SGiP NIST Smart Grid Collaboration Site NIST

Home-to-Grid (H2G) Domain Experts Working Group

Intentional, Unintentional & Incidental Emitters

EMC Task Group

The SGIP Home-to-Grid Domain Experts Working Group presents "**Intentional, Unintentional and Incidental Emitters**" by the EMC Task Group. This is a summary of the white paper of the same name that was recently submitted to the Group for comment.

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Radio Emitters in the U.S.

Intentional Emitters – devices which must generate and radiate RF energy in order to function

Radio Emitters in the U.S.

All man-made radiators of RF energy are regulated by the FCC. Whether specific limits apply and what those limits are depends on the nature of the devices and their intended end-use environment. Equipment capable of generating RF signals is divided into three categories. The first, intentional emitters, are devices which must generate and radiate RF energy in order to function. Radio transmitters are an example of intentional radiators. These are beyond the scope of this group.

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Radio Emitters in the U.S.

Intentional Emitters – devices which must generate and radiate RF energy in order to function

Unintentional Radiators – devices which internally generate RF energy but do not need to radiate it in order to function

Unintentional radiators are devices which internally generate RF energy, but do not need to radiate it in order to function. Digital devices such as computers are an example of unintentional radiators.

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Radio Emitters in the U.S.

Intentional Emitters – devices which must generate and radiate RF energy in order to function

Unintentional Radiators – devices which internally generate RF energy but do not need to radiate it in order to function

Incidental Radiators – devices which do not need to generate or radiate RF energy in order to function

Incidental radiators are devices which do not need to generate or radiate RF energy in order to function. DC motors using brushes are an example of an incidental radiator.

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Unintentional Radiators

Limits for unintentional radiators are given in 47CFR 15.107 and 15.109
(conducted & radiated emissions limits)

Digital Devices are defined in 15.3(k) as an unintentional radiator (device or system) that generates and uses timing signals above 9kHz

Unintentional Radiators

The FCC has limits for unintentional radiators which are given in 47CFR 15.107 and 15.109 (for conducted & radiated emissions limits). Digital devices are defined in 15.3(k) as "An unintentional radiator (device or system) that generates and uses timing signals or pulses at a rate in excess of 9,000 pulses (cycles) per second and uses digital techniques; inclusive of telephone equipment that uses digital techniques or any device or system that generates and uses radio frequency energy for the purpose of performing data processing functions, such as electronic computations, operations, transformations, recording, filing, sorting, storage, retrieval, or transfer."

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Incidental Radiators

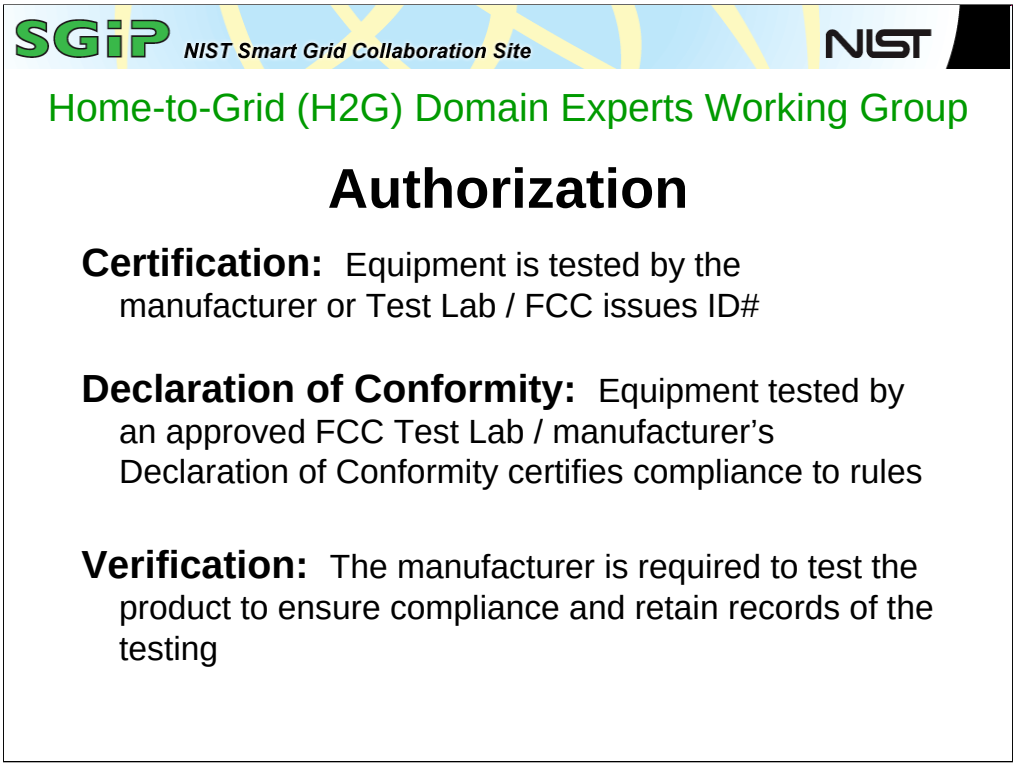
Limits for incidental radiators are not given in the rules

