

EMCS – EASYFIT MAGNET CONTACT SENSOR

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EMCS - Easyfit Magnet Contact Sensor

27.02.2019



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

**EMCS – EASYFIT MAGNET CONTACT SENSOR**


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**REVISION HISTORY**

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

Version	Author	Reviewer	Date	Major Changes
1.0	AA	MK	22.01.2018	
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	EFP number corrected in Chapter 2.2

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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 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/application-notes/](http://www.enocean.com/en/application-notes/)

#### **1.3 Radio Telegram Description**

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

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

If the unit shall be operated in High Security 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 can be found at the EnOcean EMCS product webpage.

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## 2 GENERAL DESCRIPTION

### 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 can easily be mounted to windows, door frames or at 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.

EMCS supervises an integrated reed contact and reports every status change immediately (open<>closed). In addition a sign of life signal is sent 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

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### 2.2 Technical Data

<b>On-board power supply</b>	Solar harvesting of indoor light, incandescent or fluorescent, illumination 50-100000 lux
<b>Auxiliary power supply</b>	Option for backup battery (CR1225, not included)
<b>Antenna</b>	Internal helix antenna
<b>Frequency</b>	868,300 MHz (EMCSA)
<b>Data rate / modulation type</b>	125 kbps / FSK
<b>Radiated output power</b>	Typ. +5dBm (EMCSA)
<b>Sustain condition for battery free operation</b>	min. 400 lxh per day (signs-of-life only, 25°C)
<b>Start-up time from empty energy store</b>	typ. 2.5min @ 400 lx / 4 min @ 200lx <sup>1</sup>
<b>Operation time in darkness</b>	typ. 6 days after full charge <sup>2</sup>
<b>Operation time with backup battery</b>	5 years min. (total darkness)
<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>	STM 320
<b>EnOcean Equipment Profile (EEP)</b>	D5-00-01

*Note 1:* Charge time at 25°C from empty energy store until a teach-in telegram can be sent.

*Note 2:* 6 days operation time at 25°C from a fully charged energy store sending signs-of-life only. Operation time is 3 days from a fully charged energy store if telegrams are sent on average every 6 minutes (= 10 contact events per hour).

### 2.3 Environmental Conditions

<b>Operating and storage temperature</b>	Absolute maximum: -20 °C ... +60 °C Recommended <sup>3</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 <sup>4</sup>

*Note 3:* Recommended for maximum life of energy storage capacitor

*Note 4:* After 36 months in darkness the energy storage should be recharged to keep storage performance

