


**FCC Part 15
Unlicensed Transmitters
(Consolidated Presentations)**

DRAFT

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Outline

- General Information
 - Major KDBs
 - General TCB review advice
- Part 15 intentional radiators
 - Miscellaneous transmitters.
 - RFID policies
 - Pulsed transmitters
 - Water Meter transmitters.
 - Implant transmitters
 - Wireless Chargers
 - Miscellaneous measurement info
 - Alternative peak measurements
 - Test procedure for radiated measurements at a band edge.
 - Specific rule parts
- Appendix A
 - Part 15 unintentional radiators.
 - Radar detectors
 - Scanning receivers
 - TV interface devices
 - EAS, Emergency Alert Systems (Part 11)
 - Part 18 Consumer ISM devices.

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KDBs

- **KDB# 628591 TCB exclusion list.**
 - TCB's cannot approve devices on the list.
- **KDB# 388624 Permit But Ask Procedure.**
 - TCB's must contact FCC prior to approval
 - Test labs encouraged to obtain test guideline

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General TCB review advice

- TCB's must ensure that the device is fully compliant and the filing is complete and consistent.
 - The filing must show that the device is compliant with all applicable rules.
 - *Use applicable test procedures (e.g. ANSI C63.4), guidelines, checklists, Public Notices and applicable rules.
 - *Look for frequent compliance issues.
 - The filing must be consistent throughout the filing.
 - *All information such as Output power, frequencies, operational description, specifications, device usage etc... in the filing must agree.
 - *No discrepancies in the filing between the Manual, EMC report, RF safety report, operational description, Grant condition, photo's, grant condition etc..


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Part 15 Intentional Radiators

- General information on transmitters. General information on transmitters.
 - General Checklist
 - EMC co-location policy
 - WLAN – WISP interpretations
- Miscellaneous transmitters.
 - RFID policies
 - Pulsed transmitters
 - Water Meter transmitters.
 - Implant transmitters
 - Wireless Chargers
- Miscellaneous measurement info
 - Alternative peak measurements
 - Test procedure for radiated measurements at a band edge.
- Specific rule parts e.g.
 - Permissive Changes
 - 15.203, Antenna requirements
 - 15.204, external amplifiers and antenna modifications
 - 15.207, AC line conducted requirements
 - Subpart C transmitters DTS and FHSS filing guidelines
 - UPCS
 - UNII UNII filing guidelines
 - UWB
 - Access BPL

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**General Checklist for Low Power Transmitters
subject to Certification. Page 1 of 5**

FCC Identifier: _____

Specific Rule Section applied for _____ (e.g. Section 15.235)

EUT description _____

Output power _____

Is output power consistent throughout filing? _____

Operating Frequencies: _____

Center frequency of the lowest channel to the highest channel on grant.


Confidential request per Section 0.459 ? _____

Composite device ? _____

Modular Approval ? _____

Class II permissive change statement ? _____ Do the changes require a new application?

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General Checklist for Low Power Transmitters subject to Certification. (Continued) Page 2 of 5

General Rule Requirements:

- Section 15.19: label requirements
- Section 15.27: special accessories (modifications approved by applicant?)
- Section 15.33: Frequency range of radiated measurements.
- Section 15.35: Measurement detector function and bandwidths.
- Section 15.202: Operating frequencies in US bands.
- Section 15.203: antenna connector requirement.
- Section 15.204: complete transmitter approved? Amplifier approval req.
- Section 15.205: restricted band requirements.
- Section 15.207: line conducted test.
- Section 15.209: general spurious emissions.
- Section 15.214: Cordless phone requirements only.
- Section 15.215: additional provisions, spurious less than fundamental? **20 dB within operating frequency band in the rule section applied for?**
- Check specific rule requirements in the Section of the rules applied for.**
 - a) fundamental limit
 - b) spurious limits
 - c) bandedge compliance
 - d) Operational restrictions or provisions
 - e) Other specific requirements(s)

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**General Checklist for Low Power Transmitters
subject to Certification. (Continued) Page 3 of 5**

Section 2.1033

- _____ A copy of the installation and operating instructions to be furnished the user. *User information?*
- _____ A brief description of the circuit functions of the device along with a statement describing how the device operates.
- _____ A block diagram showing the frequency of all oscillators in the device.
- _____ A schematic diagram.
- _____ Internal and external Photo's

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**General Checklist for Low Power Transmitters
subject to Certification. (Continued) Page 4 of 5**

General Test requirements noted.

- _____ Section 15.31: measurement standards.
- _____ Section 15.35: Peak measurements when Average limits are specified.
- _____ Are all available ports filled?
- _____ Bandwidth test, if appropriate, to ensure band edge compliance.
- _____ Tested in three orthogonal planes when applicable.
- _____ EUT antenna position adjusted to maximize emissions.
- _____ User controls adjusted to maximize emissions.
- _____ Input signals adjusted to maximize emissions.
- _____ Test procedure accepted by the FCC? Identify _____
- _____ Was the proper antenna used for testing? Note: For measurements below 30 MHz, a loop antenna must be used and rotated about its Horizontal and Vertical positions to maximize emissions?

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General Checklist for Low Power Transmitters subject to Certification. (Continued) Page 5 of 5

General Interpretations:

- _____ Spurious emissions cannot be higher than the fundamental regardless if all emissions comply.
- _____ Regardless of output power or field strength, intentional radiators require Certification. Exceptions per 15.201
- _____ Does it connect to a computer or have any other functions? A composite device may require an additional authorization depending on the applicable requirements.
- _____ Portions of the fundamental may **not** be in the restricted band even if it complies with Section 15.209 (except for UWB devices). However, the center frequency may not be in the restricted band. The frequency stability must not bring the center frequency into the restricted band. The receiver input bandwidth frequencies must not include the restricted band.
- _____ Is the frequency greater than 9 kHz? We do not authorize transmitters below 9 kHz.
- _____ Is the return frequency of RF tags or similar devices in the restricted band?
- _____ **Check the additional specific interpretations for the type of device applied for.**


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EMC Co-location Testing Policy

- ❑ Policy for EMC evaluation of co-located independent transmitters in a single enclosure (e.g. laptop, handheld). This does not apply to multi-radio systems with coordinated transmitters (e.g. beam forming systems, multi-sector radio systems).
- ❑ Simultaneous transmission data (radiated and antenna conducted) is required to be submitted only when the devices can transmit simultaneously and share a common antenna.
- ❑ The grantee is still responsible for compliance, even though we no longer require simultaneous transmission data to be submitted, (except for above exception).
- ❑ When a co-located, independent and non-coordinated transmitter is added, the evaluation of RF exposure conditions may still be required along with a filing of a Class II Permissive change request. However, **no additional EMC test data need to be submitted.**
 - ❑ The RF Exposure requirements are currently under review.


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WLAN – WISP interpretations

- Fixed Remote station can operate as a point to point system even if the base station operates as a point to multipoint system.
- Equivalent Antenna changes allowed without additional filings. See Section 15.204 antenna change polices.
- Adding additional amplifiers only allowed for 15.247 and 15.407 devices. Amplifier must be Certified with the transmitter per Section 15.204(d)1.
- All Sectorized systems are point to multipoint subject to 4 Watt EIRP limit except those systems that qualify as a Smart Antenna System (SAS). See SAS guidelines.
- For SAS system only, Prohibited Broadcasting does not include occasional broadcast management signals or non-permanent multi-casting. See SAS guidelines.

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Miscellaneous transmitters

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RFID General

- RFID Passive Tag Policy
 - A passive tag does not contain batteries and is not certified individually.

Only the tag reader needs to be tested. At this time, the current technology for passive tags is such that the emission levels from the passive tags are much lower than the allowed levels for the tag reader.


*Tags that translate the reader frequency (operates on a frequency different from the reader) must be tested with the reader.

The fundamental passive tag emissions may not operate within a restricted band, just as the tag reader is prohibited from operating in a restricted band.

