

## 902 MHz – Next Generation Energy Harvesting Wireless Communication for North America

**902 MHz is the optimal license-free frequency for energy harvesting wireless technology in North America. It meets legal regulatory requirements and is well situated for growth in wireless devices over the coming years. The sub 1 GHz frequency band offers reliable, longer indoor range wireless communication for numerous battery-less applications in building, home and industrial automation.**

### Radio Technology

Radio technology is a core building block of energy harvesting wireless solutions. For wireless sensor devices, the two main tasks in active state are to measure an external quantity and to wirelessly transmit information about its value. Both tasks need to be optimized for minimal power consumption. Specifically, for the case of wireless transmission, this means that the chosen protocol must be as efficient as possible. This requires an ultra-low power radio communication standard that offers long distance coverage in buildings, robust performance and minimal interference from or to other wireless networks. At the same time, OEMs request battery-less modules that are easy to integrate into their products and enable small product enclosures.

For the North American market, EnOcean has identified 902 MHz as the optimal frequency band to meet all of these requirements. The 902 MHz is license-free and in the range of the less utilized sub 1 GHz frequency band which provides reliable and high transmission range while offering fast system response and minimizing data collisions that occur often in high traffic frequency bands. 902 MHz provides an efficient combination of transmission range and ultra-low energy and therefore is most suitable for building and home automation networks, taking advantage of energy harvesting nodes. In comparison to high-power devices, the ultra-low power radio allows using the very bottom of the 902 MHz frequency band, meeting regulatory requirements. This is another unique advantage of this technology. The EnOcean protocol in 902 MHz is based on the international standard ISO/IEC 14543-3-11.

### Robust Performance

Fast, reliable transmission protocols are vital together with aggressive power schemes to meet the requirements of a robust energy harvesting wireless system. EnOcean telegrams are a millisecond in duration and are transmitted at a data rate of 125 kbs. A single telegram only requires 50  $\mu$ Ws of energy; flexibility allows the transmitted power to be up to 10 mW. The short telegram is randomly repeated at least twice in the space of 40 milliseconds to ensure reliability during transmission. This eliminates the probability of collisions and allows fast system response.

The 902 MHz modules use Frequency Shift Keying (FSK) technology. This method of transmitting wireless signals changes the frequency of data transmission without altering the power of the transmitted signal. It makes the wireless communication especially robust

against interference and provides a higher radio frequency link budget. As a result, 902 MHz battery-less communication achieves enhanced range and increased receiver sensitivity in parallel.

In addition, all 902 MHz modules use the EnOcean Serial Protocol 3.0 (ESP3). This advanced protocol defines the serial communication between a host and the EnOcean modules. It transmits the received radio signal strength and the number of the received sub telegrams. Furthermore, the protocol offers improved data security, reliable packet detection on the serial byte stream and a high baud rate.

The frequency band of 902 MHz comes with another benefit: it is not impacted by “near-field” emitted interference from co-located devices such as lighting ballasts, LED drivers or microprocessors. This also includes the so called “man-made noise” which decays at 500 MHz or higher. In addition, the 902 MHz frequency avoids highly crowded bands, such as the 2.4 GHz ISM band, which is used by Wi-Fi or Bluetooth devices, for example. These characteristics build the basis for an effective, robust wireless platform.

### 902 MHz Module Portfolio



The 902 MHz modules are based upon EnOcean’s reliable platform which enables self-powered wireless switches and sensors, as well as full wireless networks with receivers and transceivers to enable building, home and industrial automation.

The portfolio includes switch modules for very slim wall mountable rocker switches or remote controls, programmable bidirectional transceiver modules for operation and control units such as bidirectional temperature sensors, sensors in building automation and innovative relay controllers.

### Longer, Building-wide Range

The robust performance is combined with building-wide range communication. Radio waves at 902 MHz provide an excellent penetration through obstructions like walls and furniture, reaching twice the range of 2.4 GHz signals at equivalent power transmission, for example. As a consequence, a 902 MHz system requires about four times less receiver nodes area-wide. This significantly reduces labor and material costs and simplifies system planning and implementation. The range of battery-less wireless sensors at 902 MHz is about 1000 feet (300 meters) in an open field and up to 100 feet (30 meters) inside buildings. This good signal propagation at an efficient use of energy is ideally suited for communication within buildings. For precise range planning, please use the [EnOcean Range Planning Guide](#).

## Easy Design-in

902 MHz modules use simple wire antennas to conserve cost, while the short antenna length allows for integration into very small product enclosures. That way, OEMs can align with modern design demands and implement smaller form factors. At the same time, this increases the possible range of battery-less end products for the building automation sector, for smart home solutions or health care products, such as portable emergency buttons. Product developments benefit from the robust performance of the 902 MHz frequency band and an easy design-in process based on EnOcean's broad module offering and excellent development tools.

