001-G320	868.300MHz	Tray Packaging (grey housing)
EMCSU	S3051-C320	902.875MHz	Single Unit Packaging
EMCSJ	S3001-T420	928.350MHz	Tray Packaging (chapter 2.7)

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## 2.5 Physical Dimensions

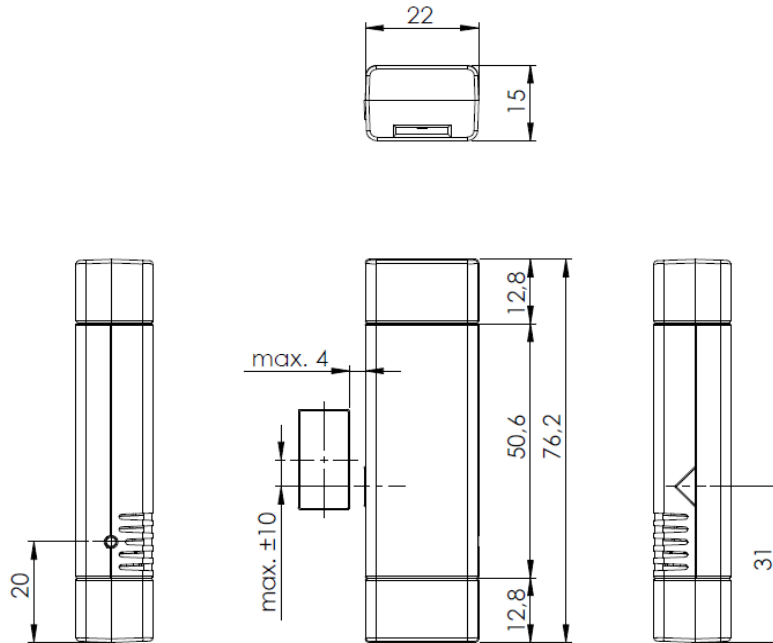
<b>Colour of unit housing and mounting plate</b>	EMCSA, EMCSU, EMCSJ: White, similar to RAL 9010, EMCSA-G: Grey, similar to RAL 7016
<b>Material of unit housing and mounting plate</b>	PC-ABS (housing), POM (mounting plate)
<b>Dimensions of unit with mounting plate</b>	79 x 23.8 x 18.6 mm
<b>Dimensions of unit without mounting plate</b>	76.2 x 22 x 15 mm
<b>Dimensions of housing adhesive</b>	50 x 18 x 0.8 mm
<b>Dimensions of magnet (incl. adhesive)</b>	20 x 10 x 1.5 mm



EMCSx Mechanical Outline (with mounting plate)



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EMCSx Mechanical Outline (without mounting plate)

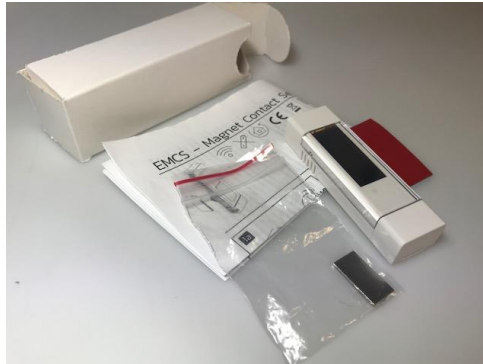
## 2.6 Packaging Information – Single Unit Packaging

Content of single unit box:

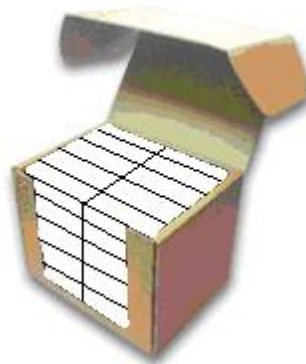
1. Reed Contact Unit (wireless sensor in housing)
2. Mounting Plate (for mounting the sensor)
3. Adhesive Tape (double-sided, for easy gluing the unit onto a smooth surface)
4. Magnet with adhesive tape (separate in a little plastic bag)
5. Installation Instructions

<b>Weight of sensor unit</b> (without magnet)	20 g
<b>Weight of single unit box</b> (housing, magnet, mounting plate, packaging)	37 g
<b>Size of single unit card box</b>	32 x 32 x 99 mm
<b>Minimum order quantity</b> (transport packaging)	50 units
Dimensions of transport card box (50 single unit boxes)	232 x 176 x 174 mm
<b>Weight of transport box</b> (including 50 single unit boxes)	2.0 kg

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Content of single unit box:  
Reed Contact, Magnet, Adhesive, Mounting Plate, Instructions



Transport Packaging with 50 single unit boxes

## 2.7 Packaging Information – Tray Packaging

Card box with 7 plastic trays containing 8 sensor units each, plus 1 tub-tray for the accessories.