Implanted passive "sensor" (tag) used with external RF ID Readers are not covered by TCB exclusion for implant transmitters and are allowed for TCB approval.

- TCBs must consult TCB exclusion list to determine if the external RF ID reader can be approved by the TCB.


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RF ID

- Battery assisted passive tags.
 - Battery assisted passive tags (BAPT) can be treated as passive tags under the following conditions. Certification not required for BAPT's.
 - 1) The device does not operate in a restricted band.
 - 2) The RF portion of the BAPT must be isolated from the battery.
 - 3) The field strength level of the BAPT is comparable to passive tags.

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RF ID tag implants

- Implanted passive "sensor" (tag) used with external RF ID Readers are not covered by TCB exclusion for implant transmitters and are allowed for TCB approval.
 - TCBs must consult TCB exclusion list to determine if the external RF ID reader can be approved by the TCB.

- Implanted active (battery powered) tags cannot be approved by TCBs

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RFID

- ❑ Circularly polarized or Elliptically polarized antennas
When determining Antenna Gain for RF ID Systems Operating Under 15.247, use the highest linear vertical or horizontal gain to determine compliance with Section 15.247.
- Printers with an internal transmitter (RFID tag encoder) are classified as an intentional radiator.
- ❑ Specific RF ID policies in 15.231, 15,245 and 15.247

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RFID 15.231

- Operation of passive tags RF ID systems allowed in 15.231 as long as all requirements are met. Especially...
 - Deactivated within 5 seconds per event activation.
 - Data transmission under 15.231(e)
 - Ensure silent period and transmission duration is met under all circumstances.
 - Individual/Separate Transmissions can be categorized under 15.231(a)-(d) or 15.231(e)
 - No mixing of rules for transmission!

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RFID 15.245

Question: We have a request to certify a 2.45GHz device under 15.245. The device communicates with tag transmitters which come into range. We think this is not a field disturbance sensor and is therefore excluded from this section by 15.245(a). Please confirm that RF communications capacity with another device is not allowed by field disturbance sensors unless specifically called out (for example in 15.253(a)).

Response: Data transfer is possible only with FDS systems using passive tags and only if the data transfer function is ancillary to the primary purpose of a FDS system which is the detection of the presence of people or objects.

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RFID
15.247


Part 15.247 Frequency Hopping RFID
Systems

- See 15.247 related KDBs

**Determining Antenna Gain for RF ID
Systems Operating Under 15.247**

- See 15.247 related KDBs

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Pulsed transmitters

- Check PRF and pulse width of pulsed transmitters.
Watch out for devices with very fast pulses < 1 mS. Use HP note 150- 2 for guidelines on pulse desensitivity.
 - Device May be categorized as UWB.
- For pulse modulated devices with a PRF less than 20 Hz(greater than 50 mS) when QP limits are specified, Peak detection is employed. We then compare the peak level to the QP limit. See section 15.35.
- For burst transmissions where the burst repetition rate is less than 20 Hz(greater than 50 mS) and the burst width is too short for the QP detector to fully respond, peak detection is employed and the peak level is compared to the QP limit.
 - * May modify signal for continuous operation to make QP measurement. However, also supply PEAK measurement.
- Typical devices include those for...
 - meter readers where transmission of a single transmission packet is sent in bursts(e.g. once every 5 seconds or once a day)
- For pulsed modulated device, (Non UWB devices), continuous operation of pulsed signals still require PDCF. For example, a 100% continuous burst signal requires PDCF. 100% transmission of CW signal does not require PDCF. Consider Fluid level measuring transmitters that use burst of nanosecond pulses. Operation at 100% continuous bursts still requires PDCF to be considered.

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Pulsed transmitters

- **DUTY CYCLE CORRECTION FACTORS**
- Purpose - average detector measurements are dependent on the pulse width or pulse train characteristics and the measuring instrument specifications, so repeatability is almost impossible from test instrument to test instrument.
- Basic formula (15.35(c))
- Duty cycle = on time/100 milliseconds or period, whichever is less
- On time = $N_1L_1+N_2L_2+\dots+N_N-1L_{N-1}+NNLN$
- Where N_1 is number of type 1 pulses, L_1 is length of type 1 pulses, etc.
- Restating the basic formula
- Duty cycle = $(N_1L_1+N_2L_2+\dots+NN-1L_{N-1}+NNLN)/100$ or T , whichever is less
- Where T is the period of the pulse train


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Pulsed transmitters

- EXAMPLE 1
- A transmitter sends a pulse once every 120 milliseconds. The pulse length is 4 milliseconds. What is the duty cycle?
- Answer 1
- Duty cycle = $4/100$
- Duty cycle = .04 or 4 %.
- To correct the peak reading to the average value of an emission, you either multiply the percent duty cycle factor expressed in decimal form (.04) times the field strength value
- expressed in terms of microvolt/meter @ 3 meters.
- Suppose the peak reading is 1000 uV/m @ 3 meters. If you multiply 1000 times .04, you get 40 uV/m @ 3 meters as the average field strength.
- OR
- You take 20 times the log of (.04) to convert to the duty cycle correction factor to dB and add this value from the field strength when expressed in terms of dB above a microvolt/meter (dBuV/meter) @ 3 meters.
- The 1000 uV/m @ 3 meters level is equivalent to 60 dBuV/m @ 3 meters. $20 \log (.04)$ equals -27.958 dB (approximately -28 dB). $60-28=32$ dBuV/m @ 3 meters or 39.76 uV/m @ 3 m (approximately 40 uV/m @ 3 m).


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Pulsed transmitters

- EXAMPLE 2
- A transmitter has the following pulse train plots. What is its duty cycle correction factor?
- Answer 2
- The first plot shows the period to be 34.557 milliseconds..
- The second plot shows the long pulses last 688.889 microseconds or .689 milliseconds.
- The third plot shows that the short pulses last .356 milliseconds.
- There are 10 long pulses and 6 short pulses on the third plot.
- According to the general formula given above
- Duty cycle = $(N_1L_1+N_2L_2+\dots+N_{N-1}L_{N-1}+N_NL_N)/100$ or T
- this reduces to
- Duty cycle = $((10)(.689)+(6)(.356))/34.6$
- $((6.89)+(2.14))/34.6 = 9.03/34.6 = .260982659 = .26$ or -11.7 dB


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Pulsed transmitters

- EXAMPLE 3
- A transmitter uses a code that changes each time a pulse train transmission is initiated (The Commission calls these "rolling codes"). The duty factor ranges from 45 to 64 %. What duty cycle correction factor should they use?
- Answer 3
- Use the duty cycle correction factor that gives the lowest correction. A duty cycle of 45 % yields a correction factor of -6.9 dB ($20 \log .45 = -6.9$ dB). A duty cycle of 64 % yields a correction factor of -3.8 dB ($20 \log .64 = -3.8$ dB). Therefore, use the 64 % duty cycle correction factor. The test report should verify that the duty cycle factor does change with each transmission by showing several (not all) sample pulse trains.


