RF SAFETY AND HONEYWELL'S SMART GRID TECHNOLOGY

A Honeywell Whitepaper

There has been some concern in the industry, especially on the part of energy consumers, over the potential health impact of smart meter radio communications. This document will assist Honeywell's EnergyAxis® and SynergyNet™ customers in understanding matters related to radio frequency (RF) safety and the smart meter endpoints — the REX family of meters, the A3 ALPHA® meters, and the ALPHA® A4 meters for residential and commercial and industrial applications — these svstems use.

Typical values based on FCC 47CFR1.1310, which averages exposure over 30 minutes of usage. Comparative data for Honeywell Smart Meters provided by Honeywell.

OVERVIEW

The use of RF in consumer-facing products has increased considerably over the past decade, and continues to increase. Prominent examples of this are the prolific use of cellular phones, wireless routers and even microwave ovens. A lack of education on smart metering technology has led to rising public concern over their use and associated health risks.

Although smart meters utilize RF technology, they represent significantly lower RF exposure for consumers than nearly all other products, such as cellular phones, which we use daily without concern.

The bottom line is that smart meters represent no known health hazards and have significantly lower exposure levels than most other typical devices that emit radio waves. Two additional contributing factors to the negligible RF exposure from smart meters follow:

- The distance consumers are typically from smart meters
- The minimized transmission time of smart meter radios

Honeywell's smart meters and modules operate on the low-power end of the cellular RF spectrum and achieve equivalent performance with a much lower power than most other smart meter designs. This is an intentional characteristic of the Honeywell design to avoid potential equipment interference and to lower the technical losses on utility distribution grids, while also lowering RF emissions.

For example, a typical Honeywell electric smart meter transmits (that is, emits power) with an approximate duty cycle of only 1% (i.e., the radio is only in use 1% of the time). In addition, these meters are normally outdoors, with a wall and a metal socket separating the meter from the living space. Similarly, a gas module will be mounted outdoors on the gas meter. This significantly diminishes the signal that reaches occupants of the living space.

CONCLUSION

Honeywell smart meters have significantly lower RF emissions compared to many commonly used consumer devices like cell phones, WIFI access points, and cordless phones.

POWER LEVELS AND DENSITY

All electronic devices have some RF emissions. The measure of the strength of these signals is the power density, which is the amount of RF power (measured in milliwatts, mW) hitting a particular surface area (measured in square centimeters, cm^2). The power density of a signal can be calculated using the output power level (for example, 250 mW), and the distance from the transmitter. Higher power density numbers equate to stronger signals, a closer proximity to the signal, or a combination of these two factors.

Calculate the power density using the following formula:

Power density = $(TxPwr \cdot AntGain) / (4 \cdot \pi \cdot Distance^2)$ mW/cm^2 where:

TxPwr = The radio frequency transmit power input to the antenna (in milliwatts)
AntGain = The power gain of the antenna (unit less)

π = 3.1417 (unit less)

Distance = Distance from the transmitter (in centimeters)

Honeywell smart meters use two primary types of radios, ones that operate in the 900-MHz ISM band using Frequency Hopping Spread Spectrum (FHSS) technology and they have a maximum transmit power (TxPwr) of 250 mW (EnergyAxis) and 1000 mW (SynergyNet), and Cellular Radios operating in the bands allotted by the FCC for LTE-M communications. The radiation pattern of a device depends on the antenna and on surrounding objects. When installed in an electrical socket, the energy radiated backwards through the socket into the home would be significantly less due to the metal socket and wall of the home or building. When mounted on the front of your gas meter, the metal body of the meter also acts to diffuse the radiated energy between the radio and your home.

The metal socket reduces the energy transmitted into the residence but redirects the energy out the front of the meter. As measured as part of the FCC certification process, the maximum antenna gain for a meter in a metal socket was 5.64 dBi, which equates to a gain of 3.66. For calculation purposes, we will use a distance of two feet (61 cm), the approximate distance of a person reading the meter. However, typically, the distance between an electric meter and a person would be far greater than two feet.

Using the numbers in the previous paragraph, we can calculate a worst-case theoretical power density for our 250-mW smart meter.