Content:

1. 56 Reed Contact Units
2. Mounting Plates (preinstalled at reed contact units)
3. Adhesive Tapes (in separate tray)
4. Magnets with adhesive tape (in separate tray)

<b>Minimum order quantity</b> (transport packaging)	56 units
<b>Dimensions of transport box</b> (56 units)	232 x 176 x 174 mm
<b>Weight of transport box</b> (56 units)	2.2 kg

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## 2.8 Device Label

The structure of the EMCSx device label is shown in the following figure:

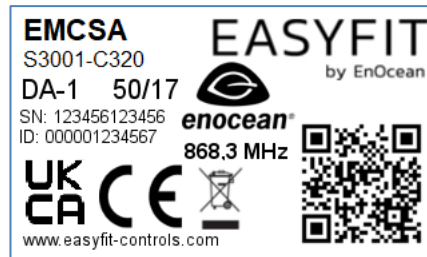


Figure: Unit Label

### 2.8.1 Step Code

The Step Code describes the functional product status of the device and can be found on the product label between the product ordering code and the unit’s serial number. In the upper figure the step code is “DA”.

### 2.8.2 QR-Code

In order to improve logistic and commissioning of the sensor unit a QR code can be found on the unit label. The QR code used in the new product label encodes the product parameter according to the ANSI/MH10.8.2-2013 industry standard.



Figure: QR Code Example

The QR code shown in the example figure above encodes the following string:  
„30S000001234567+30PS3001-C350+2PDA01+S01123456123456“

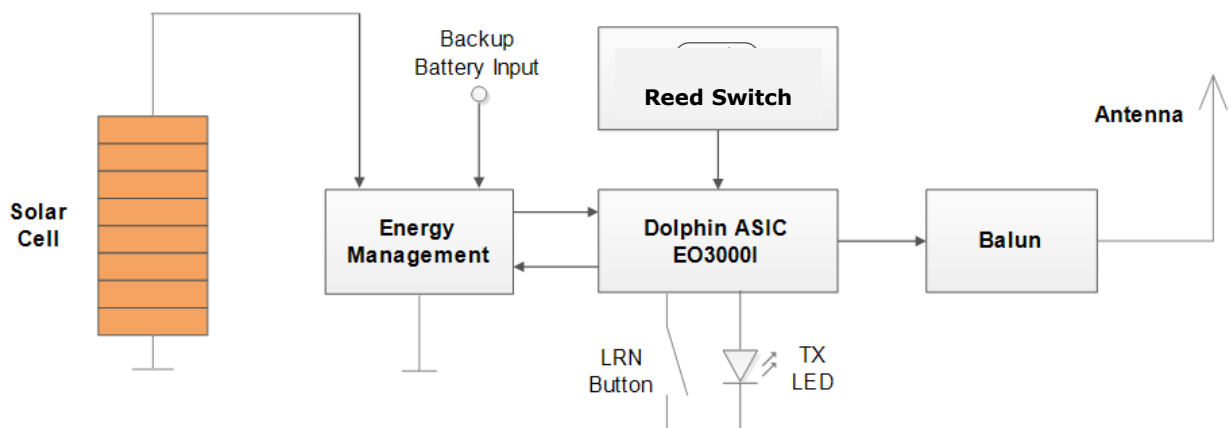
The following table shows the interpretation of the data therein:

Identifier	Length of data excluding identifier	Value	Comment
30S	12 characters	ID, Static Source Address	hex
30P	10 characters	Ordering Code	“S3001-C350”
2P	4 characters	Step code and revision	“DA-01”
S	14 characters	Serial Number	

Table: QR Code content

### 3 FUNCTIONAL DESCRIPTION

#### 3.1 Block Diagram



A change of the reed contact status or pushing the LRN button will wake the transmitter unit to send a radio telegram immediately (reed contact position, LRN push button status, unique 32-bit sensor ID, checksum). In addition a redundant retransmission signal is sent to announce the contact status even in case of no input signal changes. This signal is transmitted every 20-30 min, affected at random. The transmit indicator LED flashes briefly at every radio transmission. Between the wake-up phases the device is in sleep mode for minimum power consumption.

#### 3.2 Teach-in to Receiver Unit

Push the button behind the hole in the side wall to trigger a teach-in telegram. You will see a LED shining at the housing side as telegram indicator (pay attention to a sufficiently dark environment).

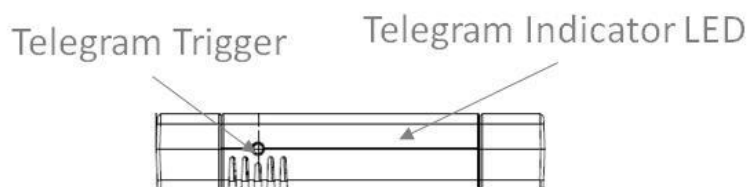


Figure: Teach-in telegram trigger

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When pressing the LRN key, the module sends a teach-in telegram to a suited receiver according to the currently selected communication mode (see chapter 3.3, 4BS teach-in telegram for standard mode, secure teach-in telegram for Secure Mode). The teach-in telegram identifies the device manufacturer and the function and type of the device via the EEP used. For EASYFIT devices, EnOcean is set as manufacturer with ID 0x00B.

