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
REVISION HISTORY

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

<table>
<thead>
<tr>
<th>Version</th>
<th>Author</th>
<th>Reviewer</th>
<th>Date</th>
<th>Major Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>AA</td>
<td>MK</td>
<td>22.01.2018</td>
<td>Light requirement details added, housing dimensions corrected, some more minor additions</td>
</tr>
<tr>
<td>1.1</td>
<td>AA</td>
<td>AA</td>
<td>26.02.2018</td>
<td>Chapter 4.4 added (Installing Supplemental Battery)</td>
</tr>
<tr>
<td>1.2</td>
<td>AA</td>
<td>AA</td>
<td>29.05.2018</td>
<td>Additional supplied Wall Mounting Plate added (in chapters 2.1, 2.5, 2.6)</td>
</tr>
<tr>
<td>2.0</td>
<td>AA</td>
<td>AA</td>
<td>04.01.2019</td>
<td>Tray packaging added (chapter 2.4, new chapter 2.7)</td>
</tr>
<tr>
<td>2.1</td>
<td>AA</td>
<td>AA</td>
<td>01.02.2019</td>
<td>EEP number corrected in Chapter 2.2</td>
</tr>
<tr>
<td>3.1</td>
<td>AA</td>
<td>MHö</td>
<td>13.01.2019</td>
<td>EMCSJ version added (928 MHz)</td>
</tr>
</tbody>
</table>

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

© EnOcean GmbH, All Rights Reserved

Other trademarks and trade names are those of their respective owners.

**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](http://www.enocean.com).

As far as patents or other rights of third parties are concerned, liability is only assumed for modules, not for the described applications, processes and circuits. EnOcean does not assume responsibility for use of modules described and limits its liability to the replacement of modules determined to be defective due to workmanship. Devices or systems containing RF components must meet the essential requirements of the local legal authorities. The modules must not be used in any relation with equipment that supports, directly or indirectly, human health or life or with applications that can result in danger for people, animals or real value. Components of the modules are considered and should be disposed of as hazardous waste. Local government regulations are to be observed. Packing: Please use the recycling operators known to you.
# TABLE OF CONTENT

1 RELATED DOCUMENTS ........................................................................................................4  
  1.1 Installation Instructions .................................................................................................4  
  1.2 Range Planning ............................................................................................................4  
  1.3 Radio Telegram Description .......................................................................................4  
  1.4 Declaration of Conformity ............................................................................................4  
2 GENERAL INFORMATION ..................................................................................................5  
  2.1 Basic Functionality ........................................................................................................5  
  2.2 Technical Data ................................................................................................................6  
  2.3 Environmental Conditions .........................................................................................7  
  2.4 Ordering Information ....................................................................................................7  
  2.5 Physical Dimensions ....................................................................................................8  
  2.6 Packaging Information – Single Unit Packaging .........................................................9  
  2.7 Packaging Information – Tray Packaging ....................................................................10  
  2.8 Device Label ................................................................................................................11  
3 FUNCTIONAL DESCRIPTION ..........................................................................................12  
  3.1 Block Diagram ...............................................................................................................12  
  3.2 Teach-in to Receiver Unit .............................................................................................12  
  3.3 Commissioning and Mode Change ..............................................................................13  
  3.4 Radio Telegram Format, EEP ......................................................................................14  
  3.5 Energy Consumption .....................................................................................................16  
  3.7 Storing the Rolling code counter ..................................................................................17  
4 APPLICATION INFORMATION ..........................................................................................18  
  4.1 General Installation Instructions ...................................................................................18  
  4.2 Magnet Positioning .........................................................................................................18  
  4.3 Lighting Conditions ........................................................................................................19  
  4.4 Installing Supplemental Battery (optional) .................................................................21  
  4.5 Transmission Range .....................................................................................................22  
5 REGULATORY NOTES .......................................................................................................24  
  5.1 European Union (EMCSA) ............................................................................................24  
  5.2 United States (EMCSU) .................................................................................................25  
  5.3 Canada (EMCSU) ...........................................................................................................27  
  5.4 Japan (EMCSJ) ...............................................................................................................29
1 RELATED DOCUMENTS

This document describes set-up and operation of the EMCS 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/

1.3 Radio Telegram Description

EMCS 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/

If the unit is operated in Secure Mode please refer to the EnOcean security specification:

www.enocean.com/security-specification

1.4 Declaration of Conformity

The Declaration of Conformity can be found at the EnOcean EMCS product webpage.
2 GENERAL INFORMATION

This user manual specifies EMCS 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

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

Powered by a solar cell, EMCS 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 preassembled adhesive pad.