15.5(b) Subject to Conditions that no “harmful interference” is caused and that interference must be accepted from other legal products

15.5(c) Operation must stop if notified by the FCC that they are causing “harmful interference,” may not resume until interference cause is fixed

Incidental Radiators

Specific limits for incidental radiators are not given in the FCC Rules. However, Section 15.5(b) states, "Operation of an intentional, unintentional, or incidental radiator is subject to the conditions that no harmful interference is caused and that interference must be accepted that may be caused by the operation of an authorized radio station, by another intentional or unintentional radiator, by industrial, scientific and medical (ISM) equipment, or by an incidental radiator." 15.5(c) goes on to state that operation of such devices must stop if notified by the FCC that they are causing harmful interference and operation may not resume until the cause of the interference is fixed.



Authorization

..to sell products covered under Part 15 can be attained with Certification; where equipment is tested by the manufacturer or a recognized Test Laboratory and the FCC issues an ID number for the product after reviewing the application. Or, a Declaration of Conformity can be used when covered equipment is tested by a recognized Laboratory to support a manufacturer's Declaration that the equipment complies with the rules. Lastly, Verification is a path that requires the manufacturer to test the product to ensure compliance and retain records of the testing.

Marketing

Both Part 15 (digital devices) and Part 18 (lighting) have separate limits for commercial and residential environments. (Class A and Class B limits, respectively) Manufacturers may make devices that comply with either set of limits, but they must be marketed appropriately so they end up being used in the proper environment. If a device is designed to meet the "industrial" levels of Class A, it may not be marketed by the manufacturer or their resellers into residential environments. Devices that connect to residential AC mains within buildings, or that are used in homes, should be Class B compliant (including the Part 18 equivalent). Devices used in business environments are industrial or Class A.

Devices sold through the local electrical-supply wholesaler can probably be either Class A or Class B, provided they are marketed appropriately. It is generally assumed that electrical devices sold in retail stores open to the public must be Class B devices. The legality of an individual case would be determined by the actual marketing effort used to sell the product.

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Responsibilities under Part 15

Manufacturer responsibilities:

Must design equipment to comply with the rules
Must meet the appropriate authorization requirements

Marketing / sales channel responsibilities:

Manufacturers **and** sellers of Class A and Class B equipment must market these products only to the appropriate environment (commercial or residential)

Operator responsibilities:

Operators of Part 15 devices must operate them in a way that does not cause harmful interference to licensed radio services

Responsibilities under Part 15

Manufacturer responsibilities:

Must design equipment to comply with the rules
Must meet the appropriate authorization requirements

Marketing / sales channel responsibilities:

Manufacturers **and** sellers of Class A and Class B equipment must market these products only to the appropriate environment, either commercial or residential.