### **3.3 Commissioning and Mode Change**

The module is shipped in Transport Mode (Mode 3) to switch off the energy store for long term shelf storage and air cargo. The mode can be changed by pressing the learn button. Please note that the modes have been changed with Stepcode DE (and later). Make sure that the solar cell will get enough light for mode change and/or learn telegram.

■ **Change from Transport Mode to Standard Mode:**

After pressing learn button **1x short (around 1s)** the radio module will enter Standard Mode (Mode 1). **A standard learn telegram will be sent and the LED will flash 2x.**

■ **Change from Standard Mode to Secure Mode:**

After pressing learn button **2x long (2x around 5s, pause <1s)** the radio module will enter Secure Mode (Mode 2). **A secure learn telegram will be sent and the LED will flash 2x.**

■ **Change from Secure or Standard Mode to Transport Mode:**

After pressing learn button **1x long (around 5s)** the radio module will enter Transport Mode (Mode 3). **A signal telegram will be sent and the LED will flash 3x.**

The following diagram illustrates all implemented mode transitions:

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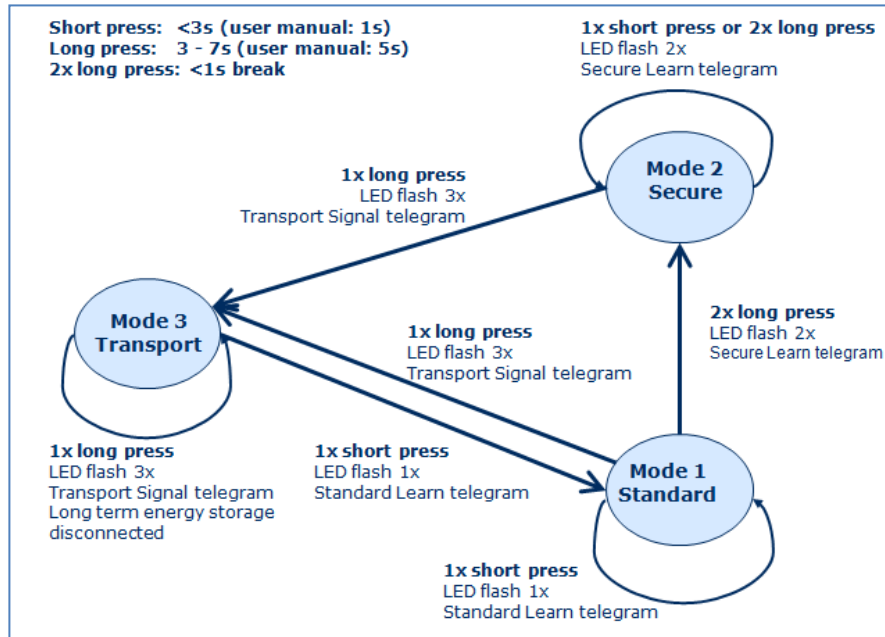


Figure: Mode Transitions

The following pushbutton timing is implemented:

- Short press: **around 1s** (firmware 0.1 – 3.0 s)
- Long press: **around 5s** (firmware 3 – 7 s)
- 2x long press with very short pause of max. 1 s between



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.



The flag for actual mode itself is stored in non-volatile memory. After power down reset the previous selected mode is active. The mode change is limited to 50 times. In normal application scenario only very few are required.

### 3.4 Radio Telegram Format, EEP

#### 3.4.1 Standard Mode

EMCSx transmits a radio telegram according to EnOcean Equipment Profile EEP D5-00-01 as defined in the EEP EnOcean Equipment Profiles specification:

[www.enocean-alliance.org/eep/](http://www.enocean-alliance.org/eep/)

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### 3.4.2 Secure Mode and Secure Telegram (Stepcode DE and later)

In Secure Mode the payload content of the telegram is protected with advanced security features. Normal operation telegram payload and also teach-in telegram payload both are protected in the same way. The security features used are defined by the Security Level Format (SLF). This parameter is set by default to following values:

- 24-bit RLC which starts from 0 at production
- RLC sent explicitly
- 3-byte CMAC
- VAES encryption

The security features are added to the communication by encapsulating the payload and teach-in telegram payload into a secured telegram. The payload itself is not changed and corresponds to the standard mode payload like defined by EEP D5-00-01. Please refer to the EnOcean Security Specification for details:

