

## RELIABLE COVERAGE PLANNING

Compared to installing wired systems, wireless systems provide much simpler installation as well as the flexibility to relocate or add to a system. Based on the physical principle of the propagation of radio waves, certain basic conditions should be observed. The following simple recommendations are provided to ensure successful installation and reliable operation of a robust radio network.

By Armin Anders, co-founder and head of product marketing, EnOcean GmbH

### BASIC PRINCIPLES OF RADIO SIGNALS IN BUILDINGS

An EnOcean radio transmitter sends wireless transmissions to an EnOcean radio receiver. The receiver checks the incoming telegrams for accuracy and uses the data to control outputs. Radio signals are electromagnetic waves, hence the signal becomes weaker the further it travels. Remember that coverage is decreased by specific materials found in the direction of the propagation. While radio waves can penetrate a wall, they are dampened more than on a direct line-of-sight path. Examples of different types of wall:

MATERIAL	ATTENUATION
Wood, plaster, glass uncoated, without metal	0 to 10%
Brick, press board	5 to 35%
Ferroconcrete	10 to 90%
Metal, aluminium lining	90 to 100%

In practice, this means that the materials used in buildings play an important role in assessing the radio coverage. Here are some typical guideline figures:

**LINE-OF-SIGHT CONNECTIONS:**  
typ. 30 m range in corridors, up to 100 m in halls

**PLASTERBOARD WALLS / DRY WOOD:**  
typ. 30 m range, through 5 walls

**BRICK WALLS / AERATED CONCRETE:**  
typ. 20 m range, through 3 walls

**FERROCONCRETE WALLS / CEILINGS:**  
typ. 10 m range, through 1 ceiling

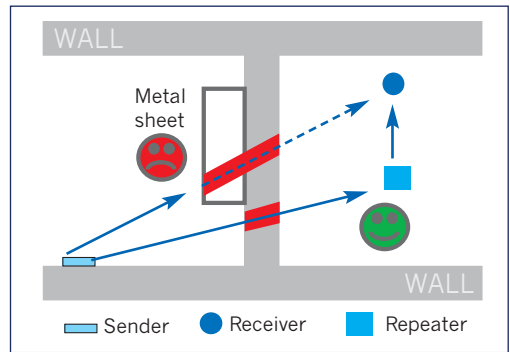
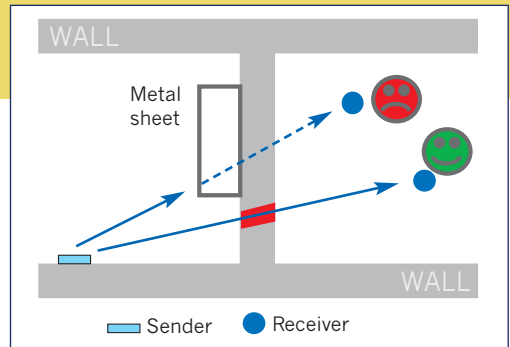
### SCREENING

Objects made of metal, such as wall reinforcements, the metal foil of heat insulations or metallised heat protection glass, reflect electromagnetic waves and thus create what is known as radio shadow.

The main factors decreasing coverage include:

- **Switch mounted on metal surfaces** (typically 30% loss of range)
- **Use of metallic switch frames** (typically 30% loss of range)
- **Hollow lightweight walls filled with insulating wool on metal foil**
- **Inserted ceilings with panels made of metal or carbon fibre**
- **Lead glass or glass with metal coating, steel furniture**

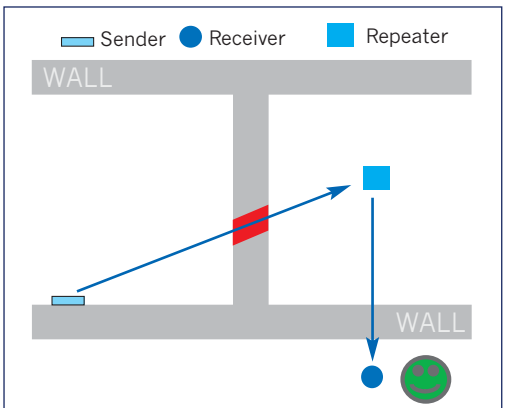
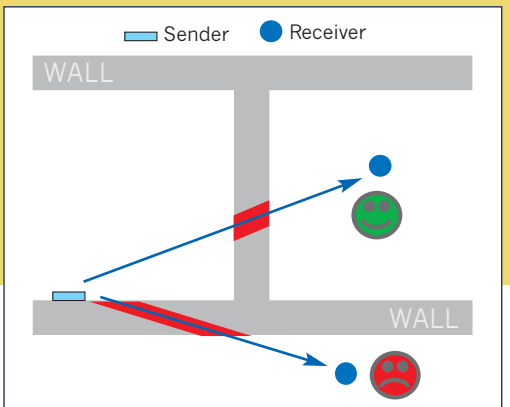
**TIP 1**  
Fire-safety walls, elevator shafts, staircases and supply areas should be considered as screening.



**TIP 2**  
Avoid screening by repositioning the transmitting and/or receiving antenna away from the radio shadow, or by using a repeater.

### PENETRATION ANGLE

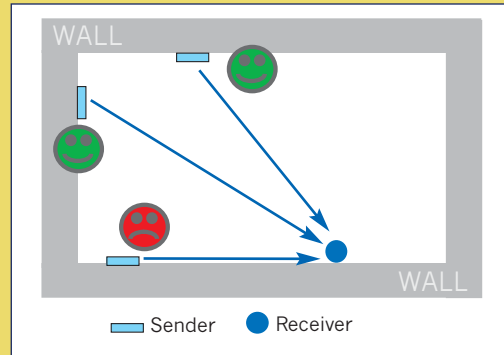
The angle at which the transmitted signal hits the wall is very important. The effective wall thickness – and with it the signal attenuation – varies according to this angle. Signals should be transmitted as directly as possible through the wall. Wall niches should be avoided.