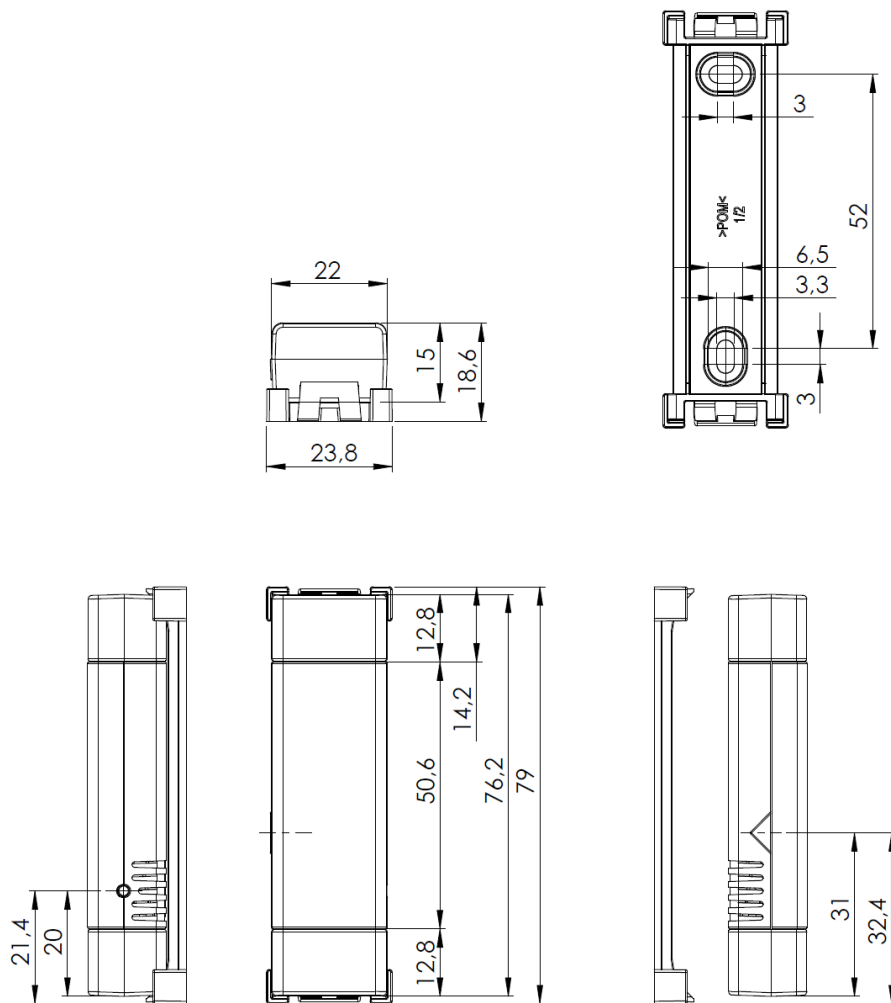
### 2.4 Ordering Information

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)

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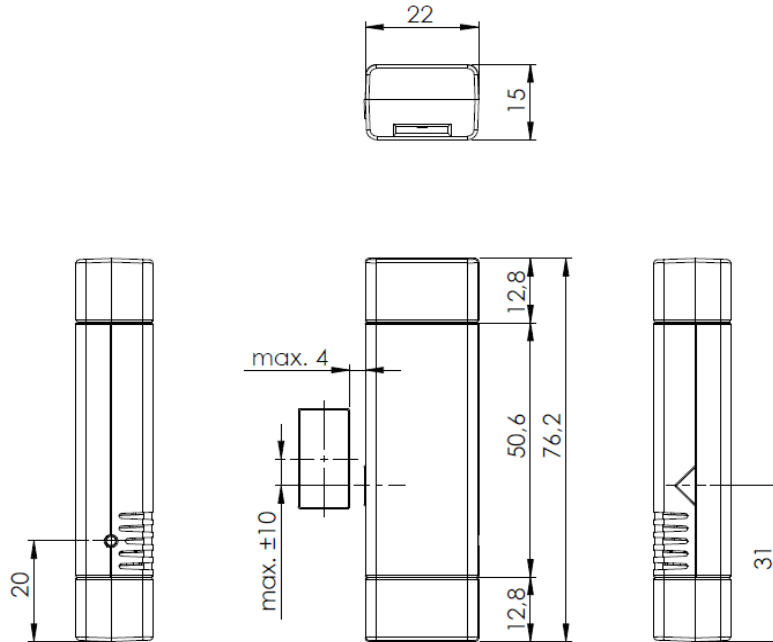
**2.5 Physical Dimensions**

<b>Colour and material of unit housing</b>	White, similar to RAL 9010, PC/ABS
<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



EMCS Mechanical Outline (with mounting plate)

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EMCS Mechanical Outline (without mounting plate)

## 2.6 Packaging Information – Single Unit Packaging

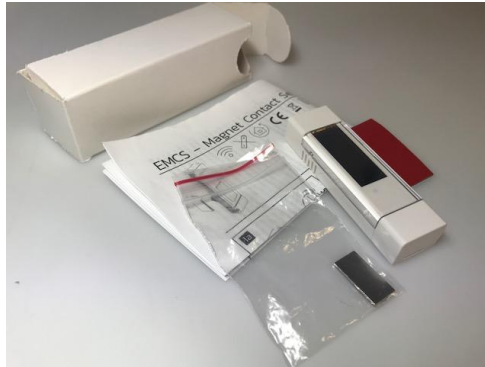
Content of single unit box:

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

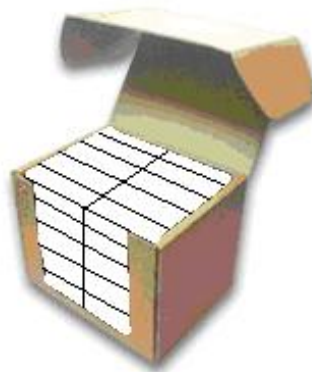
<b>Size of single unit card box</b>	32 x 32 x 99 mm
<b>Weight of single unit box</b> (housing, magnet, mounting plate, packaging)	37 g
<b>Minimum order quantity</b> (transport packaging)	50 units
<b>Dimensions of transport card box</b> (50 single unit boxes)	232 x 176 x 174 mm
<b>Weight of transport 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)