<http://www.enocean.com/en/security-specification/>

### 3.4.3 Secure Learn Telegram

In Standard Mode an 1BS teach-in telegram is transmitted by pressing the LRN button. To process secured communication on a receiver the EMCSx has to send a security teach-in telegram to the receiver and so inform him about the used security profile, AES key and initial RLC counter. The security teach-in has to take place before any other communication can be executed (profile teach-in included). Press the LRN button to trigger the transmission of the teach-in telegram. The security teach-in and then the profile teach-in are transmitted. The profile teach-in telegram is already protected by advanced security features. The process of sending security teach-in telegram and profile teach-in telegram is triggered by pressing the LRN button in secure mode, the behaviour of the LRN button is following:

1. Button is pressed
2. Security teach-in is send.
3. Profile teach-in is send.

For more information on the structure of the teach-in telegram please refer to chapter 4.2 of the EnOcean Security Specification: [www.enocean.com/security-specification](http://www.enocean.com/security-specification)

## 3.5 Radio Telegram Timing

The setup of the EMCSx transmission timing reliably avoids possible collisions with data packages of other EnOcean transmitters as well as disturbances from the environment.

### 3.5.1 Standard Mode Transmission Timing

In Standard Mode with each transmission cycle, 3 identical sub-telegrams are transmitted within 40 ms. Transmission of a sub-telegram lasts approximately 0.9 ms. The delay between the three transmission bursts is affected at random.

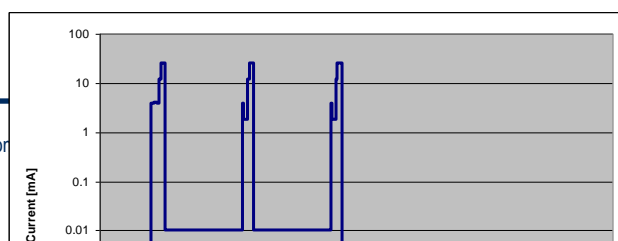


Figure: Transmission timing in Standard Mode

### 3.5.2 Secure Mode Transmission Timing

In Secure Mode the transmission cycle is reduced to 2 identical sub-telegrams that are transmitted within 20 ms. This compensates the additional energy requirement of enhanced security computing and additional payload. The transmission of a sub-telegram lasts approximately 1.2 ms.

## 3.6 Storing the Rolling Code Counter (RLC)

In Secure Mode the RLC counter needs to be stored in a non-volatile memory. For security reasons the RLC counter is incremented by every transmitted telegram. Together with the CMAC the RLC ensures that messages cannot be reproduced or forged. The RLC is stored in the chip flash memory. To improve the endurance of the flash memory and also the energy budget not every increment is saved to the non-volatile flash memory. During deep sleep the RLC is stored in RAM0 memory.

## 3.7 Energy Consumption / Battery Lifetime

The diagram in chapter 3.4 illustrates a complete cycle in standard mode which starts with controller active phase (setup, measurement etc.) immediately followed by a telegram transmit. After short sleep phase the controller will get active two times and send two telegrams.

### 3.7.1 Prerequisites for example calculation

- Internal energy storage MS412FE with usable capacity of about 0.7 mAh  
<https://www.sii.co.jp/en/me/datasheets/ms-rechargeable/ms412fe-5/>  
(voltage range 2.4 - 3 V at 25 °C)
- Solar cell ECS 200 delivers at 200 lux about 5 µA  
<https://www.enocean.com/de/enocean-module/details/ecs-300/>
- Power consumption wake-up and transmit cycle standard mode: 100 µAs
- Power consumption wake-up and transmit cycle secure mode: 140 µAs



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- 10 reed contact changes per day (e.g. 5x window open/close)
- Average leak current of STM 3xy at 25°C: 0.5 uA
- Wake-up cycle 20 - 25 min (average 1.500 s) for status telegram
- 8 h light per day (24 h) light @ 200 lux and 25°C

### 3.7.2 Example calculation of the energy consumption

- Current consumption (depending on amount of wake-ups due to reed contact change):
  - Current consumption for status telegrams and sleep:  
 $100 \text{ uAs} / 1,500 \text{ s} + 0.5 \text{ uA} = 0.57 \text{ uA}$
  - Power consumption for 10 reed contact changes incl. additional transmits per day:  
 $100 \text{ uAs} / (60 \times 60 \times 24 \text{ s}) = 1.2 \text{ nA} = 0.0012 \text{ uA}$
  - Average current consumption: 0.57 uA
- Average solar power harvested:  $5 \text{ uA} / (8 \text{ h} / 24 \text{ h}) = 1.67 \text{ uA}$
- Time to fully charge energy storage (2.4 to 3.0 V) at stable temperature:  
 $0.7 \text{ mAh} / (1.67 \text{ uA} - 0.57 \text{ uA}) = 636 \text{ h} = 27 \text{ days}$
- Average operation time in darkness when fully charged (3.0 V to 2.4 V):  
 $0.7 \text{ mAh} / 0.57 \text{ uA} = 1,228 \text{ h} = 51 \text{ day}$

#### Remarks:

- Calculation examples and values have tolerances of about +/- 20%.
- Energy storage performance, power consumption and solar cell performance varies over temperature.
- Energy storage performance degrades over lifetime, especially if energy storage is long time exposed to very high temperatures. High temperatures will accelerate aging, each 10 K increase from 25°C will half expected life time. Very low temperature will temporary reduce capacity of energy store and this leads to considerable shorter dark time operation.
- Short wake-up cycles (e.g. 1 s) and transmit intervals (e.g. 1 s) significantly reduce energy storage performance, for this use case an external power supply is recommended.

