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RF Exposure Comparison of Smart Meters to Other Commonly Used Devices

The use of radio frequencies (RF) in consumer products such as cellular phones and wireless routers has increased considerably over the past decade, and continues to increase. Although Smart Meters utilize RF technology, by staying within regulated requirements, transmitting infrequently, and remote placement, they present significantly lower RF exposure for consumers than many other products that are used daily without concern.

In the US, the FCC establishes the requirements for use of the RF spectrum and acceptable exposure limits for the public. Honeywell Smart Meters comply with and exceed these requirements, as well as international requirements set by global bodies. Typical exposures from Honeywell Smart Meters are well below the most conservative limits.

Smart Meters send information about electricity use to utilities by RF signals. The exposure from Smart Meters is much lower when measured over time than other common sources for two reasons:
1) infrequent signal transmission, and
2) distance from the source.

Why Smart Meters?

Smart Meters bring many benefits to consumers through operational efficiencies and enhanced service. A few examples of the many benefits are improved energy management, minimized utility visits to your home through remote meter reading and remote turn-on and turn-off capabilities, as well as improved outage response. Deferred generation and transmission capital expenditures for utilities may defer rate increases and provide for a cleaner environment, while benefits such as optional load control and new rate designs can help reduce costs during periods of peak demand.

Smart Meter
900 MHz radio

Baby Monitor
7 x greater

Wii Remote Controller
30 x greater

Nintendo DS with WiFi
180 x greater

WiFi Access Point
400 x greater

Cordless Phone
1,000 x greater

Cell Phone
10,000 - 10,000 x greater

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

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RF Safety and Honeywell's Smart Grid Technology

A Honeywell White Paper

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 and the A3 ALPHA® meters—these systems use.

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, that we use daily without concern.

The bottom line is that smart meters represent no known health hazard 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 and the minimal amount of time smart meter radios are actually transmitting.
- Honeywell smart meter radio achieves 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 smart meter transmits (that is, emits power) with an approximate duty cycle of only 1%. In addition, these meters are normally outdoors with a wall and a metal socket separating the meter from the living space.

This effectively diminishes the signal that reaches occupants of the living space.

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 (cm2)). 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 · AntGain) / (4·ϖ·Distance²) mW/cm² 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 electricity meters use radios 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 Gatekeeper) and 1000 mW (SynergyNet Router). 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.

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). However, typically, the distance between an electricity 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 = (250·3.66) / (4·ϖ·(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 = (250·0.5) / (4·ϖ·(305) 2) = 0.0001 mW/cm²

It is helpful to compare this typical power density of a smart electricity meter to other types of devices that we commonly expect to find in a home:

	Transmitter power*	Antenna gain	Typical distance	Power density	Typical exposure times
Cellular phone	600 mW	1	1 cm	48 mW/cm²	Continuously when in use
Cordless phone (handset)	20 mW	1	1 cm	1.6 mW/ cm²	Continuously when in use
SynergyNet meters (close proximity)	1000 mW	1	61 cm (2 ft)	0.02 mW/ cm²	1.5 seconds every 4 hours
EnergyAxis meters (close proximity)	250 mW	1	61 cm (2 ft)	0.005 mW/ cm²	1.5 seconds every 4 hours
WiFi access point or NIC	100 mW	1	30.5 cm (ft)	0.008 mW/ cm²	Nearly continuously when in use
SynergyNet meters (typical proximity)	1000 mW	0.5	305 cm (10ft)	0.0004 mW/ cm²	1.5 seconds every 4 hours
EnergyAxis meters (typical proximity)	250 mW	0.5	305 cm (10 ft)	0.0001 mW/ cm²	1.5 seconds every 4 hours

*May be higher depending on the specific device

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.

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/cm².

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/cm², which is 0.431 mW/cm² below the limit, less than one-third of the limit.

It is important to note these calculations assumed the device was transmitting 100% of the time during the six-minute averaging period, whereas there is no possible scenario existing where a Honeywell smart electric meter or device would transmit at a 100% duty cycle for even a short period, let alone for six minutes.

As highlighted above, raw power density calculations do not take into account how often a device is transmitting. The consumer electronic devices listed above are transmitting nearly continuously when they are in use. In comparison, an electricity meter transmits hardly at all. 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.

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 (2009), page seven.
The World Health Organization (WHO) on electromagnetic fields and public health:
http://www.who.int/mediacentre/factsheets/fs193/en/
The American Cancer Society on smart meters:
https://www.cancer.org/cancer/cancer-causes/radiation-exposure/smart-meters.html

Conclusion

In summary, Honeywell smart meters:

- Pose no known health risks to humans through RF emissions
- Are proven to have lower RF emissions than other readily accepted consumer devices in use today
- Comply with all applicable FCC and Health Canada exposure limits by a wide margin
- Emit lower RF energy than many competing smart meters which use radios with 1W or 2W of transmit power

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

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