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Pulsed transmitters

- **RADIATED MEASUREMENTS OF FUNDAMENTAL wide band carrier based pulsed systems that are not filed under the UWB rules.**
- Only spurious emissions are permitted in restricted band
- Main lobe must not be in restricted band.
- 20 dB of Main lobe must be within frequency band of authorization.
- How do you estimate the Main lobe width of a carrier pulsed on for 1 nanosecond?
 - Mainlobe is approximately = $2/\text{pulse width}$ Mainlobe= 2GHz for pulse width of 1 nanosecond.
 - Mainlobe must be measured due to effects of antenna and/or cable effecting signal.
- **UNMODULATED (CW) CARRIER**
- 1. With the pulsing stopped, the peak level of the fundamental emission is measured with a 1 MHz RBW and a VBW equal to, or greater than, the RBW. No pulse desensitization factor is added to this level.
- The average level of the fundamental emission is determined by subtracting the calculated duty cycle factor from the peak level measured above. No pulse desensitization factor is added to this level.
- **OTHERWISE,**
- 1. Hewlett Packard Application Note 150-2 (pulsed RF). Republished by Agilent.
- This training is not intended to replace a thorough understanding of the above application note. It is intended to give you a basic understanding of its applications regarding EMC measurements.
- Also, see PN http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-04-3946A1.doc


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Part 15 In ground Water Meter transceivers

- KDB# 139720
- Allows testing in ground as opposed to an open area test site (OATS).
- Professional installation is required.
- Section 15. 249 requires Quasi-Peak Measurements in the 902-928 MHz band.
- Instructions must provide appropriate details for the installation of the transmitter in the pits and must specify the types of pits.
- Condition grant accordingly.
 - Professional installation and specific types of pits.
- Tests
 - Use mast. Do not use a tripod with fixed height.
 - Section 8.1 in ANSI C63.4 should be consulted. Frequency scans of the EUT field strength with both polarities of the measuring antenna shall be made at a minimum of 16 azimuth angles (nominally 22.5 degrees) around the EUT.


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Implant transmitters

- TCB's cannot approve implant transmitters
- For EAB filings
 - use “IT” note code
 - “IT” Implanted Transmitter
 - Account for RF safety requirements.
 - Test on OATS test table or in appropriate Part-95-like in-liquid phantom.

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Wireless Chargers

Wireless battery chargers and wireless power pads operating at frequencies above 9kHz As intentional radiators.


Wireless battery chargers and wireless power pads could be subject to either Part 15 and/or Part 18 of our rules. The specific rule part would depend on how the device operates and if there is communications between the charger and device being charged.

According to the rules, Part 18 devices may not transmit information from the PAD to the local device being charged. Parts 18 devices that charge devices not placed in the close proximity of the surface of the power source pad require a case by case review by the Commission. Further, at the present time, we require a SAR evaluation for these products for consumer application and recommended an equipment certification for part 18 devices. It is possible to obtain a Declaration of Conformity (DoC) for consumer part 18 devices. In that case, the Commission requires a RFE evaluation and needs to be submitted to the FCC for review.

Intentional radiators transmitting information must be certified under appropriate part 15 rules and will generally require an equipment certification. It is possible that the power charging function could also be approved under part 15 if the device meets all of the specific requirements. Further, for a very special types of devices listed in Section 15.201 may be subject to verification. However, we need to see more detailed explanation to determine if the rules are appropriate.

Finally, a wireless battery charger may also be certified under multiple rule parts (part 18 and part 15) When power and communications functions can be demonstrated independent from each other. In all these cases an RFE evaluation will also be required.


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Miscellaneous measurement info

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Miscellaneous Measurement Updates

- Adoption of C63.4 and C63.10; We are working on a Public Notice and will accept either C63.4-2003 or C63.4-2009 or C63.10-2009 as appropriate.
- - Power measurement techniques for 802.11 a/b/g/ n devices – In the works.
- - Interim plans for 5.4 GHZ DFS equipment – A KDB will be issued.


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Miscellaneous Updates

- Devices subject only to verification or are exempt may not be Certified.
 - Section 15.101 and 15.103 indicates verification and exemption.
 - Some License transmitters are verified.
- Loop antennas are required for measurements below 30 MHz.
- Bluetooth and WLAN composite filings
 - When filing Bluetooth as a DTS, file a DTS test report.
- Cell phones with computer port connectors must also be authorized as a computer peripheral.
- PDCF (Pulse Desensitization Correction Factor)
 - For pulsed modulated device, (Non UWB devices), a 100% continuous burst signal requires PDCF. 100% transmission of CW signal does not require PDCF.
 - Radar fluid level sensor transmitters commonly use short pulse widths.

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Alternative peak output power procedures.

Alternative peak output power procedures.

Channel bandwidth

Bandwidth power function for output power measurements(#1-8)

For Peak output power measurements when the analyzer RBW is not large enough as required, the analyzer band power function can be used.


(For UNII output power measurements where VBW averaging is allowed. See the UNII test procedure.)*

- 1) Set the RBW and VBW to the maximum available.
- 2) Set the band limits as appropriate for the power measurement. (e.g. 6dB, 20 dB or 26 dB bandwidth). Expand the band limits by about 0.5*RBW on each end.
- 3) Turn average off.
- 4) Set sweep to automatic.
- 5) Set the span just large enough to capture the emission.
- 6) Use a peak detector on max hold.
- 7) The analyzer should be in linear (rather than log) display mode.
- 8) Let the emission stabilize before making a final reading.

BW correction factor-

$10 \log (6\text{dB BW of emission/ analyzer RBW})$ * Use largest available analyzer RBW.


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RADIATED MEASUREMENTS AT A BANDEDGE

- **KDB# 913591**
 - Procedure for making band edge measurements of a Part 15 intentional radiator


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Measurement related KDBs

- KDB# 746324
 - Measurements above 1 GHz. CISPR 22 does not satisfy FCC maximization requirements.
- KDB# 460108
 - Monopole (rod) antennas prohibited for measurements < 30 MHz.
- KDB# 890966
 - Testing radar level gauges info

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Specific Rule Sections

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2.1043 Permissive Change polices

- **KDB# 178919 Permissive Change Policies**
 - **Contains Permissive change info.**
- KDB # 685804
 - Updating an FCC approved device to meet the European RoHs (No lead) directive.
 - Section 2.1043 rules apply


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General Tx requirements Section 15.1-15.38 and 15.215

- Frequent issues
 - Section 15.15(b)
 - User controls must not bring device out of compliance.
 - Section 15.31(h)
 - Composite systems> also test with all radiating sources employed.
 - Section 15.215(c)
 - 20 dB of fundamental must be within the permitted band of operation.


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15.19 related KDBs

- **KDB# 784748** – Labeling and User Information Requirements for Part 15 and 18 Devices
 - Includes electronic display labeling for SDRs and Modular transmitters.

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15.101 and 15.103

- Devices subject only to verification or are exempt may not be Certified.
 - Section 15.101 and 15.103 indicates verification and exemption.
 - Some License transmitters are verified.

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15.102 related KDBs

- KDB# 657217
 - Test procedures and info on Notebook assembled by components.

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15.103 related KDBs

- KDB# 275534
 - Vehicular Battery Chargers (VBC) for Cellular Phones Exempted per Section 15.103(a).
 - Exempted per Section 15.103(a).
 - The VBC is not promoted for applications other than use within a vehicle. Section 15.103(a) exempts digital devices used exclusively in transportation vehicles
 - Classified as a digital device under Part 15 of our rules.
 - Subject only to our non-interference provisions (Sections 15.5 and 15.29).

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15.103 related KDBs

- See KDB# 149045
 - Comparison Noise Emitter (CNE) exempted under Section 15.103(c)
 - Comparison Noise Emitter (CNE) used to evaluate anechoic chambers and Open Area Test Sites (OATS is exempt from an Equipment Authorization under Section 15.103(c).
 - The CNE in question
 - » broadband noise source
 - » low power
 - » permanently attached antenna
 - » operates over the frequency range of 9 kHz to 2 GHz.
 - » Used by a skilled technician
 - Other types of reference noise sources used in a shielded enclosures for immunity and similar types of testing, or a license must be obtained under Part 5 of the Rules.

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Section 15.201(a)

- Section 15.201(a) Lower power devices(40 dB below 15.209) are subject to verification
 - These devices may not operate in a restricted band in 15.205.
 - Per 15.205(c), there are some exceptions to operating under a restricted band but 15.201 is not an exception. Section 15.205(c) also indicates that regardless of the field strength of the device, it cannot operate in the restricted bands.

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15.202 Rule

Section 15.202 Certified operating frequency range

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Client devices that operate in a master/client network may be certified if they have the capability of operating outside permissible Part 15 frequency bands, provided they operate on only permissible Part15 frequencies under the control of the master device with which they communicate.