### 3.7.3 Consumption in secure mode

Enhanced security mode requires more energy due to encryption algorithm computing time and extended telegram length because of CMAC. This added consumption is compensated by reducing the sub-telegram count to 2.

### 3.7.4 Battery lifetime calculation

Battery lifetime calculation for operation in total darkness (no support by solar cell):

- Current consumption for status telegrams and sleep: 0.57 uA (=  $100 \text{ uAs} / 1,500 \text{ s} + 0.5 \text{ uA}$ , see 3.6.2)
- Average current consumption for 100 reed contact changes per day = 12.0 nA (=  $1.2 \text{ nA} \times 10$ , according to 3.6.2)
- CR1225: 48mAh according to data sheet. Assume you can discharge by 90%, 43mAh are left for use
- By that CR1225 life time =  $43 \text{ mAh} / (0.57 + 0.012) \text{ uA} = 75438 \text{ h} = 8.6 \text{ a}$
- You can assume CR1225 self-discharge reduces this number by additional 10%
- Results in lifetime of EMCSx powered by battery only: 7.8 years

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This calculation assumes constant room temperature (22°C). In order to take dynamic effects into account, the operating characteristics overview in chapter 2.2 indicate at least 5 years. Please also note, this is an energy balance calculation, early failure of batteries is not considered. In practical operation, at least some light will be available that enlarges this calculated lifetime in addition.

## **4 APPLICATION INFORMATION**

### **4.1 General Installation Instructions**

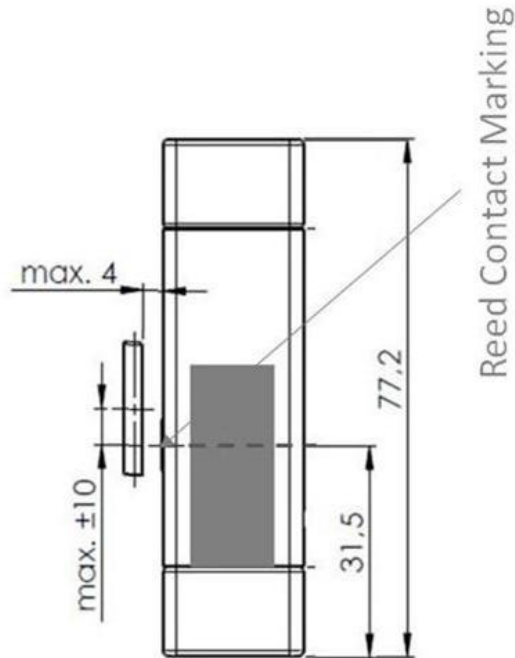
The reed contact unit and the magnet are both easily mountable at windows or doorframes made of aluminum, plastic or wood using the included adhesive pads. Mounting position of the reed contact unit is horizontal, vertically or even tilted. The reed contact housing offers protection against splashing water drops. Mounting the reed contact unit on metal surfaces or aluminum window frames will reduce the radio transmission range. This physical effect is strongest in extension of the metal surface. So if the unit is mounted on a metal surface please note that a radio receiver unit should NOT be mounted at the same window front side.

**Further important installation notes please find in the Installation Instructions provided together with the unit.**

### **4.2 Magnet Positioning**

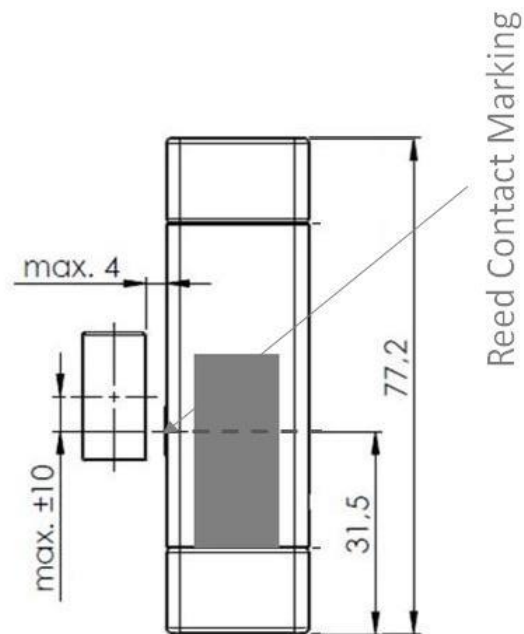
The very flat magnet can be very easily mounted onto a smooth surface using the preinstalled adhesive tape. The magnet has to be positioned by facing the housing near to the middle of the reed contact marking as follows:

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**Magnet in Righted Position  
(Typical for window mounting)**

The magnet can be positioned in vertical or in horizontal position to the reed contact housing. The distance between housing and magnet should be less than 4 mm.