Operator responsibilities:

Operators of Part 15 devices must operate them in a way that does not cause harmful interference to licensed radio services

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Inverters

May be unintentional or incidental emitters

Clocked >9kHz then it is an unintentional emitter

Operates <9kHz it is not an RF device but is an incidental emitter

"Good Engineering Practice" is required and it must not cause "harmful interference"

Inverters and other similar low-frequency devices may be unintentional emitters or incidental emitters, depending upon their design. If the device operates at a frequency of 9 kHz or greater, it is an unintentional emitter. If it operates below 9 kHz, it is not an RF device, so it would be treated as an incidental emitter. If a 12 pole inverter operates at a fundamental frequency of 720 Hz, the device may be rich in harmonics and make radio noise, but it is still an incidental emitter. As such, it would not have any specific conducted or radiated emissions limits. The manufacturer of the device would have a requirement to use "good engineering practice" in its design and construction. (such as snubbing the gate circuits of the switching devices to lower the amount of RF noise generated by their edge transients) The operator of an incidental emitter is required to use it in a way that does not cause "harmful interference" or it must be removed from service.

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Inverters

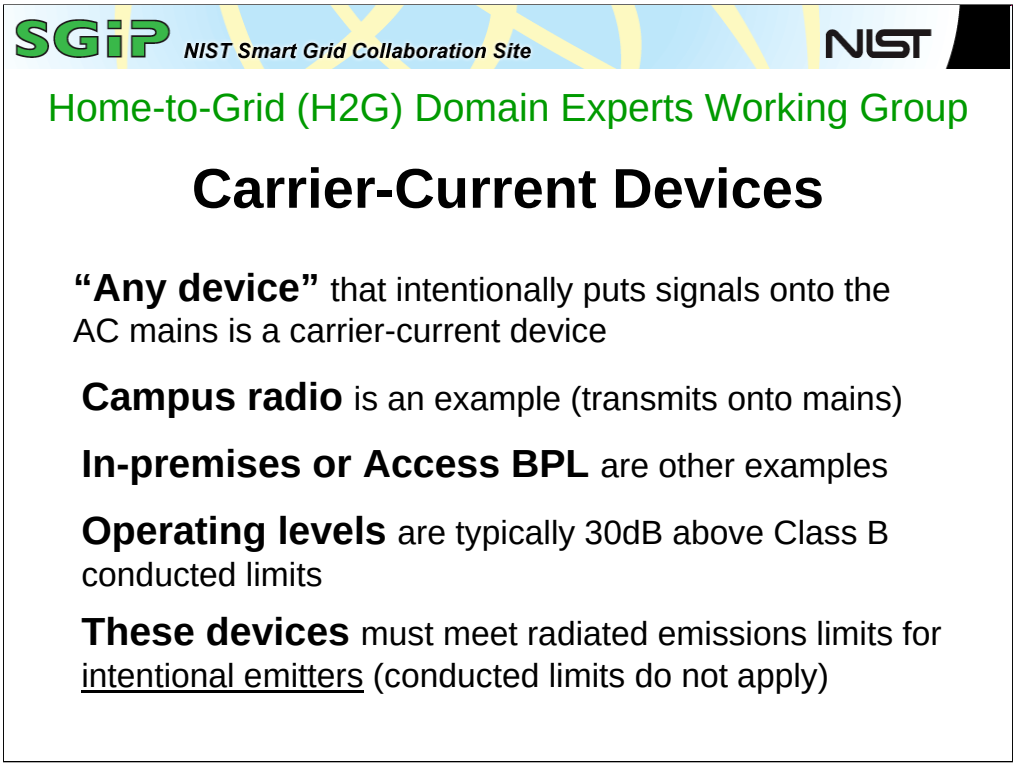
Most inverters also use digital controls

If clocked >9kHz then it is an unintentional emitter

Must be verified meeting limits for conducted & radiated emissions

"Good Engineering Practice" is still required and it must not cause harmful interference or be shut-down

Most inverters don't operate stand-alone, they usually have additional digital controls. If that digital circuitry is clocked above 9 kHz, the device would be an unintentional emitter. Other than personal computers, most unintentional emitters must be verified under the Part 15 rules to meet conducted emissions limits below 30 MHz, back into the AC mains, and radiated emissions limits above 30 MHz, radiated into free space. Like all unlicensed devices regulated by Part 15, it must employ "good engineering practice" and not cause harmful interference or it can be removed from service.