Master devices marketed within the United States must be limited to operation on permissible Part 15 frequencies.

Client devices that can also act as master devices must meet the requirements of a master device.

For the purposes of this section, a master device is defined as a device operating in a mode in which it has the capability to transmit without receiving an enabling signal. In this mode it is able to select a channel and initiate a network by sending enabling signals to other devices. A network always has at least one device operating in master mode. A client device is defined as a device operating in a mode in which the transmissions of the device are under control of the master. A device in client mode is not able to initiate a network.


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15.202

- Client devices in ad hoc mode must be limited to USA frequencies. Therefore, passive listening of client devices in ad hoc mode on non-USA frequencies is not allowed.
- Active listening (beacon transmissions) on non-USA frequencies is not permissible
- **Question 1:** Is it permissible to control country-of-origin setting of master/client devices with the use of a key "switch" that is shipped with the product to the specific country? The frequency of operation is limited by encrypted key "switch" software.
 - **Reply 1: No,** The key "switch" encryption method is not strong enough to acceptably prevent transmission on non authorized US frequency bands.
- Reduction in channels; PC I or PC II, Tests required to verify PC type. No change in output power and software change only.
- Increase in frequency range. For Non SDR device, PC II allowed to extend range only by software. Hardware change requires new FCC identifier. Submit tests for new frequency range.


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15.203

- **ANTENNA REQUIREMENTS** (Section 15.203)
- Purpose - to prevent attaching any other antenna(s) (from the one(s) approved with the transmitter) to a Part 15 transmitter. All antennas must be listed in the filing.
- There are three ways to demonstrate compliance
- 1) Antenna permanently attached
 - Antenna soldered to a printed circuit board
 - Antenna permanently glued with epoxy to a standard connector
 - 1. Specify the type of adhesive to be use
 - 2. Confirm that the adhesive will be applied at the factory (prior to shipment)
- 2) Unique (non-standard) antenna connector
- Standard antenna connector - Any antenna connector found in an electronic parts catalogue is not unique and, therefore, prohibited by Section 15.203
- Examples of standard connectors that are prohibited
 - BNC, TNC, N, SMA, SMX, and F type connectors.
- Unique antenna connectors
 - Standard connectors with a left-handed thread
 - Reverse polarity connectors (standard connectors in which the male pin has been inserted in what is normally the female end of the connector and vise-versa)
 - Standard connectors with non-standard thread gauge or physical dimensions
 - Screw-type connectors typically used by cordless phones
- 3) Professional installation.
- Justifying Professional installation does not justify that ANY antenna can be used with the tx.

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15.203

- Motion to stay RF connector Public Notice on Antenna connector extended indefinitely
- http://www.fcc.gov/Bureaus/Engineering_Technology/Public_Notices/2000/da002225.txt
Petition for reconsideration pending. See Ray Laforge at RLaforge@fcc.gov


“...MMCX, MCX, and reverse polarity SMA, reverse polarity BNC and reverse polarity TNC type antenna connectors...”

- Until petition is worked on, **these connectors are acceptable.**

- We have in the past, allowed the following to show compliance with Section 15.203.
- 1) Use of permanent, industrial epoxy, loctite or solder to make the connection permanent prior to shipping.
- 2) Allowed the use of standard connectors if the transmitter has a sensing circuitry that disables the transmitter if an unauthorized antenna is used. An application should detail how this is accomplished.
- 3) The use of a standard connector is also allowed if the connector is within the transmitter enclosure and can only be accessed by disassembly of the transmitter that is not normally required. Check the manual to ensure that the user has no access to the connector.
- 4) BIOS lock. Radio card and laptop exchange code to ensure only authorized system works in laptop.

- **Professional installation.** Must be justified and grant condition must state **“This device must be professionally installed.**

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Professional installation justification

The applicant should confirm the following when justifying Professional installation:

Professional installation
To qualify for professional installation, you must explain why the hardware cannot simply be purchased and installed by the average (technically inclined) person

- 1) Marketing
 - * The device cannot be sold retail, to the general public or by mail order. It must be sold to dealers.
- 2) Requires professional installation;
 - installation must be controlled.
 - installed by licensed professionals (EUT sold to dealer who hire installers)
 - installation requires special training (special programming, access to keypad, field strength measurements made) What is unique, sophisticated, complex, or specialized about your equipment which REQUIRES it to be installed by a professional installer?
- 3) Application
 - The intended use is generally not for the general public. It is generally for industry/commercial use.

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Professional installation

- Grant condition - In those situations where we agree that professional installation is "*required*", we condition the Grant accordingly (i.e., "**This device must be professionally installed.**").
- Professional installation examples
- Transmitters used for data and control signal transmissions located in oil fields
- Transmitters mounted on trains and train stations
- Pole-mounted transmitters used by utility companies
- Transmitters mounted on traffic signals for use by police and/or emergency vehicles.
- *** Section 15.203 Antenna requirement applies to all devices except
 - 15.211 – Tunnel radio systems
 - 15.213 – Cable locating equipment
 - 15.217 – 160 - 190 kHz transmitters
 - 15.219 – 510 – 1705 kHz transmitters
 - 15.221 – 525 – 1705 kHz transmitters
 - Perimeter protection systems and some field disturbance sensors requiring professional installation

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15.203 related KDBs

- KDB# 602159
 - Part 15 repeater requirements
- KDB# 816806
 - Non standard antenna connectors
- KDB# 239743
 - Antennas with antenna sensing circuit
- KDB# 268277
 - Snap on locking antenna connector

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15.204


- Do Not authorize a Part 15 standalone amplifier
- Do Not authorize a Part 15 amplifier and antenna device. (aka active antenna).
- Authorize only complete transmitter systems.
- Device must be marketed as a system to end user.

Exceptions.

- Standalone amplifier is certified with system per Section 15.204(d)
- Device may be OEM installed but device must be complete system to end user.

Grant condition: **OEM installation only.**
User manual must not have user installation instructions.

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15.204

- Authorize only complete transmitter systems.
- Device must be marketed as a system to end user.

Exceptions (CONTINUED)

- BIOS lock. Radio and antenna sold separately. Radio card and laptop exchange code to ensure only authorized system works in laptop.
 - Grant condition: **"This device must utilize a BIOS lock mechanism which ensures use only with hosts as specified in the Certification filing."**
 - *** Do not grant user installable plug-in mini PCI radio cards that operate with antennas built in laptop and can be used in any laptop computer with mini PCI plug in slot.
 - For user installed radios used with integrated antennas in laptops, we require a two-way bios lock implementation to ensure compliance with the requirements. This ensures the module verifies that the proper laptop is used and the laptop verifies that the proper module is used.

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15.204 Antenna Changes

- See KDB# 178919 Permissive Change Policies
 - Contains Permissive change info.

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15.204 related KDBs

- KDB# 189073
 - Selling transmitter without antenna for professionally installed transmitters.
- KDB# 420149
 - Passive reflectors are treated like antennas
- KDB# 696199
 - Part 15 amplifier option added
- KDB# 144180
 - Actual antennas must be used for testing.


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15.205

- Regardless of the levels, a device may not operate in a restricted band.
- For 2.4 GHz 802.11b/g WLAN devices, operating in the 2400 - 2483.5 MHz frequency band the following channel plan is generally used.
 - Channel 1 : 2412 MHz
 - Channel 2 : 2417 MHz
 - Channel 3 : 2422 MHz
 - Channel 4 : 2427 MHz
 - Channel 5 : 2432 MHz
 - Channel 6 : 2437 MHz
 - Channel 7 : 2442 MHz
 - Channel 8 : 2447 MHz
 - Channel 9 : 2452 MHz
 - Channel 10 : 2457 MHz
 - Channel 11 : 2462 MHz
 - Channel 12 : 2467 MHz
 - Channel 13 : 2472 MHz
 - Channel 14 : 2484 MHz
- Operation on channel 14 is not allowed.
- Operation on the channels near the restricted band but within the allowed frequencies is possible only if it meets all of the requirements.
 - Restricted band field strength limits have to be met. The antenna must be taken into account. For devices with low output power, these channels may be compliant with a low gain antenna but non-compliant with a higher gain antenna.
 - Section 15.215(c) which requires that the 20 dB bandwidth of the emission to be within the 2400-2483.5 MHz band for this device.
 - Check all modulations and data rates.