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(Typical for door mounting)**

Always take care for sufficient distance of the magnet to magnetic data carriers, e.g. credit cards. Data could be erased!

## 4.3 Lighting Conditions

### 4.3.1 Minimum Illumination

- **400 lx hours per day** is the minimum illuminance over time of the solar panel that has to be ensured in order to recharge the device for night operation
- lxh (lux hours) is the multiplication value between illuminance (lux) and time (hours). This value can roughly be taken as a constant at illuminances greater than 100 lx: e.g. 100 lx illumination for 4 hours equals 200 lx for 2 hours
- The value applies to daylight, artificial light and mixed light. Define the minimum brightness and duration in worst case (averaged over the day). Check the long-term lighting conditions at the intended location of the device under the most unfavorable conditions (e.g. winter time)

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### 4.3.2 Local Lighting Conditions

- Brightness values are highly dependent on the site. Typical values for room type and placement within a room can be found in the following table and figure. **The given numbers are reference values only.** Please use an illuminometer (lux meter) to verify a particular case. Suited lux meters are available from € 25 upwards from internet shops.
- With regard to the future use of the room, the installation site should be chosen so that it cannot be shaded (eg by a curtain).
- Determine the best compromise position between the best illuminance and the location requirements of the sensor. A place that is not sufficiently illuminated during the day should be avoided or, if not possible, a CR1225 battery can be retrofitted.

Illumination Area	Type Destination / Workspace	Typical Brightness
Home	Usually	100 – 500 lx
Schools	Corridor	100 – 300 lx
	Classroom in general	300 – 750 lx
	Reading room, laboratory	500 – 1500 lx
Offices	PC room, working at PC	200 – 500 lx
	Meeting room	300 – 700 lx
	Canteen	150 – 300 lx
	Corridors	50 – 100 lx
	Reception	300 – 700 lx
Factories	Restroom	100 – 300 lx
	Production hall	500 – 1500 lx
	Development, office	300 – 750 lx
	Design CAD	500 – 1500 lx
	Laboratory, inspection work	750 – 1500 lx
	Packaging of products	150 – 500 lx
Hospitals	Storage	100 – 300 lx
	Visitor room	300 – 500 lx
	First aid, surgery	500 – 1500 lx
	Bedroom	100 – 300 lx
	Pharmacies	500 – 1000 lx
Hotels	Wash rooms	150 – 300 lx
	Reception	200 – 500 lx
	Entrance area	100 – 300 lx
	Restaurant	150 – 300 lx
	Restroom	100 – 300 lx
	Bars	50 – 150 lx
Stores	Corridors	50 – 100 lx
	Staircases	50 – 150 lx
	Saleroom	300 – 1000 lx
	Show room	500 – 1500 lx
	Packaging area	200 – 300 lx
Trade Show	Lounge	300 – 500 lx
	Conference room	300 – 700 lx
	Booth	300 – 500 lx
Sports Arena	Indoor area	200 – 500 lx

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Table: Typical Indoor Brightness Levels (Lux)

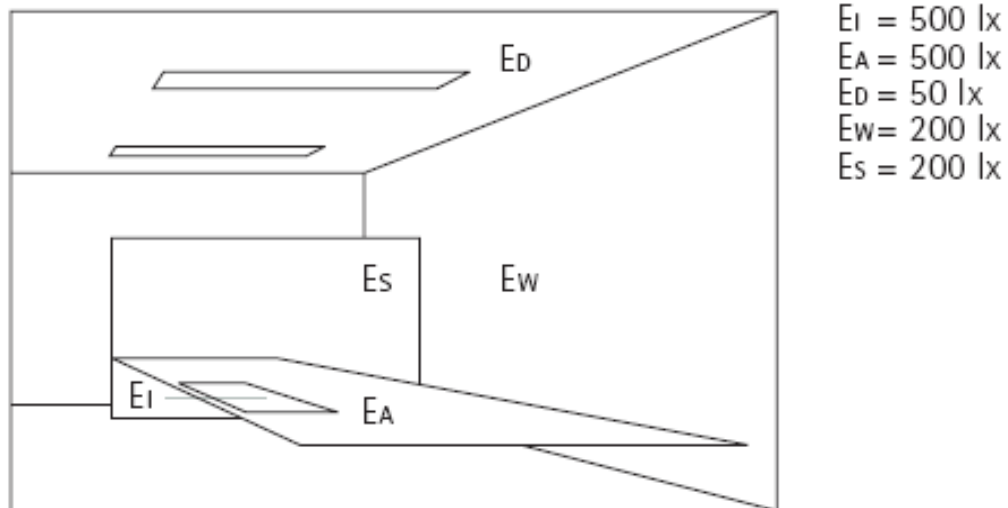


Figure: Examples of brightness levels at different spots in a typical office room (worktable  $E_A=500$  lx)

### 4.3.3 Initial Sensor Operation

To reach full performance the solar-powered energy storage must be recharged after a long storage in dark (e.g. at initial installation). This is done automatically from the beginning of operation in the light and the sensor will reach its full operating state after 3 to 4 days. Then the sensor will have enough energy to work in dark the whole weekend.