EMCS 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.

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

Key product features EMCS

- 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
## 2.2 Technical Data

<table>
<thead>
<tr>
<th><strong>On-board power supply</strong></th>
<th>Solar harvesting of indoor light (solar, incandescent, fluorescent or LED), illumination 50-100000 lux</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Auxiliary power supply</strong></td>
<td>Option for backup battery (CR1225, not included)</td>
</tr>
<tr>
<td><strong>Antenna</strong></td>
<td>Internal helix antenna</td>
</tr>
</tbody>
</table>
| **Frequency**             | EMCSA: 868.300 MHz  
EMCSU: 902.875 MHz  
EMCSU: 928.230 MHz |
| **Data rate / modulation type** | EMCSA: 125 kbps /ASK  
EMCSU: 125 kbps /FSK  
EMCSU: 125 kbps /FSK |
| **Radiated output power**  | EMCSA: max +6.4dBm (EIRP),  
EMCSU: +99 dBµV/m ± 2 dB  
EMCSJ: typ. 0dBm |
| **Sustain condition for battery free operation** | min. 400 lx hours per day  
(signs-of-life only, 25°C) |
| **Start-up time with empty energy store** | typ. <2.5min @ 400 lx, 25°C 1) |
| **Operation time in darkness** | >10 days (energy storage fully charged,  
signs-of-life only, 25°C) 2) |
| **Operation time with backup battery** | 5 years min. (total darkness) |
| **Teach-in telegram trigger** | Pushbutton behind hole in side wall |
| **Teach-in telegram indicator** | LED shining through housing side wall |
| **Sign-of-life transmission** | Contact status update once every around 20...30 minutes |
| **EnOcean module integrated** | EMCSA: STM 320  
EMCSU: STM 320U  
EMCSJ: STM 420J |
| **EnOcean Equipment Profile (EEP)** | D5-00-01,  
SIGNAL 0x0E (Entering 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!
2.3 Environmental Conditions

<table>
<thead>
<tr>
<th>Environmental Conditions</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating and storage temperature</td>
<td>Absolute maximum: -20 °C ... +60 °C</td>
</tr>
<tr>
<td></td>
<td>Recommended 1): +10 °C...+30 °C</td>
</tr>
<tr>
<td>Operating and storage humidity</td>
<td>Maximum: 0% ... 93% r.h., non-condensing</td>
</tr>
<tr>
<td></td>
<td>Recommended: &lt; 60% r.h.</td>
</tr>
<tr>
<td>Shelf life (in absolute darkness)</td>
<td>36 months after delivery in transport mode 2</td>
</tr>
</tbody>
</table>

**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 noticeably 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

<table>
<thead>
<tr>
<th>Type</th>
<th>Ordering Code</th>
<th>Frequency</th>
<th>Packaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMCSA</td>
<td>S3001-C320</td>
<td>868.300MHz</td>
<td>Single Unit Packaging (chapter 2.6)</td>
</tr>
<tr>
<td>EMCSA</td>
<td>S3001-T320</td>
<td>868.300MHz</td>
<td>Tray Packaging (chapter 2.7)</td>
</tr>
<tr>
<td>EMCSA-G</td>
<td>S3001-G320</td>
<td>868.300MHz</td>
<td>Tray Packaging (grey housing)</td>
</tr>
<tr>
<td>EMCSU</td>
<td>S3051-C320</td>
<td>902.875MHz</td>
<td>Single Unit Packaging</td>
</tr>
<tr>
<td>EMCSJ</td>
<td>S3001-T420</td>
<td>928.350MHz</td>
<td>Tray Packaging (chapter 2.7)</td>
</tr>
</tbody>
</table>
2.5 Physical Dimensions

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

EMCS Mechanical Outline (with 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

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

| Minimum order quantity (transport packaging) | 56 units |
| Dimensions of transport box (56 units) | 232 x 176 x 174 mm |
| Weight of transport box (56 units) | 2.2 kg |
2.8 Device Label

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

![Unit Label](image)

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.

