> Itron white paper

Analysis of Radio Frequency Exposure Associated with Itron OpenWay® Communications Equipment

Mike Belanger
Product Line Manager

Overview

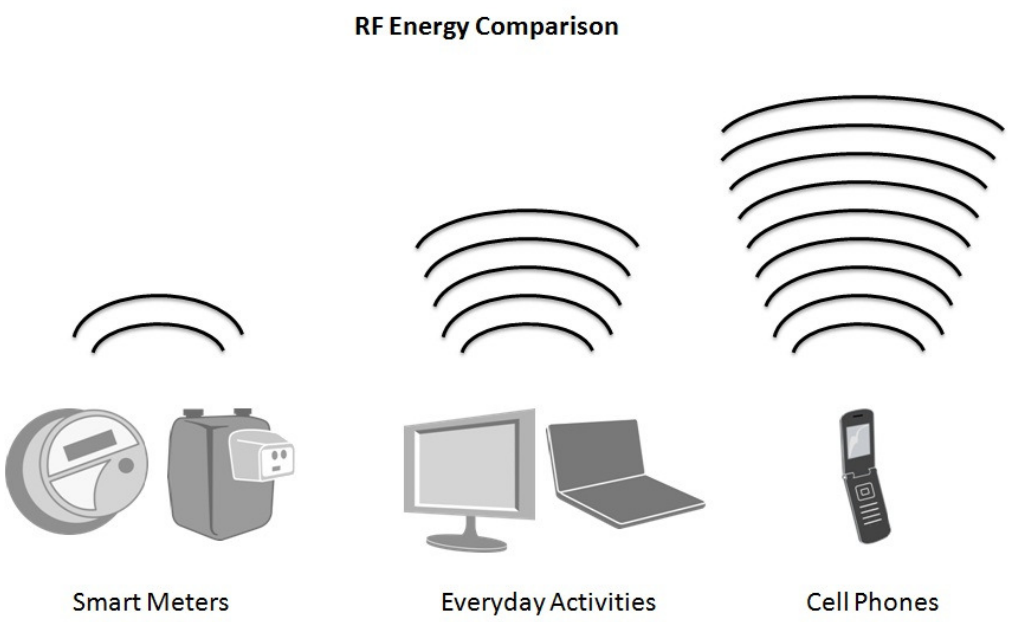
This document provides information regarding radio frequency (RF) energy exposure from Itron's OpenWay wireless communications equipment, which is used by utilities for smart metering communications and other utility applications. The OpenWay equipment has been certified by the Federal Communications Commission (FCC) and Industry Canada (IC).

Introduction

We live in a world where RF energy is all around us. It plays a critical role in the communications systems that we depend on every day, such as police and fire radio systems and pagers, radio and television broadcasts, and cellular telephones. Many of the conveniences we've grown accustom to in our homes, such as cordless phones, wireless LAN (WiFi), and microwave ovens also utilize and emit RF energy.

This same technology is used by utilities and energy service providers to team with consumers to make our energy grid more efficient and reliable, and to optimize our use of limited energy resources. By providing a two-way communications network between the meters and the utility, the RF technology establishes the critical foundation for the realization of the Smart Grid.

It is important to recognize the relative amounts of RF energy the smart meters contribute to the existing RF environment. The chart below provides an approximate comparison of the various sources found in and around typical households.



Itron recognizes that there are concerns related to the health effects of exposure to RF energy and monitors the various organizations researching this topic. Additionally, Itron ensures that our products are compliant with the established regulatory requirements related to RF emissions.

Regulatory Compliance

The FCC recently revised a document detailing how to measure or calculate levels of RF radiation. The document titled "*OET Bulletin 65 Edition 97-01, Evaluating Compliance with FCC guidelines for Human Exposure to Radiofrequency Electromagnetic Fields"* may be found at www.fcc.gov/oet/rfsafety. Additionally, in June 2001, the FCC released "*OET Bulletin 65 supplement C Edition 01-01"* (known as OET-65C), which provides further guidance on determining compliance for portable and mobile devices.

The FCC has completed a rulemaking titled "*Guidelines for Evaluating the Environmental Effects of Radio Frequency Radiation"* (FCC Report and Order, ET Docket 93-62). This document combines standards developed by ANSI and the National Council on Radiation Protection and Measurement (NCRP). The new rules have been incorporated into Title 47 of the Code of Federal Regulations (Parts 1, 2, 15, 24, and 97). These rules dictate the level of compliance necessary to meet the standards.

The Industry Canada has also published an RSS-102 standard that addresses RF exposure issues on the territory of Canada. This standard references to the Safety Code 6 from Health Canada: "*Limits of Human Exposure to Radiofrequency Electromagnetic fields in the Frequency Range from 3 kHz to 300 GHz*."

Types of RF Exposure and Maximum Permissible Exposure Limits

The revised ANSI standards, the NCRP Report and the FCC Rules and Guidelines define two types of exposure to RF energy:

> Occupational / Controlled Exposure when persons are exposed as a consequence of their employment and they have been made fully aware of the potential for exposure and can exercise control over their exposure.
>
> General Population / Uncontrolled Exposure when persons who are exposed to RF fields may not be made fully aware of the potential for exposure or cannot control their exposure.

The standards specify the Maximum Permissible Exposure (MPE) levels as the strength of electromagnetic field or the equivalent power density associated with this field to which a person may be exposed without harmful effect.

The FCC defines the Maximum Permissible Exposure (MPE) levels according to the following equations:

Occupational MPE: Exposure $[mW/cm^2]$ = Frequency $[MHz]$ / 300

General Population MPE: Exposure $[mW/cm^2]$ = Frequency $[MHz]$ / 1,500

The MPE limits are dependent on the frequency of the transmitting device and allow for higher levels of exposure for occupational/controlled environments.