### 4.4 Installing Supplemental Battery (optional)

If the sensor is installed where the light levels are consistently too low, battery power can be used to supplement the solar energy harvester. Use CR1225 battery only.

1. Pull off the cap which rests directly at the solar cell.
2. Insert the battery with the larger positive pole (+) directed to the solar cell and slide it between the two contact terminals (see following figure).
3. Put the cap back on.

**NOTE:** It is strongly recommended to wear protective gloves while handling coin cell batteries. Failure to do so might result in the formation of a conductive layer on the battery surface due to skin moisture and a much shorter battery lifetime.

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**WARNING:** Ensure the battery is properly oriented. Improper handling of lithium batteries may result in heat generation, explosion, or fire.



Figure: Properly inserted battery

## 4.5 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 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
- 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:

- Switch mounted on metal surfaces (up to 30% loss of transmission range)



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- 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 **AN001 "EnOcean Wireless Systems - Installation Notes"** (PDF) available as download from: <https://www.enocean.com/en/application-notes/>

## **5 REGULATORY NOTES**

### **5.1 EMCSA Market Approval for European Union (CE)**

Hereby, EnOcean GmbH declares that the radio equipment EMCSA is in compliance with the essential requirements and other relevant provisions of the EU Radio Equipment Directive 2014/53/EU (RED). A copy of the Declaration of Conformity can be obtained from the product webpage. The OEM customer (B2B) is responsible for country specific local documentation.

Waste & Battery:  
WEEE-Reg-No.: DE 93770561  
UBA Reg-No.: 21008516

Since the European Union requires country specific recycling, for all other countries than Germany the OEM customer (B2B) must register at country specific recycling organizations.

### **5.2 EMCSA Market Approval for United Kingdom (UKCA)**


Till end of 2022 UK will accept EU (CE) market approval (see above). From 2023 UK will introduce its own market approval system, which is derived from the EU CE (EU directives will be UK statutory instruments, EU standards will be British standards). EnOcean will provide the UK declaration of conformity (UK DoC) document at the product website for download.

The final product package including EnOcean EMCSA must meet all necessary application specific requirement for UK conformity (e.g., building automation application, UK WEEE registration and documentation with UKCA). The OEM customer (B2B) is responsible for the final product documentation and must register at UK specific recycling organizations.

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### 5.3 EMCSU Market Approval for US (FCC)

#### FCC Certificate

<b>TCB</b>	<p><b>GRANT OF EQUIPMENT AUTHORIZATION</b></p> <p>Certification Issued Under the Authority of the Federal Communications Commission</p> <p>By:</p> <p>EMCCert Dr. Rasek GmbH Stoernhofer Berg 15 D-91364 Unterleinleiter, Germany</p>	<b>TCB</b>
<p>EnOcean GmbH Kolpingring 18a Oberhaching, 82041 Germany</p> <p>Attention: Amin Anders , Director Product Marketing</p>	<p>Date of Grant: 06/20/2013 Application Dated: 06/20/2013</p>	
<p><b>NOT TRANSFERABLE</b></p> <p>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.</p>		
<p>FCC IDENTIFIER: SZV-STM320U</p> <p>Name of Grantee: EnOcean GmbH</p> <p>Equipment Class: Part 15 Security/Remote Control Transmitter</p> <p>Notes: 902.875 MHz transmitter</p>		
<u>Grant Notes</u>	<u>FCC Rule Parts</u>	<u>Frequency Range (MHZ)</u>
	15.231	902.875 - 902.875
		<u>Output Watts</u>
		<u>Frequency Tolerance</u>
		<u>Emission Designator</u>
		

#### FCC Regulatory Statement

The EMCSU 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

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**ENOCEAN MAGNET CONTACT SENSOR**

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(2) this device must accept any interference received, including interference that may cause undesired operation

**FCC Usage Conditions**

STM 320U is a RF module approved for Single Modular use. It is incorporated into EMCSU as OEM installation using an approved antenna.

The module is optimized to operate using small amounts of energy, and may be powered by a battery. The module transmits short radio packets comprised of control signals, (in some cases the control signal may be accompanied with data) such as those used with alarm systems, door openers, remote switches, and the like.