**TIP 3**  
Avoid an unfavourable penetration angle by repositioning the transmitting and/or receiving antenna, or by using a repeater.

### ANTENNA INSTALLATION

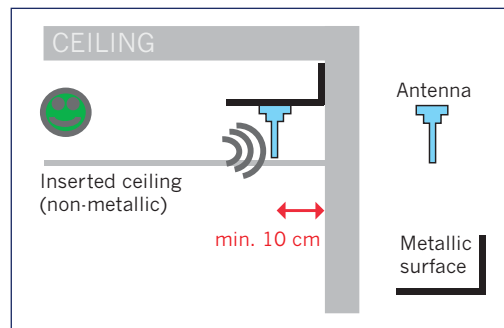
When using devices with an internal receiving antenna, the device should not be installed on the same side of the wall as the transmitter. Near a wall, the radio waves are likely to be subject to interfering dispersions or reflections. Consequently, position the antenna on the opposite or connecting wall.



**TIP 4**  
Avoid radio propagation along a wall.

When using devices with an external antenna, the antenna should be mounted in a central location in the room. Where possible, the antenna should be at least 10 cm away from the wall or concrete ceiling .

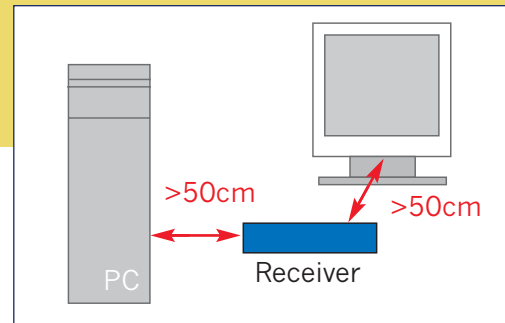
A magnetic antenna needs to be placed on a large metallic surface to create an adequate antipole. Due to the polarisation of the radio waves, a magnetic base antenna should be placed vertically. Flexing the antenna cable during installation can result in irreparable damage (performance reduction through change of impedance level).



**TIP 5**  
A so-called "active antenna" is a radio receiver with integrated antenna. It communicates with the actuator unit via a RS485 cable for example ("RS485 gateway"). Thus the antenna cable, which would loose performance with increasing length and could be folded during installation, can be avoided.

**DISTANCE BETWEEN RECEIVER AND SOURCES OF INTERFERENCE**

The distance between EnOcean receivers and other transmitters (e.g. GSM / DECT / wireless LAN) or high-frequency sources of interference (computers, audio and video equipment) should be at least 50 cm. However, EnOcean transmitters can be installed next to any other high-frequency transmitter without any problem.



**TIP 6**  
The distance of the EnOcean receiver to different high-frequency transmitters should be at least 50cm, the transmitter position is not critical.

**USE OF REPEATERS**

In case of poor reception it may be helpful to use a repeater. EnOcean repeaters do not require any configuration (e.g. programming) and are put into operation simply by connecting them to the supply voltage. The various possibilities of use are shown by the illustrations in the chapters "Screening" and "Penetration".

**TIP 7**  
While planning, it may be worth considering retrofitting the system with a repeater.

In their basic function, EnOcean repeaters cannot be cascaded, telegrams already repeated are not repeated again ("1-level" repeater). Repeaters which can be switched to 2-level function are currently in preparation. This extended function will allow two repeaters to be cascaded which is required only in rare cases in the building industry.

**TIP 8**  
Do not use too many repeaters as this is counter-productive (higher costs, telegram collisions).

**FIELD INTENSITY METER**

The EPM 100 is a mobile field intensity meter enabling the installer to determine the ideal mounting positions for sensors and receivers. Furthermore, faulty connections of devices already



**TIP 9**  
The EPM 100 field intensity meter can be used for on-site determination of the ideal mounting position and for identification of an interfering transmitter.

**TIP 10**  
Even after careful planning, the EPM 100 should be used to verify proper reception at the receiver position during installation.

installed can be checked. The meter shows the field intensities of radio telegrams received and any interfering radio signals in the 868MHz range:

The flashing of one of the two GREEN light emitting diodes signals that the receiving field strength possesses sufficient power reserve for a reliable installation. There will be generous provision for subsequently changing conditions of the surroundings (i.e. additional screening caused by lightweight walls, shadowing by people etc.). For differentiation from a jammer the YELLOW light emitting diode simultaneously signals a valid EnOcean telegram. For further information, refer to the operating instructions provided with the EPM 100.

How to use the field intensity meter:  
Person 1 operates the radio sensor and generates radio telegrams by pressing the button. Person 2 checks the field intensity received on the display of the device and thus determines the ideal position.

**PLANNING INFORMATION FOR COMMERCIAL BUILDINGS**

The radio coverage in commercial buildings is usually restricted by fire safety walls, which must be considered as screening. Inside the fire protected sections lightweight or glass partition walls are used with excellent radio wave propagation properties (except for metal reinforcements or metallised walls). Here are two common installation architectures:

**Automation system (e.g. TCP/IP, LON, EIB):**  
For complete coverage, each fire safety section usually requires 1 or 2 central radio gateways to the automation bus.

**Direct activation of the actuators:**  
Usually, the radio paths to be covered are not very long ("cubicle installation") .

Unfavourable conditions can be improved by appropriately repositioning the devices (antennae) or by using a repeater.



Field intensity test set EPM 100

Download:  
Further information regarding commercial and residential buildings as well as troubleshooting can be downloaded from our website: [www.enocean.com](http://www.enocean.com) (see products/kits and accessories)