The Itron OpenWay communications equipment is assessed against the more stringent General Population Exposure limits.

An important feature of the regulatory guidelines is that exposure, in terms of power density, may be averaged over certain periods of time with the average not to exceed the limit for continuous exposure. The averaging time is defined as six minutes for occupational/controlled exposure and 30 minutes for general population/uncontrolled exposure.

Itron OpenWay Wireless Communication Equipment under Consideration

The Itron OpenWay wireless communication equipment operates in the Industrial, Scientific and Medical (ISM) bands at frequencies from 902 MHz to 928 MHz and from 2,400 MHz to 2,483 MHz. Also, a small number of devices incorporate wireless modems operating at frequencies 824-849 MHz and 1,850-1,910 MHz designated for the cellular operators (Cell Relays constitute about 1% of all the OpenWay wireless devices and can be mounted on poles or as part of a meter). This analysis will focus on the OpenWay CENTRON® smart meter.

The following table reflects the data contained within the Certification Exhibits for FCC Rule Part: 15.247 for Itron OpenWay Smart Meters:

FCC ID	SK9AMI-xx
FCC Rule Part	15.247
Classification	Digital Transmission System Transmitter Frequency Hopping Spread Spectrum Transmitter
Device Category	Mobile
Environment	General Population / Uncontrolled Exposure
Exposure Conditions:	Greater than 20 centimeters (8 inches)
Frequency bands	RF LAN 902 – 928 MHz ZigBee 2,400 – 2,483.5 MHz
Transmitter Power*	RF LAN 24.83dBm (304.09 mW) at 902.25 MHz ZigBee 18.94 dBm (78.34 mW) at 2,475 MHz
Antenna Gain*	RF LAN 2.2 dB (1.660 times) at 902.25 MHz ZigBee 3.8 dB (2.399 times) at 2,475 MHz

*Values have been updated to reflect the latest meter hardware release (FCC ID: SK9AMI6)

The duty cycle (or amount of time a device is active in any given time period) will have a significant impact on the long term exposure levels for a device. The Itron OpenWay smart meters are actively transmitting a very small portion of the time. The maximum duty cycle for each transmitter is listed below:

Max Duty Cycle (over period of 30 minutes)	RF LAN	5%
	ZigBee	1%

For the Itron OpenWay smart meters wireless communication equipment, the MPE limits for continuous exposure are as follows:

Frequency	**MPE level**	
	Occupational	***General population***
RFLAN (902 MHz)	3.0 mW/cm^2	0.6 mW/cm^2
Zigbee (2,400 MHz)	8.0 mW/cm^2	1.0 mW/cm^2

Calculation of RF emissions

The FCC MPE levels represent the guaranteed safety limits based on the thermal effect of continuous RF radiation.

The FCC guidelines define the following equation to calculate the power density of RF radiation under far-field conditions:

$$\text{Power\_Density } [mW/cm^2] = \frac{\text{Transmitter\_Power } [mW] \times \text{Antenna\_Gain } [times]}{(4 \times \text{pi} \times \text{Distance } [cm] \times \text{Distance } [cm])}$$

The 1992 ANSI/IEEE standard specifies that 20 cm (~ 8 inches) should be the minimum separation distance where reliable field measurements to determine adherence to MPEs can be made.

It is important to note that the Itron's equipment operates in short bursts randomly distributed over prolonged period of silence (5% and 1% duty cycles). According to the rules, the MPE levels for interrupted transmission should be calculated by averaging the active time over interval of 30 minutes in the case of General Population exposure or six minutes in the case of occupational exposure.

A comparison of the MPE from the Itron OpenWay smart meter's transmitters to the General Population MPE limits with the duty cycles accounted for is shown in the table below:

Transmitter	MPE Limit	MPE	Margin
RF LAN (902MHz)	0.6 mW/cm^2	0.0050 mW/cm^2	**0.833%** of the limit
ZigBee (2,405MHz)	1.0 mW/cm^2	0.00037 mW/cm^2	**0.037%** of the limit

The data indicates that the Itron OpenWay smart meters present an extremely low level of RF exposure when compared to the regulatory limits established for safe operation.

Summary

The RF power densities for OpenWay communications calculated according to the recommended method are only a small fraction of the Maximum Permissible Exposure limits.

Itron will continue to monitor the regulatory standards and research related to RF Exposure to verify that its products are in compliance with all applicable legal requirements.

Additional Information

Additional information from the World Health Organization

- *World Health Organization (WHO) Fact Sheet*
- *Electromagnetic Fields*
- *International EMF Project*

Information from the Federal and Drug Administration (FDA)

- *Radiation-Emitting Products*
- *Interference with Pacemakers and Other Medical Devices*

Information from the Federal Communications Commission (FCC)

- *Radio Frequency Safety*

Information from the California Council on Science and Technology (CCST)

- *Health Impacts of Radio Frequency from Smart Meters*

Information from Itron

- Itron Radio Frequency Resource Center

About Itron

At Itron, we're dedicated to delivering end-to-end smart grid and smart distribution solutions to electric, gas and water utilities around the globe. Our company is the world's leading provider of smart metering, data collection and utility software systems, with nearly 8,000 utilities worldwide relying on our technology to optimize the delivery and use of energy and water. Our offerings include electricity, gas, water and heat meters; network communication technology; collection systems and related software applications; and professional services.

To realize your smarter energy and water future, start here: www.itron.com.

Itron Inc.
Corporate Headquarters
2111 North Molter Road
Liberty Lake, Washington 99019
U.S.A.
Tel.: 1.800.635.5461
Fax: 1.509.891.3355

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