The module does not support continuous streaming of voice, video, or any other forms of streaming data; it sends only short packets containing control signals and possibly data. The module is designed to comply with, has been tested according to 15.231(a-c), and has been found to comply with each requirement.

Thus, EMCSU containing the STM 320U radio module can be operated in the United States without additional Part 15 FCC approval (approval(s) for unintentional radiators may be required for the OEM's finished product), under EnOcean's FCC ID number if the OEM requirements are met.

**FCC OEM Requirements**

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

- 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:

*Contains FCC ID: SZV-STM320U*

*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.*

- The FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

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

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**5.4 EMCSU Market Approval for CA (ISED)**

**ISED Certificate**



FCB under the Canada-EC MRA  
TCB under the USA-EC MRA  
RFCAB under the Japan-EC MRA  
Notified Body R&TTE Directive 99/5/EC  
Notified Body EMC Directive 2004/108/EC

No. ► CA001350D

**TECHNICAL ACCEPTANCE  
CERTIFICATE  
CANADA**

**CERTIFICAT D'ACCEPTABILITÉ  
TECHNIQUE  
CANADA**

CERTIFICATION No. ► 5713A-STM320U  
No. DE CERTIFICATION  
ISSUED TO ► EnOcean GmbH  
DÉLIVRÉ A  
Street Address ► Kolpingring 18 a  
Numéro et rue  
Province or State ► Germany  
Province ou État

City ► Oberhaching  
Ville  
Postal Code ► 82041  
Code postal

TYPE OF EQUIPMENT ► Remote Control Device  
GENRE DE MATÉRIEL  
FREQUENCY RANGE ► 902.88 - 902.88 MHz  
BANDE DE FRÉQUENCES  
R.F. POWER ► 66.58 dBµV/m @ 3m  
PUISSANCE H.F.  
SPECIFICATION ► RSS-210  
SPÉCIFICATION

TRADE NAME & MODEL ► Transmitter Module STM 320U  
MARQUE ET MODELE  
EMISSION TYPE ► 322K1F1DAN  
GENRE D'ÉMISSION  
ANTENNA ► Integrated  
ANTENNE Incorporé  
ISSUE ► 11 December 2010  
ÉDITION 8

TEST LABORATORY ► EMCCons DR. RAŠEK GmbH &  
LABORATOIRE D'ESSAI Co. KG  
Street Address ► Moggast, Boelwiese 8  
Numéro et rue  
Province or State ► Germany  
Province ou État  
Name ► Karlheinz Kraft  
Nom  
E-mail ► k.kraft@emcc.de

CN 3464C OATS 3461C-1  
City ► Ebermannstadt  
Ville  
Postal Code ► 91320  
Code postal  
Tel 0049 9194 9016  
Fax 0049 9194 8125

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 Industry Canada 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 Industry Canada. 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 Industry Canada.

La certification du matériel signifie seulement que le matériel a satisfait aux exigences de la norme indiquée ci-dessus. Les demandes de licences nécessaires pour l'utilisation du matériel certifié sont traitées en conséquence par le bureau de délivrance d'Industrie Canada et dépendent des conditions radio ambiantes, du service et de l'emplacement d'exploitation. Le présent certificat est délivré à la condition que le titulaire satisfasse et continue de satisfaire aux exigences et aux procédures d'Industrie Canada. Le matériel à l'égard duquel le présent certificat est délivré ne doit pas être fabriqué, importé, distribué, loué, mis en vente ou vendu à moins d'être conforme aux procédures et aux spécifications techniques applicables publiées par Industrie Canada.

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

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

DATE 21 June 2013

Certification Officer

EMCCert DR. RAŠEK GmbH • Stoernhofer Berg 15, 91364 Unterleinleiter, Germany  
Tel.: +49 9194 72279-01 • Fax: +49 9194 72279-06 • E-mail: emcc.cert@emcc.de • Web: www.emcc.de

**ISED Regulatory Statement**

The EMCSU device contains the EnOcean module STM 320U that 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.

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."


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**5.5 EMCSJ Market Approval for United Japan (ARIB)**

**ARIB Certificate**

**認 証 書**

認証を受けた者	ローム株式会社
特定無線設備の種別	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
電波の型式、 周波数及び 空中線電力	F1D 928.35MHz 0.001W
型式又は名称	STM429J、STM425J 又は STM420J
販売業者	ローム株式会社
認証番号	003-130160
認証をした年月日	2020年2月19日
備考	No.20-0376 920MHz / テレコントロール、テレメーター、データ伝送用 P131169

 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。

2020年2月19日

株式会社ディーエスピーリサーチ



**Regulatory Statement**

The EMCSJ device contains the EnOcean module STM 420J. The STM 420J module has been developed and tested to meet the approval requirements for ARIB STDT108. For sales and operation on the Japanese market, the EMCSJ device is marked with the corresponding ARIB Marking with number (003-130160).