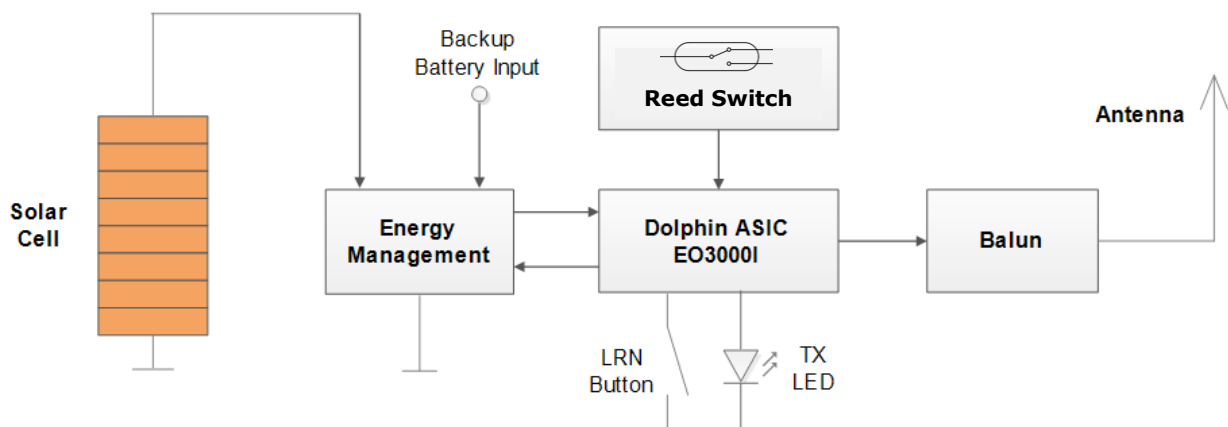
<b>Minimum order quantity</b> (transport packaging)	56 units
<b>Dimensions of transport box</b> (56 units)	232 x 176 x 174 mm
<b>Weight of transport box</b> (56 units)	2.2 kg

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### 3 FUNCTIONAL DESCRIPTION

#### 3.1 Block Diagram



#### 3.2 Radio Telegram Format, EEP

EMCS transmits a radio telegram according to EnOcean Equipment Profile EEP D5-00-01 as defined in the EnOcean Equipment Profiles specification: [www.enocean-alliance.org/eep/](http://www.enocean-alliance.org/eep/)

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.

##### 3.2.1 Standard Mode and High Security Mode

EMCS supports both standard and high security communication:

- Standard Mode – This is the common operation mode and the default by factory.
- High Security Mode – Communication is protected by enhanced security features.

In High Security Mode the unit payload content of the telegram is protected with advanced security features. Normal operation telegram payload and also Teach-in telegram payload are protected in the same way. The security features used are defined by the Security Level Format SLF: 24-bit RLC, No RLC TX, 4-byte CMAC, VAES encryption. This security features are added to the communication by encapsulating the payload and teach-in telegram pay-

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load into a high secured telegram. The payload itself is not changed and corresponds to the standard mode payload like defined by EEP D5-00-01. For further details please refer to the EnOcean Security Specification:

[www.enocean.com/security-specification](http://www.enocean.com/security-specification)

### 3.2.2 Switching between Modes

The unit can be switched from Normal Mode to High Secure Mode and vice versa by long press of the LRN Button. The behaviour of the LRN button is following:

1. Button is pressed and released within a period < 10 seconds:  
The LED flashes briefly, Teach-in is performed according to the actual mode. Actual mode is kept, no further action.
2. Button is hold for at least 10 seconds:  
The actual mode is changed (standard -> secure or secure -> standard). The LED flashes briefly. Teach-in is performed according to the actual (new) mode.
3. Button is released: No action.



**Before changing the mode, check your receiver if it can process the Enhanced Security Mode.** The Standard mode is factory delivered as this mode is the common one originally available. Secure mode was added in later product generations.



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. Therefore mode change is limited to 50 times. In normal application scenario only very few are required.

### 3.2.3 Teach-in Telegram

In standard mode an 1BS teach-in telegram is transmitted by pressing the LRN button. To process high 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](http://www.enocean.com/security-specification)

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### 3.2.4 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.