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15.207

- AC line conducted test requirement for transmitters.
- Not applicable for Battery operated devices.
- For transmitters that use AC to DC power adapters that are not supplied by the grantee, compliance must be shown with an unmodified “off the shelf” AC to DC power adapter.


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AC line conducted data for Part 15 Modules.

- Section 15.207(a) requires test data unless the device is battery powered.
- Battery powered examples.
 - The transmitter is powered by an on-board battery.
 - Transmitter has a battery connector/compartament.
 - The transmitter is only intended for battery powered applications and installed by OEM.
 - Device is conditioned only for battery powered applications and a limited module approval is issued.
 - Any new non-battery application requires a new authorization.
 - The transmitter is installed only in the manufacturers equipment that will be battery powered.
 - Device is conditioned accordingly and a limited module approval is issued.


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CISPR AC Line Conducted Limits for All Transmitters

- The CISPR AC line conducted limits only apply to Part 15 and 18 devices.
 - Devices that operate under any other rule parts (e.g., 22, 24, 90, etc.) are not affected by this rule change.
- To update a Part 15 grant, a Class II permissive change filing is submitted showing compliance with the CISPR AC line conducted limits.
 - Applies to devices will continue to be marketed after July 11, 2005.
 - The conducted output power of the device does not change beyond the tolerance for this measurement (+/- 0.5 dB).
- The policies for filing Class II permissive changes are different for some Part 18 devices because Part 18 devices had no AC line conducted emissions limits before we adopted the CISPR limits.
 - Microwave ovens
 - <http://gulfoss2.fcc.gov/prod/oet/cf/kdb/forms/FTSSearchResultPage.cfm?id=20040&switch=1>
 - Contact the lab for other devices

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Note codes "CE" or "O5"

- AC line conducted limits 15.207
 - The "CE" note was used all on devices that are tested and comply with the new requirements and are granted before July 11, 2004. After July 10 all new approvals must meet the new rules.
 - The "O5" note was used on all devices that met the current line conducted regulations and not the new limits up until the time that all devices must meet the new rules.
 - An issue that comes up based on the way the rulemaking is worded is that the rulemaking uses the words "...must be authorized by ..." in the transition date sections. For TC applications this is correct but for EA applications it means that a device received on July 11, 2004 under the old rules would have to be granted by July 12, 2004. The proposed solution for this is to process EA applications based on the receipt date but TC applications must be granted by the transition date.

-"CE" - This device has shown compliance with the conducted emissions limits in 15.107, 15.207, or 18.307 adopted under FCC 02-157 (ET Docket 98-80) and may be marketed after July 11, 2005 and is not affected by the 15.37(j) and 18.123 transition provisions.

-"O5" - The manufacture and importation of this device must cease on July 10, 2005.


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15.207 related KDBs

- KDB# 1 74176** - Use of a dummy load for AC power line conducted measurements for a Part 15 device.

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15.209

- **Section 15.209** General section (Does not prohibit certain devices or modulation types)
- **Operating frequencies:** Transmitters in 15.209 can operate on any frequency except restricted bands in 15.205 and in frequencies listed in 15.209(a). 54-72 MHz, 76-88MHz, 174-216 MHz or 470-806 MHz.
- **Requirements:** ::(Check current rules for details and any changes)
- **Fundamental:** Must be below radiated limits 15.209(a).
- **Spurious emissions:** Must be below level of fundamental.

- **Check list:** Use the General Checklist with the following frequent compliance issues.
 - Confirm the level of the fundamental and compare to spurious levels.
 - Check to see if a Loop antenna was used for testing? Rod antennas are not permitted.
 - levels in table listed in 15.209(a) is Quasi-peak except for emissions in the bands 9-90kHz, 110-490kHz and above 1000 MHz. Limits in these three bands are Average.
 - 15.209(g) perimeter protection may only operate under 15.209 in the bands 54-72 MHz and 76-88 Mhz. Limited to industrial, business and commercial applications.


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15.209 related KDBs

- KDB# 220340
 - Can conducted measurements replace radiated measurements?

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15.211 Tunnel Radio Systems

- Verified
- Do Not Certify devices in this Section.

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15.212 Modular transmitters

Modular intent is to allow manufacturers to build new devices with same transmitter in multiple hosts without the need for Re-Certification of the transmitter.

- Part 15 Unlicensed Transmitter Modules (Small Entity Compliance Guide) (DA 08-314):
 - http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-08-314A1.pdf
- Modular approval must be requested to obtain modular approval.
 - Provide a cover letter requesting modular approval and addressing the modular requirements.
 - Mark 731 with appropriate modular approval type.
- A Part 15 limited single or split module is described in Section 15.212(b). **A limited single or limited split modular transmitter may be granted if it does not meet single or split modular requirements listed in 15.212(a) and if compliance can be demonstrated under the operating conditions in which the transmitter will be used (e.g. grant conditions are needed for compliance).**
- For RF Exposure compliance consideration, a portable modular transmitter is considered limited (single or split) if compliance must be demonstrated in a specific host such as for SAR. **Mobile and fixed modular approved transmitters are not considered limited, unless they are limited to a specific host or a particular product configurations**
- For a Part 15 limited single or split module, the manufacturer must state how control of the end product into which the module will be installed will be maintained such that full compliance of the end product is always assured.
- A single or split module approval is one that is not limited (Section 15.212(b)).


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PC Motherboard with Integrated TX Module Policy 1 of 2

1. Approval must not allow undefined mixing of motherboards and radios. Authorization is only for the specific transmitter board/components layout and specific CPU motherboard layout within a filing.
2. Approve as composite system subject to certification for transmitter portion, and additional certification or DoC for motherboard portion as subassembly under 15.102.
3. Emissions testing is to be done both with enclosure open for motherboard portion, and enclosure closed for transmitter portion, therefore allowing alternate enclosures.


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PC Motherboard with Integrated TX Module Policy 2 of 2

4. Radiated limits apply to specific device – i.e. motherboard has relaxed limits with enclosure open.
5. Filing should clearly account for at least 2.925(d) label visibility, 15.32 CPU requirements, 15.203 antenna connector, 15.204 sold-as-system.
6. To ensure RF exposure compliance, this approval procedure is limited for operations in mobile or fixed RF exposure conditions, i.e., desktop computer - not portable laptop, tablet, etc.
7. Motherboard/transmitter approvals shall be for use with connected/cabled antennas only, with antennas external to enclosure, not printed-circuit antennas installed or embedded on the motherboard. Due to use of metal enclosures for PC's.
8. TCBs may approve specific motherboard/transmitter devices, per conditions described above.

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Modular policies

- A change from non-modular approval to modular approval **does not** require a new FCC identifier.
- A change from modular approval to limited modular approval **does not** require a new FCC identifier.


Modular review issues

- Remove all modular references on grant if approval is for a non-modular device.
- Watch out for undeclared and optional co-located transmitter. i.e. Bluetooth
- Do not lay antennas for cabled modules on wooden table.
- Licensed modular transmitters requirements are similar.

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15.213 Cable locating equipment

- Verified
- Do Not Certify devices in this Section.