Power density = $(250 \cdot 3.66) / (4 \cdot \pi \cdot (61)2) = 0.02$ mW/cm²

More typical numbers, especially for someone in the residence of the meter in question, would be an antenna gain of 0.5 and a distance of more than 10 feet. Using these numbers, a more realistic power density value would be:

Power density = $(250 \cdot 0.5) / (4 \cdot \pi \cdot (304.8)^\wedge 2) = 0.00011$ mW/cm²

Similarly, a worst-case and realistic power density value for our cellular radios, as installed in the NXCM Gas modules, might be:

Power density = $(5 \cdot 1.28) / (4 \cdot \pi \cdot (200)2) = 0.000013$ mW/cm²

It is helpful to compare this typical power density of a smart meter to other types of devices that we commonly use, like a personal cell phone. Comparisons to other commonly used devices are included further down for reference as well.

DEVICE	POWER DENSITY (AT TYPICAL DISTANCE) (MW / CM²)	EXPOSURE TIMES (TYPICAL)	TYPICAL DISTANCE (WHEN IN USE)
Personal cell phone	48	Continuous, when in use	1 cm
Cordless phone (handset)	1.6	Continuous, when in use	1 cm
WiFi access point or NIC	0.008	Nearly continuous, when in use	30.5 cm (1 ft)
Electric Meters Mesh	0.0002 to 0.02	1.5 sec / 4 hours	61 cm (2 ft) to 305 cm (10 ft)
Electric Meters Cellular	0.0003 to 0.02	1.5 sec / 4 hours	61 cm (2 ft) to 305 cm (10 ft)
NXCM Module Mesh	0.000004 to 0.0001	3 sec / 24 hours	61 cm (2 ft) to 305 cm (10 ft)
NXCM Module Cellular	0.00009 to 0.004	3 sec / 24 hours	61 cm (2 ft) to 305 cm (10 ft)

FCC AND HEALTH CANADA PERMISSIBLE EXPOSURE LIMITS

A substantial number of studies have been performed by various organizations to evaluate the impact of RF emissions on the human body. Taking input from these studies, the FCC set exposure limits that “incorporate prudent margins of safety” (according to the FCC’s RF Safety FAQ sheet[1]). Similarly, Health Canada has issued limits of human exposure to RF radiation in Safety Code 6.[2] The FCC and Health Canada validate a device using a calculation distance of 20 cm.

1. Viewed at http://www.fcc.gov/oet/rfsafety/rf-faqs.html

2. “The basis restrictions in Safety Code 6 are similar to those adopted by most other nations, since all recognized standard setting bodies use the same scientific data.” Health Canada Safety Code 6 (2015). https://www.canada.ca/en/health-canada/services/health-risks-safety/radiation/occupational-exposure-regulations/safety-code-6-radiofrequency-exposure-guidelines.html

   The American Cancer Society on smart meters: https://www.cancer.org/cancer/cancer-causes/radiation-exposure/smart-meters.html

Devices that emit radio energy must be certified by the FCC to meet maximum permissible exposure (MPE) requirements, as specified in FCC 1.1310. The limits specified by the FCC vary based on frequency. The power density limits are specified as an average value over a six-minute period. The power density limit for the 915 MHz band is 0.6 mW/cm^2.

Health Canada has a similar limit specified in Safety Code 6.[2] The FCC and Health Canada validate a device using a calculation distance of 20 cm. In the MPE report submitted to the FCC for the communications device used on the REX meter, the transmitter power was measured as 232 mW, with an antenna gain of 3.66 and at a distance of 20 cm. This results in a calculated power density of 0.169 mW/cm^2, which is 0.431 mW/cm^2 below the limit, less than one-third of the limit.

The calculations assume the device transmits continuously for six minutes, but Honeywell smart meters never transmit continuously for that long. The power density calculations do not consider the actual, much lower, transmission frequency of the device. As highlighted above, raw power density calculations do not take into account how often a device is transmitting. In comparison, an electric meter transmits extremely infrequently. A Honeywell smart meter has a transmit duty cycle of less than 1%. The average power density would therefore be 1/100 of the maximum calculated power density.

For more information

https://automation.honeywell.com/us/en/solutions/smart-energy

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