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

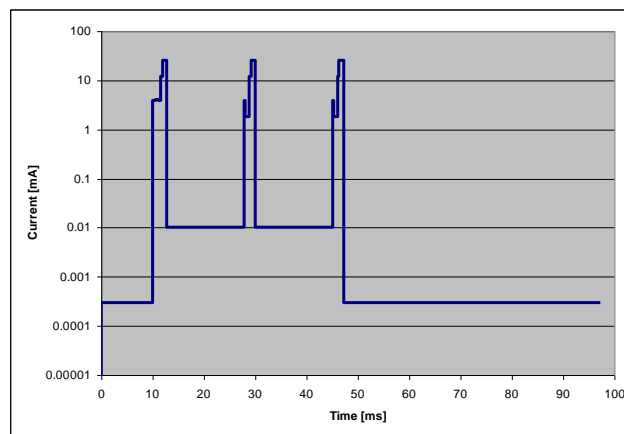


Figure: Transmission timing in Standard Mode

In High Security Mode the transmission cycle is reduced to 2 identical subtelegrams that are transmitted within 20 ms. This compensates the additional energy requirement of enhanced security computing and additional payload. The transmission of a subtelegram lasts approximately 1.2 ms.

### 3.3 Energy Consumption

Typical performance parameters in Standard Mode at room temperature:

Wake and transmit cycle [s]	Operation Time in darkness [h] when storage fully charged	Required reload time [h] at 200 lux within 24 h for continuous operation
1500	175	1.8

Accuracy is about +/-20%. The performance varies over temperature and may be strongly reduced at extreme temperatures.

High Security Mode requires more energy due to encryption algorithm computing time and extended telegram length for CMAC. This added consumption is compensated by reducing the subtelegram count from 3 to 2. With this measure the operation time in dark is not reduced by using enhanced security.

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### 3.4 Teach-in

Push the button behind the hole in the side wall to trigger a teach-in telegram. In sufficiently dark environments you will see a LED shining through the housing side wall as telegram indicator.

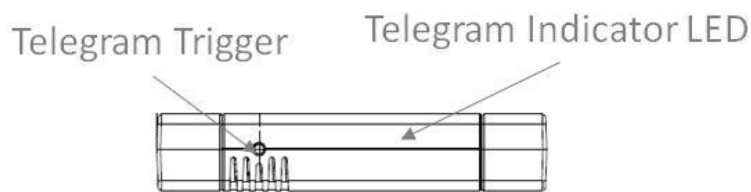


Figure: Teach-in telegram trigger

When pressing the LRN key, the module sends a teach-in telegram to a suited receiver according to the currently selected communication mode (4BS teach-in telegram for standard mode, secure teach-in telegram for high security 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.

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## 4 Application Information

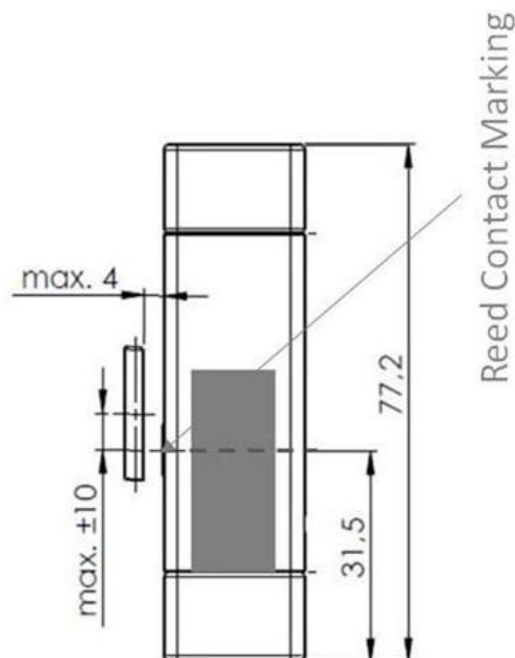
### 4.1 General Installation Instructions

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

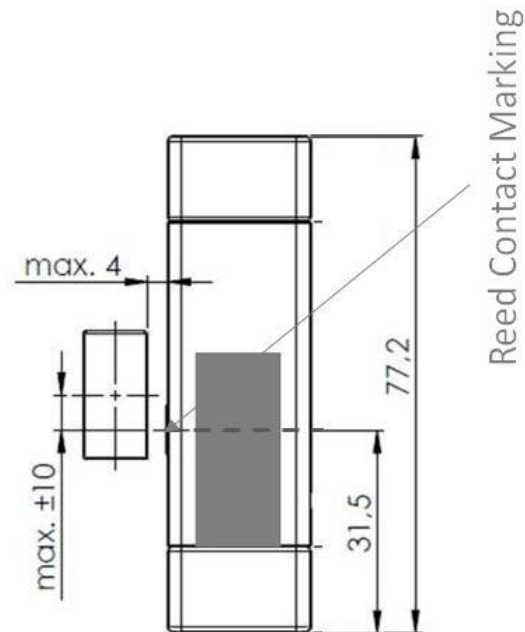
The very flat magnet can be very easily mounted onto a smooth surface using the pre-installed adhesive tape. The magnet has to be positioned by facing the housing near to the middle of the reed contact marking as follows:



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

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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.