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15.214 Cordless Telephones

- Applies to all Cordless Telephones
- Must meet Cordless telephone definition in Section 15.3(j)


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15.214 related KDBs

- KDB# 868660
 - Cordless phones in which the remote and base operate on different frequencies can be filed under one FCC identifier


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15.217

- **Section 15.217** General section (Does not prohibit certain devices or modulation types)
- **Operating frequencies:** 160-190 kHz
- **Requirements:** ::(Check current rules for details and any changes)
- Fundamental: Input power to the final RF stage limited to 1 watt
- Length of the transmission line, antenna and ground lead(if used) limited to 15 meters.
- Spurious emissions: 20 dB below the unmodulated carrier
- **Check list:** Use the General Checklist with the following frequent compliance issues.
 - Confirm the level of the unmodulated carrier and check the spurious limits.
 - Check to see if a Loop antenna was used for testing? Rod antennas are not permitted.
 - Confirm that the Loop antenna was rotated about the horizontal and vertical axis?
 - The proper Equipment Class is "DCD"


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15.219

- **Section 15.219** General section
-
- **Operating frequencies:** 510 - 1705 kHz.
- **Requirements** ::(Check current rules for details and any changes)
- Fundamental: Input power to the final RF stage is limited to 100 mW.
- Length of the transmission line, antenna and ground lead(if used) limited to 3 meters.
- Spurious emissions: 20 dB below the unmodulated carrier.
-
- **Check list:** Use the General Checklist with the following frequent compliance issues.
 - Check to see if a Loop antenna was used for testing?
 - Rod antennas are not permitted.
 - Confirm that the Loop antenna was rotated about the horizontal and vertical axis?
 - Check for compliance of spurious emissions in the restricted bands.
 - The proper Equipment Class is "DCD"

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AM transmitters operating under Section 15.219

- Section 15.219 restricts the length of the antenna, connecting cable and ground lead to 3 meters. Watch out for filings with elevated installation mounting that require running a ground connection down to a ground plane. It is the ground, which now is well over 3 m itself and becomes the major radiator. This is how Certified AM transmitters are being installed or modified to operate over long distances.

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15.221

- Operation in the band 525 kHz-1705 kHz
- Carrier current systems and transmitters employing leaky coaxial cables as the antenna.
- VERIFIED
- Do Not Certify devices in this Section.

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15.223

- **Section 15.223** General section
- **Operating frequencies** 1.705 - 10 MHz.
- **Requirements:** *(Check current rules for details and any changes)*
 - Fundamental: 100 uV/m at a distance of 30 meters. (average)
 - When $BW < 10\% F_c$, Higher of 15 uV/m or $BW(kHz) / F_c(MHz)$
 - Spurious emissions: Section 15.209.
- **Check list:** Use the General Checklist with the following frequent compliance issues.
 - -Restricted band requirements
 - Fundamental can not be in a restricted band.
 - -Exception: Swept frequency field disturbance devices in the band 1.705-10 MHz that will be covered later.
 - - Check for compliance with the spurious emissions in restricted bands.
 - - Check for Peak measurement data
 - - Check to see if a Loop antenna was used for testing? Rod antennas are not permitted.
 - - Confirm that the Loop antenna was rotated about the horizontal and vertical axis?


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Swept Frequency Anti-pilferage Device Section 15.223

- **Section 15.223**
- **Operating frequencies** 1.705 - 10 MHz.
- **Requirements:** *(Check current rules for details and any changes)*
- (Fundamental: 100 uV/m at a distance of 30 meters. (average)
- Higher of 15 uV/m or $BW(\text{kHz}) / F_c(\text{MHz})$ when $BW < 10\% F_c$
- *The total width of the swept signal is considered to determine the 6 dB bandwidth for calculating the field strength limit.*
- *Spurious emissions: Section 15.209.*
- **There are two common systems. The carrier swept system and the carrier hopped system.**
- **1) Carrier swept systems are allowed to sweep through restricted bands per Section 15.205(d)1.**
- *When applying 15.205(d)1, swept frequency field disturbance sensors which sweep thru restricted bands, the 1% of the sweep time allowed to be spent in a restricted band should be applied to each restricted band separately. That is, do not add up the frequency range of every restricted band thru which the device sweeps for comparison to the device's sweep range.*
- **2) Carrier hopped systems are NOT allowed to operate in restricted bands.** *This system must avoid hopping on discrete frequencies in the restricted band.*


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Section 15.223 Frequent compliance issues

- **Check list:** Use the General Checklist with the following frequent compliance issues.
 - Frequency sweep stopped for radiated measurements?
 - Restricted band requirements. What kind of system is it?
 - The proper Equipment Class "FAP"
 - Check to see if a Loop antenna was used for testing? Rod antennas are not permitted.
 - Confirm that the Loop antenna was rotated about the horizontal and vertical axis?
 - Quasi-peak measurements are made with the frequency stopped.
 - Check for peak measurement data.
- For average measurements, a duty cycle correction factor is NOT applied to carrier swept systems. However, a duty cycle correction factor IS applied for Carrier hopped systems as follows...
 - *For carrier hopped systems that hop on discrete frequencies, you can apply the averaging described in 15.35. The averaging factor should be determined by measuring (with a 9 kHz measurement instrument RBW) how long the hopping signal actually spends on a frequency during any 100 ms time interval. If the device goes through its hop set and returns to the same frequency during the 100 ms measuring interval, then the total occupancy time on that frequency during the 100 ms interval should be used in calculating the duty cycle correction.*
 - *Note that if the hopping frequencies are so close that more than one frequency falls within the 9 kHz measurement instrument bandwidth, then the above duty cycle measurement applies to the total time occupied by all frequencies falling within the 9 kHz bandwidth during the 100 ms time interval.*


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15.225

- **Section 15.225:** General section
- **Operating frequencies:** 13.110 - 14.010 MHz
- **Requirements:** *(Check current rules for details and any changes)*
Fundamental; Various levels depending on frequency.
- Spurious: Section 15.209.
- Frequency tolerance: $\pm 0.01\%$
- **Check list:** Use the General Checklist with the following frequent compliance issues.
 - Bandedge compliance
 - Does a plot of the bandwidth show bandedge compliance?
 - Quasi peak measurement of the fundamental
 - Check to see if a Loop antenna was used for testing? Rod antennas are not permitted.
 - Confirm that the Loop antenna was rotated about the horizontal and vertical axis?

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15.227

- **Section 15.227** General Section
- **Operating frequencies:** 26.96 - 27.28 MHz.
- **Requirements:**:(*Check current rules for details and any changes*)
 - - Fundamental: 10,000 uV/m at 3 meters. (Average)
 - -Spurious emissions: Section 15.209.
- **Check list:** Use the General Checklist with the following frequent compliance issues.
 - Bandedge compliance
 - Does a plot of the bandwidth show bandedge compliance?

 - Check for Peak measurement data.
 - Check to make sure Rod antennas were not used.

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15.229

Section 15.229 General Section

- **Operating frequencies:** 40.66 - 40.70 MHz.
- **Requirements:** *(Check current rules for details and any changes)*
- Fundamental: 1000 uV/m at 3 meters. QP
Perimeter protection alternative: 500 uV/m at 3 meters. Average
- Spurious: Section 15.209
- Frequency tolerance: $\pm 0.01\%$ of the operating frequency
- **Check list:** Use the General Checklist with the following frequent compliance issues.
- - Bandedge compliance. Check the bandwidth plot to help determine compliance.
 - Check for the proper measurement detector.
 - Peak measurement data


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15.231

- **Section 15.231** Periodic transmitters.
- **Operating frequencies:** 40.66 - 40.70 MHz and above 70 MHz.
- **Requirements:** (Check current rules for details and any changes)
- Periodic operation except as specified in Section 15.231(e).
 - Transmission of a control signal only.
 - Toys are not permitted.
- Continuous transmission such as voice and, video not permitted.
 - Data transmissions not permitted.
- Recognition codes for sensor identification allowed.
 - 5 second transmission limitation.
- Manual transmission must deactivate 5 seconds after release.
- Automatic transmissions must cease 5 seconds after activation.
- Transmissions at regular predetermined intervals are not permitted. However,
- Polling or supervision transmissions to determine system integrity of transmitters used in security or safety applications are allowed if the periodic rate of transmission does not exceed one transmission of not more than one second duration per hour for each transmitter.
- *** Transmissions with a non-predetermined(random) delay time every few seconds are not allowed.
- Transmissions during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.
- Fundamental and spurious limits are listed in the table of Section 15.231(b). Average limit or alternatively Quasi peak
- Spurious limit is 20 dB below the fundamental limit.
- Bandwidth requirement
- Frequency tolerance requirement for devices in 40.66-40.70 MHz.