## Strength of Interoperability

The companies utilizing EnOcean technology drive innovative solutions both within lighting control and HVAC. Collectively the EnOcean ecosystem continues to push the limits of wireless technology by proving that automation devices can operate efficiently and effectively even without the need for batteries.

Interoperability of different end-products based on energy harvesting wireless technology has been an important success factor for the technology's establishment on the market. For this reason, the EnOcean Alliance has formalized standardized application profiles (EnOcean Equipment Profiles) that ensure that solutions from different vendors can communicate with each other in a system. This approach of seamless networking also applies to the next generation 902 MHz products and all other frequencies.

**Batteryless wireless Light sensor** automatically matches lighting to daylight  
STM 3xyU

**Room Controller/ Gateway/ BMS**  
TCM 320U

**Batteryless wireless Occupancy sensor** adjusts temperature and turns off lights when a room is not in use  
STM 300U EOSC

**Batteryless wireless Switches** control lighting and shading  
PTM 210U EDRP

**Wireless Plug-in switch module** to control lighting and consumer appliances  
EPSM TCM 300U

**Batteryless wireless Position sensors** setback HVAC when windows or balcony doors are left opened  
STM 320U EDWS

**Batteryless wireless Room temperature sensor** for minimal energy consumption and maximum comfort  
STM 3xyU

**BENEFITS FOR PRODUCT MANUFACTURERS**

- Maintenance-free sensor solutions
- Easy to integrate
- Faster time-to-market
- Interoperability of end-products

## Market Penetration Building Automation and LED Lighting

With its ultra low energy consumption, comprehensive application level features, and simple antenna integration, EnOcean 902 MHz modules are the ideal basis for energy harvesting wireless devices. The 902 MHz frequency was selected and tested with many commercial control applications in mind, such as occupancy control, daylight harvesting, HVAC and LED lighting control. Based on this next generation of battery-less technology for integrated wireless building automation systems in North America, building automation industry leaders such as Acuity, Distech Controls, Hubbell, Leviton and WattStopper have introduced a range of new self-powered products to the US market.

The self-powered technology significantly eases energy monitoring and control in buildings with only little invasion into the existing systems. The wireless devices offer highly flexible installation so that individual components, wall switches, sensors and relay receivers can be easily networked to form an intelligent system without complex and costly cabling. Due to these characteristics, the standardized battery-less technology is ideally suited for zone level communication in automation applications, reliably providing the needed data from each measurement point for an optimized control and a comfortable user experience.

Based on EnOcean technology, an intelligent system can be realized by interconnecting kinetic-powered switches, occupancy sensors, light sensors, automated thermostats, window contacts, humidity sensors, and CO<sub>2</sub> sensors. These are just a few examples of the 902 MHz products in place, to regulate climate control and lighting automatically. In addition, there are many comprehensive gateway solutions on the market that link EnOcean-based self-powered solutions to other established standards such as TCP/IP, BACnet or LON.

A new push for self-powered sensors and switches is expected from the new trend of LED lighting applications including daylight harvesting. Day-lighting is required by an increasing number of industry standards such as ASHRAE 90.1-2010 or governmental energy code requirements such as Title 24 in California, and will strongly impact retrofit and new installations. With a modern lighting control system, it is possible to save about 20 to 30 per cent of energy in a typical building.

## Network of Multiple Benefits

Using high-performance, low-power 902 MHz battery-less devices, building owners benefit from reliable operation, lowest installation and operational cost and highly flexible system design. Due to the solutions' interoperability and the seamless connectivity to other communication standards, users can ideally address today's requirements for an intelligently controlled building; being a system that synchronizes HVAC, lighting, occupancy control etc. to an integrated solution combining energy-efficiency, comfort and security.

## About EnOcean

EnOcean is the originator of patented energy harvesting wireless technology. Headquartered in Oberhaching, near Munich, the company manufactures and markets energy harvesting wireless modules for use in building, smart home and industrial applications as well as in further application fields such as the Internet of Things. EnOcean technology combines miniaturized energy converters with ultra-low-power electronics and robust RF communication. For more than 10 years, leading product manufacturers have chosen wireless modules from EnOcean to enable their system ideas. EnOcean is a promoter of the EnOcean Alliance, a consortium of companies from the world's building sector that has set itself the aim of creating innovative solutions for sustainable buildings. Self-powered wireless technology from EnOcean has been successfully deployed in several hundreds of thousands buildings worldwide. [www.enocean.com](http://www.enocean.com)