**Magnet in Planar Position  
(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 lxh 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
	Restroom	100 – 300 lx
Factories	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
	Corridors	50 – 100 lx
Stores	Staircases	50 – 150 lx
	Saleroom	300 – 1000 lx
	Show room	500 – 1500 lx
	Packaging area	200 – 300 lx
	Lounge	300 – 500 lx
Trade Show	Conference room	300 – 700 lx
	Booth	300 – 500 lx



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Sports Arena	Indoor area	200 – 500 lx
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Table: Typical Indoor Brightness Levels (Lux)

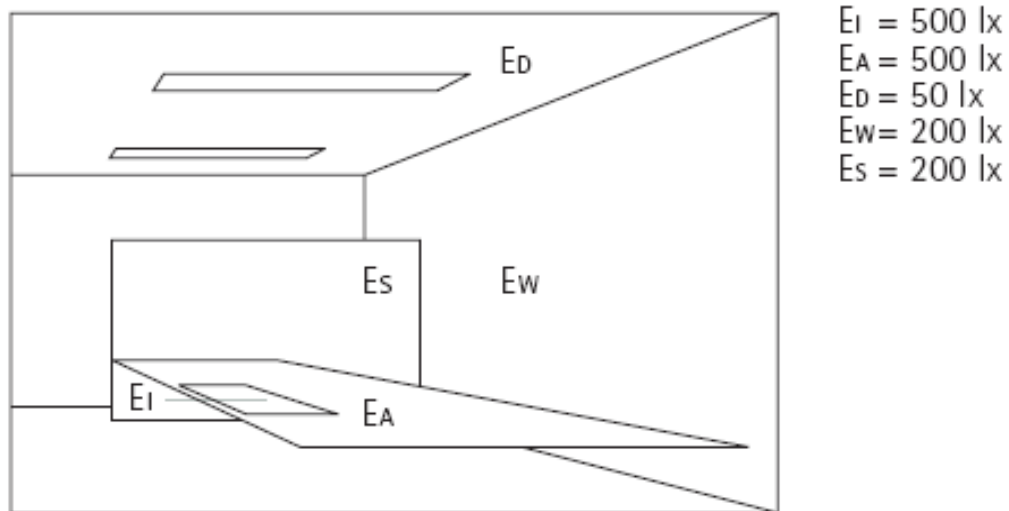


Figure: Examples of brightness levels at different spots in a typical office room (worktable EA=500 lx)

### 4.3.3 Initial Sensor Operation

To reach full performance the solar-powered energy storage must be recharged after a long storage in dark (eg 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 bat-

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teries. 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.

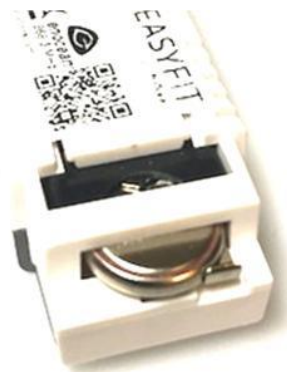


Figure: Properly inserted battery

### 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/>

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### 5 Agency Information

EMCSA has been developed and tested to fulfil all requirements for the European Market including RED, REACH and RoHS.

#### 5.1 Radio Equipment Directive (RED) for the European Union

The EMCSA unit is compliant to the Radio Equipment Directive RED (2014/53/EU) as regulatory framework for radio products in the European Union. RED conformity has been proven and the according documentation has been deposited at EnOcean. The unit can be operated without notification and free of charge in the area of the European Union and in Switzerland.



- Units must not be modified or used outside their specification limits.
- Units must not be used with gain antennas, since this may result in allowed ERP or spurious emission levels being exceeded.
- The unit itself meets the essential requirement of the EU directives. A CE marking is affixed on the ETHS unit and on the packaging each. This operating instructions containing a Declaration of Conformity.
- The transmitter is used according to the regulations of the 868.3 MHz band, a so-called "Duty Cycle" of 1% per hour is not be exceeded.

#### 5.2 Declaration of Conformity

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