FCC Provisions for Controlling Radio Noise

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Radio spectrum Pollution:
Facing the Challenge of a Threatened Resource

Note: The views expressed in this presentation are those of the author and may not necessarily represent the views of the Federal Communications Commission

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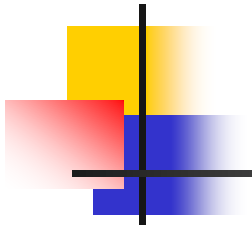
Overview

- Relevant FCC Rule Provisions
- Noise Floor Activities
- Topics for Discussion & Observations



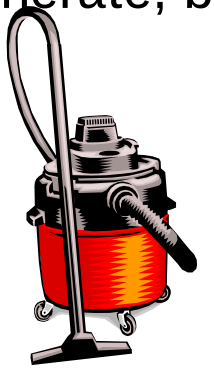
Unlicensed Devices

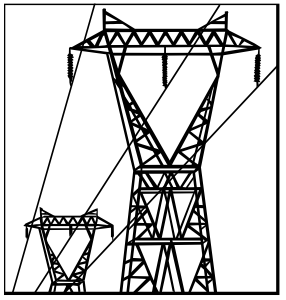
Part 15: RF Devices

- Specifies electromagnetic compatibility requirements for most electronic equipment
- Provides for operation of low power radio transmitters without the need for the user to obtain a license
- Operating conditions:
  - May not cause harmful interference
  - Must accept any interference received

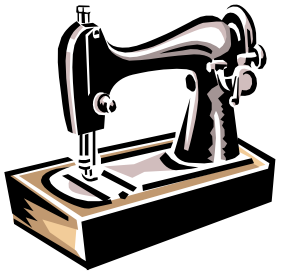
Incidental Radiators

- Any device that does not intentionally generate, but produces RF energy as a by-product of its operation.





- Examples:
  - Electrical motors
  - Devices with electrical contacts
  - SCR devices
  - Power lines
  - Active antennas



- Conditions of operations
  - Does not cause harmful interference
  - No technical requirements - just good engineering practice

Unintentional Radiators

- *Unintentional radiator.* A device that intentionally generates radio frequency energy for use within the device, or that sends radio frequency signals by conduction to associated equipment via connecting wiring, but which is not intended to emit RF energy by radiation or induction.


Computers & Peripherals


DVD Players


Pods & MP3 Players


Tablets


E-readers


Virtually All Electronics

Note: Many devices also include Intentional radiators

FCC Section 15.109: Radiated Emissions Limit

Frequency of Emission (MHz)	General (microvolts/meter @ 3 m)	Class A – Commercial (microvolts/meter @ 10 m
30 – 88	100	90
88-216	150	150
216-960	200	210
Above 960	500	300

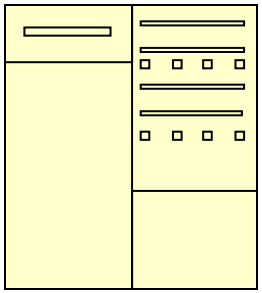
Devices also subject to power line conducted emissions limits from 150 kHz to 30 MHz

Digital Devices

- Digital devices (ITE) -- any device or system that generates and uses timing systems in excess of 9,000 pulses per second and uses digital techniques, including telephone equipment, but exclusive of transmitters

- Classes of digital devices:
  - Class A -- a digital device that is marketed for use in the commercial and industrial environment
  - Class B -- a digital device that marketed for use in the residential environment