![QR Code Example](image)

The QR code shown in the example figure above encodes the following string:

"30S00001234567+30PS3001-C350+2PDA01+S01123456123456"

The following table shows the interpretation of the data therein:

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

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).

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 tele-
gram 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:

![Mode Transitions Diagram](image-url)

**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
EMCS 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)

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

- 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/](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 EMCS 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

3.5 Radio Telegram Timing

The setup of the EMCS 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](image.png)

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 ap-
proximately 1.2 ms.

3.6 Energy Consumption

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.

3.6.1 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/](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
- Power consumption wake-up and transmit cycle standard mode: 100 µAs
- Power consumption wake-up and transmit cycle secure mode: 140 µAs
- 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

3.6.2 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 uAs / 1,500 s + 0.5 uA = 0.57 uA
  - Power consumption for 10 reed contact changes incl. additional transmits per day:
    100 uAs / (60 x 60 x 24 s) = 1.2 nA = 0.0012 uA
  - Average current consumption: 0.57 uA
- Average solar power harvested: 5uA / (8 h / 24 h) = 1.67 uA
- Time to fully charge energy storage (2.4 to 3.0 V) at stable temperature:
  0.7 mAh / (1.67 uA - 0.57 uA) = 636 h = 27 days
- Average operation time in darkness when fully charged (3.0 V to 2.4 V):
  0.7 mAh / 0.57 uA = 1,228 h = 51 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 life time, 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.

### 3.6.3 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 Storing the Rolling code counter
For the enhanced security features a RLC counter needs to be stored in 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 Dolphin 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.
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:
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.

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 lxh per day** is the minimum illuminance over time of the solar panel that has to 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)

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.

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

Table: Typical Indoor Brightness Levels (Lux)
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.

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

5.1.1  Declaration of conformity

Hereby, EnOcean GmbH declares that the radio equipment EMCSA 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.

5.1.2  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. Germany: WEEE-Reg-No.: DE 93770561

BATTERY Directive
This symbol below indicates that batteries must not be disposed of in the domestic waste as they contain substances which can be damaging to the environment and health. Please dispose of batteries in designated collection points. Germany: UBA Reg-No.: 21008516

Since the European Union requires country specific recycling, for all other countries than Germany the OEM customer (B2B) has to register at country specific recycling organizations.
5.2 United States (EMCSU)

5.2.1 FCC Certificate

5.2.2 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
(2) this device must accept any interference received, including interference that may cause undesired operation

5.2.3  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.

5.2.4  FCC OEM Requirements

n 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.
5.3 Canada (EMCSU)

5.3.1 ISED Certificate

Certification of equipment means only that the equipment has met the requirements of the designated specification. License applications, where applicable to use certified equipment, are acted on accordingly by the Industry Canada licensing office and will depend on the existing radio environment, service and location of operation. The certification 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. Hereby attest that the subject equipment was tested and found in compliance with the above-mentioned specification.

La certification du matériel signifie seulement que le matériel a subi 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 surveillance d'Industry Canada et dépendent des conditions de radio-émissions, du service et de la localisation d'exploitation. Le présent certificat est émis à la condition que le titulaire satisfasse et continue de satisfaire aux exigences et aux procédures des Forces canadiennes. Le matériel pour lequel ce certificat est émis ne peut être fabriqué, importé, distribué, loué, offert à la vente ou vendu à moins de s'être conforme aux procédures et aux spécifications techniques applicables édictées par Industry Canada. Faites par la présente que le matériel a fait l'objet d'essai et est conforme à l'espèce ci-dessus.
5.3.2 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.”
5.4 Japan (EMCSJ)

5.4.1 ARIB Certificate

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 STD 108. For sales and operation on the Japanese market, the EMCSJ device is marked with the corresponding ARIB Marking with number (003-130160).