Carrier-Current Devices

There is an additional type of emitter -- the carrier-current device. Any device that intentionally puts signals onto the AC mains is a carrier-current device. This can include campus radio transmitters or in-premises or Access BPL devices, as examples. The operating level of these devices is typically about 30 dB higher than the Class B conducted emissions limits. These devices must meet the Part 15 radiated emissions limits for intentional emitters but the conducted emissions limits do not apply.

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Exemptions

Digital devices used in motor vehicles or aircraft

Digital devices in a public utility or industrial plant

Digital devices for industrial, commercial or medical

Digital devices in appliances

Digital devices in specialized medical devices

Digital devices consuming less than 6nW

Joysticks with simple circuits or passive components

Digital devices using frequencies <1.705MHz on battery

Exemptions

The following devices are subject only to the general conditions of operation in §§ 15.5 and 15.29 and are exempt from the specific technical standards. The operator of an exempted device shall be required to stop operating the device upon a finding by the Commission or its representative that the device is causing “harmful interference.”

Digital devices used in motor vehicles or aircraft

Digital devices in a public utility or industrial plant

Digital devices for industrial, commercial or medical test equipment

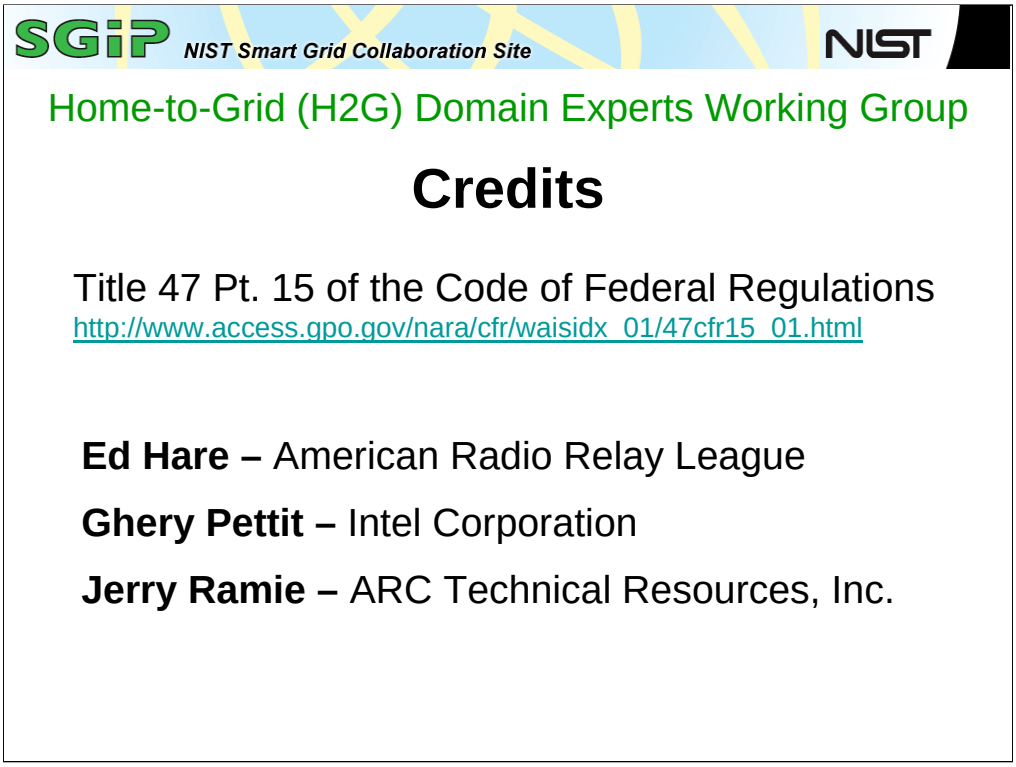
Digital devices in appliances

Digital devices in specialized medical devices

Digital devices consuming less than 6nW

Joysticks with simple circuits or passive components

Digital devices using frequencies <1.705MHz on battery



Credits

Title 47 Pt. 15 of the Code of Federal Regulations
http://www.access.gpo.gov/nara/cfr/waisidx_01/47cfr15_01.html

Ed Hare – American Radio Relay League

Ghery Pettit – Intel Corporation

Jerry Ramie – ARC Technical Resources, Inc.