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15.231 manual vs automatic activation clarification.

- Manual activation means that you, yourself, personally physically move an actual switch, lever, or whatever, the movement of which causes the transmitter to transmit.
- Automatic operation means that a sensor detects a change in something and causes the transmitter to activate as a result of that change without any intervention by some person.


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15.231 Frequent issues

- **Check list:** Use the General Checklist with the following frequent compliance issues.
 - A device must operate under the rules in 15.231(a-d) and/or 15.231(e). Do not mix requirements in one with the other.
 - Check for Peak measurement data when applicable.
 - Check for the correct spurious limits. Limit is based on the fundamental frequency not the emission frequency.
 - Continuous transmissions during non safety of life conditions are not permitted.
 - e.g. Asset protection is not considered a Safety of life Condition
 - Toggle switches that lock the button in the “on” position and causes transmission greater than 5 seconds is prohibited. Common in Crane controllers.
 - Data transmission prohibited. Transmission of temperature, pressure and elapsed time are considered data and are not allowed.
 - Toys are prohibited.


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Section 15.231(e)

- **Section 15.231(e)**
- Lower field strength and no operation limitation except for automatic transmission requirement.
- **Requirements:** *(Check current rules for details and any changes)*
- Automatic transmission limitation requirement: (The duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds)
- Fundamental limits are listed in the table.
- Spurious limit is 20 dB below the fundamental limit.
- **Check list:** Use the General Checklist with the following frequent compliance issues.
 - Automatic transmission limitation description missing or does not sufficiently indicate compliance. Check the duration of transmission.
 - Check for Peak measurement data.
 - Check for the correct spurious limits. Limit is based on the fundamental frequency not the emission frequency.
 - A device must operate under the rules in 15.231(a-d) and/or 15.231(e). Do not mix requirements in one with the other.


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15.231 Related KDBs

- KDB # 252102
 - Wireless Keyboards may not operate under 15.231
- KDB # 930766
 - Garage door opener operating on multiple frequencies.
- KDB# 151788
 - Emergency transmission
- KDB# 296753
 - Learned Mode or trainable transmitters


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Cordless Phones Section 15.233

- **Section 15.233**
- **Operating frequencies:** 43.71 - 44.49 MHz, 46.60 - 46.98 MHz, 48.75 - 49.51 MHz and 49.66 - 50.0 MHz.
- **Requirements:** (Check current rules for details and any changes)
- **Section 15.214** (provides additional requirements for cordless phones)
- Single application for both base and portable handset allowed.
- A separate application for registration under Part 68 of this Chapter is required.
- Privacy label
- Security code requirement. Provide a statement indicating how the device complies. Minimum # 256 Codes
- **Section 15.233**
- Restricted to Cordless phones
- Frequencies paired as listed in the Table except for Channels 1-15.
- *Exception.* The original 10 channels must pair with the frequencies shown in the rules.
- For phones on Channels 1-15, an automatic channel selection mechanism is required to prevent the establishment of a link on any occupied frequency. Provide a statement of compliance with this requirement.
- Information regarding interference to TV's and VCR's.
- **Fundamental:** 10,000 microvolts/meter at 3 meters. (average)
Within 20 kHz of listed frequency.
- **Spurious:** Higher of Section 15.209 or 26 dB below the unmodulated carrier.
- Report all emissions exceeding 20 microvolts/meter at 3 meters
Test with all external accessories.
- Frequency $\pm 0.01\%$ of the operating frequency.


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15.233 Cordless phones Frequent issues

- **Check list:** Use the General Checklist with the following frequent compliance issues.
 - Automatic channel selection mechanism. A description must clearly indicate how the phone will not establish a link on any of the new frequencies without first examining each frequency of intended use.
 - A flow diagram is helpful to explain link operation.
 - Both frequencies must be checked for interference before establishment of a link.
 - We require a test to show compliance with the automatic channel selection mechanism.
 - Repeaters are not allowed. They do not meet the definition of a cordless phone.
 - The proper Equipment Class is “ETS”
 - “ETB” for an application of the Base unit only
 - “ETR” for an application of the Remote unit only


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15.233 related KDBs

- KDB# 806974
 - Wireless remote telephone jack.
- KDB# 212452
 - Common Channel System


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15.235

- **Section 15.235** General Section except that Cordless phones are prohibited.
- **Operating frequencies:** 49.82 - 49.90 MHz.
- **Requirements:** (*Check current rules for details and any changes*)
 - Fundamental: 10,000 microvolts/meter at 3 meters. (Average)
 - Spurious: Section 15.209
 - Bandedge requirement within 10 kHz of band: Higher of Section 15.209 or 26dB below the level of the unmodulated carrier.
 - Cordless telephones are prohibited
- **Check list:** Use the General Checklist with the following frequent compliance issues.
 - Band edge Compliance. Check the Bandwidth plot to determine compliance.
 - Check for Peak measurement data.

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Section 15.237 Auditory Assistance Devices

- Operating frequencies
72.0-73.0, 74.6-74.8, 75.2-76.0 MHz
- Requirements: *(Check current rules for details and any changes)*
- 80 mV/m at 3m within 200 kHz band
- 1.5 mV/m at 3m outside 200kHz band

Limited to auditory assistance device per 15.3(a)
Average detector
Couple the general checklist with the following frequent compliance issues

- Band-edge measurements
- Peak measurement
- Adjacent to restricted bands: 73.0-74.6, 74.8-75.2 MHz
- Use must fit definition in 15.3(a). Check manual for use and marketing discrepancies. Use grant condition to help restrict use.


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15.237 related KDBs

- KDB# 296588
 - 2 way auditory assistance device


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15.239

- **Section 15.239** General section
- **Operating frequencies:** 88 - 108 MHz.
- **Requirements:** *(Check current rules for details and any changes)*
 - Fundamental: 200 kHz wide and must be within 88-108 MHz.
 - 250 microvolts/meter at 3 meters. (Average)
 - Spurious: Section 15.209.
- **Check list:** Use the General Checklist with the following frequent compliance issues.
 - Check for a Bandwidth test with input at maximum.
 - User controls or audio input adjusted to maximize emission for test.
 - Check the tuning range of FM transmitter
 - Does the device tune outside of the 88-108 MHz band?
 - *Operate tuning mechanism. Some tuning mechanism's do not limit frequencies within band.


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15.239 related KDBs

- KDB# 470998 describes how to test an FM-band Transmitter that uses Car wiring as the transmit antenna.
 - FM transmitters
At the present time, for FM transmitters (subject to 15.239) tested in vehicles, consult the FCC.


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15.240

- **Section 15.240** RFID to identify contents of commercial shipping containers
- **Operating frequencies:** Operation in the band 433.5-434.5 MHz.
- **Requirements:** (Restriction on use, type of operation and location. *Check current rules for details and any changes*)
 - Fundamental: 11,000 uV/meter at 3 m (Average)
 - 55,000 uV/meter at 3 m (Peak)
 - Spurious: Section 15.209.
 - Operation limitation 60 second duration, 10 second silent period
- **Check list:** Use the General Checklist with the following frequent compliance issues.
 - Check manual and installation instructions for agreement with appropriate operational requirements (a)- (e).
 - Check limits on spurious emissions

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15.241 and 15.242

DO NOT GRANT Part 15 devices in these sections.

Per 15.37(i)

- Effective October 16, 2002, an equipment approval may no longer be obtained for medical telemetry equipment operating under the provisions of § 15.241 or § 15.242. The requirements for obtaining an approval for medical telemetry equipment after this date are found in Subpart H of Part 95 of this chapter.