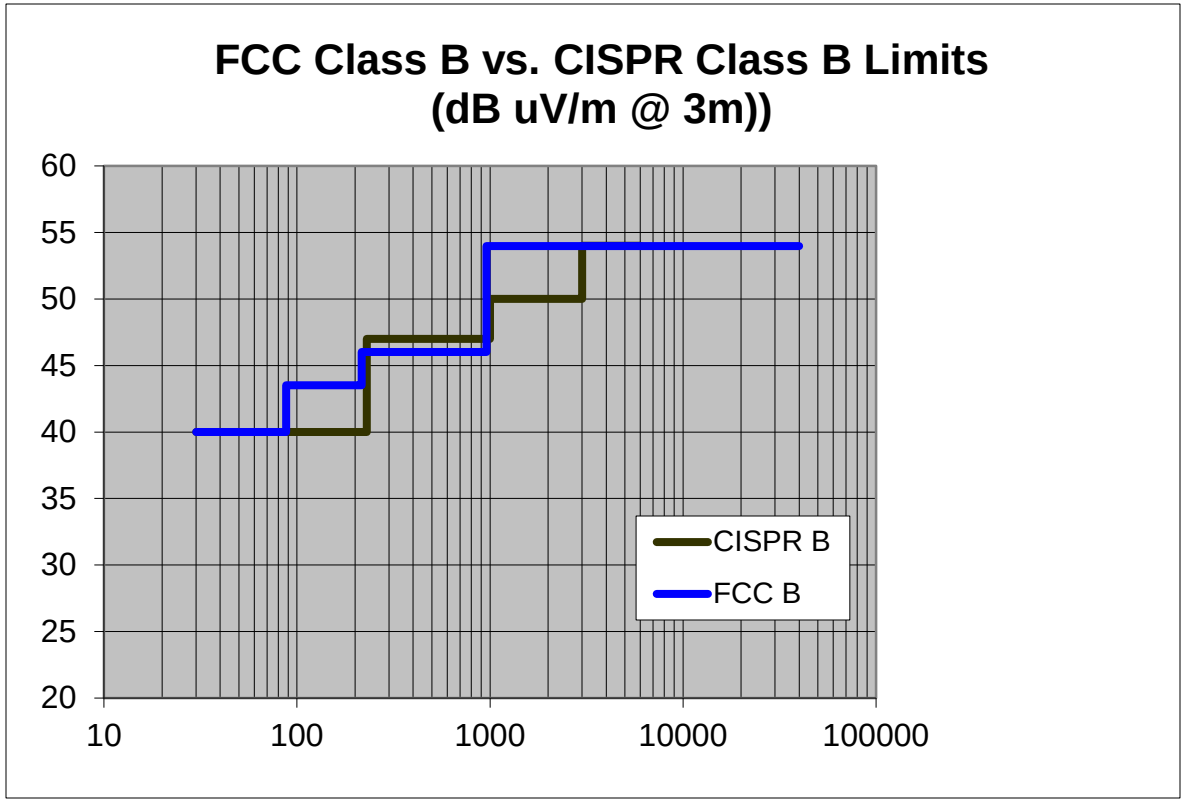
- Exemptions: (47 CFR 15.103)
  - Appliances
  - Transportation vehicles
  - Test equipment
  - Industrial control systems + others



U.S. & International Limits

FCC accepts compliance with Int'l CISPR limits

MHz	CISPR B	FCC B
30	40	40
88	40	40
88.0001	40	43.52183
216	40	43.52183
216.001	40	46.0206
230	40	46.0206
230.001	47	46.0206
960	47	46.0206
960.001	47	53.9794
1000	47	53.9794
1000.001	50	53.9794
3000	50	53.9794
3000.001	54	53.9794
6000	54	53.9794
40000		53.9794



Intentional Radiators

- *Intentional radiator.* A device that intentionally generates and emits radio frequency energy by radiation or induction
- Rules minimizes likelihood of interference by:
  - Identifying permissible frequencies
  - Limiting power to very low levels
  - Specifying out-of-band and spurious emissions limits
  - Requiring equipment authorization
- Permissible frequencies:
  - Unlicensed devices are not “allocated” spectrum (except Unlicensed-PCS)
  - Generally operate on unused spectrum or on “overlay” basis
  - Or in ISM “junk bands”: 915 MHz, 2.4 GHz, 5.8 GHz
  - Restricted from operating in public safety & low signal bands
- Industry has developed voluntary protocol standards within the framework of the rules: Wi-Fi, Bluetooth; Zigbee; etc.

Examples of Intentional Radiators

- **Wi-Fi devices - Home and business networks; hot-spots**
- Community, urban & rural broadband networks by WISPs
- Bluetooth headsets & keyboards
- Automobile keyless entry
- Wireless baby monitors
- In-home video distribution
- Remote control toys
- Toy walkie-talkies
- Utility meter readers & smart grid energy control
- Tank level meters
- Traffic light controls
- Crane controls
- Lighting controls & dimmers
- Wireless door bells
- Cordless phones
- Garage door opener controls
- Sensors for automatic doors
- Industrial automation controls
- RF ID systems
- Retail anti-theft systems
- Security alarm systems
- Wireless speakers
- Satellite Radio-to-FM radio
- Convergence w licensed devices
- Medical camera pills
- Medical panic alerts
- Meat thermometers
- Inventory control
- Pool cover controllers
- Diaper wetness sensor
- ***And the list goes on . . .***





Restricted Frequency Bands of Operation

- Only spurious emissions may fall within a restricted band. See FCC 15.205.
- No fundamental emission or modulation products may be in a restricted band.
- The limits for spurious emissions within the restricted bands are found in FCC 15.209

FCC 15.205 Restricted Bands

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
[1]0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	(2)
13.36–13.41			

(2) Above 38.6 GHz

ISM Equipment

Industrial Scientific and Medical (ISM) Equipment

- ISM Defintion – Equipment that generates and use RF to performed some work, other than telecommunications
- Historical Examples:
  - Dielectric Heaters -- used to mold plastics ... thousands across the US. Most operate around 27 MHz, but many operate outside the ISM bands with 10-25 KW of RF power.
  - Food Tempering equipment – used to thaw frozen food ... many operate at 915 MHz with about 100,000 W of RF power.
  - Wood Gluing Machines – used to fabricate plywood ... one machine in NC at 6.33 MHz with 1,000,000 W of RF power
  - Microwave ovens – most 1 KW at 2450 MHz
- Recent Examples:
  - Wireless power transfer (devices & vehicles)
  - Growth of RF lighting

ISM Technical Rules

- ISM Bands: No limit on emissions

6.78 MHz	±15.0 kHz
13.56 MHz	±7.0 kHz
27.12 MHz	±163.0 kHz
40.68 MHz	±20.0 kHz
915 MHz	±13.0 MHz
2,450 MHz	±50.0 MHz
5,800 MHz	±75.0 MHz
24,125 MHz	±125.0 MHz
61.25 GHz	±250.0 MHz
122.50 GHz	±500.0 MHz
245.00 GHz	±1.0 GHz

Note: many intentional radiators operate in these internationally allocated frequency bands.

- Limits outside ISM bands: 10 µV/m @ 1 mile and 25 µV/m @ 1000 feet outside the ISM bands depending on type of equipment *(Note: Extrapolated back to 3 and 10 m and these are extremely high field; e.g., the field is conservatively > 17 mV/m @ 3 m, assuming inverse distance.)*

Licensed Radio Services

Licensed Radio Services

- Licensed transmitters emit energy - -
  both in-band and out-of-band

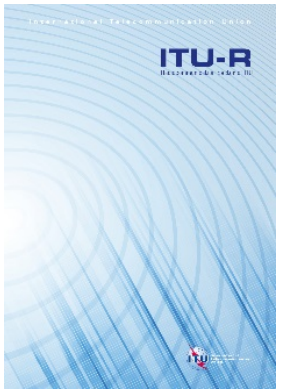
- Out of band and spurious emissions limits
  - Typically suppressed to at least 43 + 10 log P (-13 dBm)
  - More stringent requirements in many cases
  - Industry may set more stringent standards

- Applying limits has become more complex:
  - Multiple modes of operation
  - Devices often include multiple transmitters

Noise Floor Activities

Noise Floor Activities

- Various organizations:
  - International Telecommunications Union (ITU) Recommendation P-372-10 on Radio Noise
  - International Union of Radio Science (URSI)
  - National Academies Committee on Radio Frequencies
  - Others: ARRL; voluntary standards-setting bodies



- FCC:
  - Spectrum Policy Task Force – 2002: Recommended the Commission undertake a systematic study of the noise floor
  - Technological Advisory Council – Literature search and review of radio noise and its impact on wireless communications presented at June 2002 TAC meeting
  - Asked about “harmful interference” in various proceedings

Topics for Discussion & Observations

Impact of Radio Noise

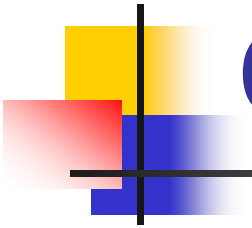
- Radio spectrum is a critical resource to be protected
- Current state of radio noise:
  - Informal reports that person-made radio noise is rising
  - Not surprising: proliferation of RF devices & transmitters & close proximity
  - But most information is anecdotal - scientific data is limited
- Keep in perspective:
  - Radio noise has been rising since the dawn of radio
  - Radio technologies today tend to be more robust
  - Ideally radio noise would be zero, but not practical
- What is the appropriate balance between control of radio noise & impact on services and devices?

Costs and Benefits of Reducing Noise Levels

- Difficult to quantify the costs:
  - There are numerous sources of radio noise
  - Little data on the most significant contributors
  - Scope is a major factor - - all of the spectrum or just parts
  - Costs & viability would depend on the standards
- Difficult to quantify benefits:
  - At what point is radio noise “harmful interference”?
  - What are reasonable targets for noise levels?
  - How would they reduce infrastructure costs - - i.e., fewer towers?
  - Improved service quality/reliability?
  - Can technological solutions mitigate impact?

Closing Thoughts

- Need to be careful not to leap to conclusions
- Your “desired signal” may be “noise” to others
- Environmental models may not translate well to the radio world:
  - Emissions fall across frequency bands
  - Acceptable levels of noise vary by service
  - Each individual device may have little impact
  - What are appropriate incentives?
- What steps, if any, might be appropriate?
- Looking forward to today’s discussions



Conclusion

Questions?