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15.243

- **Section 15.243** Restricted to devices measuring characteristics of material.
- **Operating frequencies:** 890 - 940 MHz.
- **Requirements:**:(*Check current rules for details and any changes*)
- Fundamental: 500 microvolts/meter at 30 meters. (average)
- Spurious: Section 15.209.

Voice communications or the transmission of any other type of message prohibited.


Self-contained with no external or readily accessible controls which may be adjusted to permit operation in a manner inconsistent with the provisions in this Section.

Any antenna that may be used with the device shall be permanently attached thereto and shall not be readily modifiable by the user.

Check list: Use the General Checklist with the following frequent compliance issues.

- Use of this section for purposes other than measuring characteristics of material.
- Check for peak measurement data.


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15.245

- **Section 15.245 Field disturbance sensor (FDS)**
- **Operating frequencies**
- **902-928,2435-2465, 5785-5815, 10500-10550 and 24075-24175 MHz**
- **Requirements:** *(Check current rules for details and any changes)*
- **The limit on both the fundamental and the harmonics are stated in 15.245(b) and are based on the fundamental frequency**
- **Out of band emissions except harmonics must be 50 dB below fundamental or meet limits in 15.209 whichever is lesser attenuation**
- **Average detector**
- **Further requirements/limits depend on frequency and use of the device. See Rules**
- **Couple the general checklist with the following frequent compliance issues**
 - **Harmonics in restricted bands**
 - **Band-edge measurement**
 - **Peak readings**
 - **Employing pulses may require a correction factor per 15.35**
 - **If tested in metal tanks, grand condition must state that device must only be used in metal tanks.**


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FDS tag reader policy

- Question: We have a request to certify a 2.45GHz device under 15.245. The device communicates with tag transmitters which come into range. We think this is not a field disturbance sensor and is therefore excluded from this section by 15.245(a). Please confirm that RF communications capacity with another device is not allowed by field disturbance sensors unless specifically called out (for example in 15.253(a)).
- Response: Data transfer is possible only with FDS systems using passive tags and only if the data transfer function is ancillary to the primary purpose of a FDS system which is the detection of the presence of people or objects.


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15.245 related KDBs

- KDB# 661845
 - Clarifies perimeter protection exclusion

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15.247

Spread spectrum devices

- Test for DTS and FHSS at <http://www.fcc.gov/oet/ea/eameasurements.html>
- DTS (Digital Transmission Systems) rules replace DSS (Direct Sequence Spread spectrum)
 - Processing gain requirement eliminated.
 - Equipment Class "DTS" do not use "DSS"
 - See rules and use additional separate document for DTS guideline
 - Use Smart Antenna System (SAS) guidelines as appropriate
 - Spread spectrum system defined in 2.1 is also allowed as a DTS
- Frequency Hopping Spread Spectrum devices.
 - New rules in 2.4 GHz band offer minimum of 15 channels at 125 mW.
 - Equipment Class is "DSS"
 - Use rules and Public Notice on frequency hoppers as guideline
- Frequent issues
 - Output power.
 - Use procedure in Public notice or use alternative output power
 - Discrepancies between EMC and RF safety reports.
 - List the center frequency of the lowest channel to the center frequency of the highest channel for each band.
 - Restricted band 2483.5-2500 MHz compliance
 - Do not approve Tag readers that use only CW signal or have wide receiver input bandwidth and does not hop in synchronization with tx.
 - Show compliance with Frequency hopping operational requirements in 15.247(a)1 and 15.247(g) and 15.247(h).
 - Test all modulation capabilities
 - E.g. 802.11b and 802.1g modes must be tested.

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**Passive tags used with Frequency Hopping Tag Reading systems
operating in Section 15.247.
Frequently Asked Questions**

Q: Is a passive tag subject to Certification?
A: No, a passive tag does not contain batteries and by itself is not authorized.


Q: Are passive tags tested for Certification?
A: No, only the tag reader needs to be tested. At this time, the current technology for passive tags is such that the emission levels from the passive tags are much lower than the allowed levels for the tag reader. However, even with the low emission levels, the fundamental passive tag emission(s) may not operate within a restricted band just as the tag reader is prohibited from operating in a restricted band. The tag reader receiver should never include restricted band frequencies.

Q: How can compliance with the transmit and receive nominal bandwidth matching requirement in Section 15.247(a)1 be achieved?
A: This requirement is achieved by the tag reader not the passive tag. The receive bandwidth in the reader must nominally match or can be less than either the modulated signal from the tag reader signal or the passive tag signal. The receive bandwidth can be achieved with the use of baseband/DSP filters and does not have to be centered with either the passive tag signal or the tag reader signal.

Q: Is there a limit on the bandwidth of the fundamental emission from the tag reader or the passive tag signal?
A: The maximum 20dB bandwidth of the modulated signal from the tag reader is used to determine the Channel separation requirements for the tag reader. This must be considered when determining the designed bandwidth whenever there is a minimum number of hop frequencies required. Since the emissions from the passive tag are much lower than the allowed levels for the tag reader, we are not worried about the bandwidth of the passive tag signal.

Q: Can the Tag Reader utilize a CW signal?
A: A tag reading system that uses only an un-modulated CW signal cannot operate under Section 15.247 but may operate under another rule such as Section 15.249 because Section 15.249 does not have a modulation requirement. Under Section 15.247, a tag reader system can send CW signals as part of a half duplexed signal on each hop frequency. The half-duplexed signal consists of the modulated reader signal followed by the CW signal. The modulated signal sends data to and is received by the tag. The CW signal is used only to power the passive tag. For example, the tag reader sends a modulated data signal for 7 msec, followed by a CW signal on the same frequency for 7 msec to power the passive tag before the reader hops to the next frequency. A short CW burst prior to the half duplexed signal can be used to wake up the tag.

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In band spurious emissions for Section 15.247 devices

- In band spurious emission limit is general the same as fundamental limit. However, in no case can the level of any spurious emission exceed the level of the fundamental.
- For a product operating under Section 15.247, the only limit on the emission level appearing within the assigned band is based on the fundamental limit, e.g., one watt output from the transmitter into a 6 dBi antenna is the limit anywhere within the 902-928 MHz band.

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DTS filing guidance 1 of 5

- Direct Transmission Systems Systems- 15.247
- **15.247(a):**
- ___ Does the EUT meet the definition of a Digital Transmission System, based on the technical description of the EUT?
Digital modulation is required see Section 15.403(b) *
* Spread spectrum system defined in 2.1 is also still allowed.
- **15.247(a)(2):**
- ___ Were acceptable test procedures and instrument settings used to measure the 6 dB bandwidth?
- ___ Does the measured 6 dB bandwidth comply with the minimum 500 kHz requirement?
- **15.247(b):**
- ___ Were acceptable test procedures and instrument settings used to measure the peak output power?
A peak power meter is the preferred measuring instrument. If an analyzer is used, be sure the RBW is greater than the 6 dB bandwidth.
*Alternative to peak measurement allowed. See DTS test procedure.
- **15.247(b)(3):**
- ___ Does the measured peak output power comply with the appropriate limit?
Look for consistency throughout the test report, user's manual, and technical descriptions, wrt the various measured and/or stated output power levels.


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DTS filing guidance 2 of 5

- **15.247(b)(4):**
- ___ Does the measured peak output power, in conjunction with the stated antenna gain, comply with the *de facto* +36 dBm EIRP limit for all proposed antennas?
- **Note that the output power limit is reduced in order to comply with the *de facto* EIRP limit. If the measured output power is already below the limit, a reduction may not be necessary.**
- **If compliance with the EIRP limit is achieved for various antennas by adjusting the output power at the time of installation, then professional installation of this transmitter is required. The installation manual must contain adequate instructions such that the correct output power can be chosen for any antenna being used.**
- **15.247(c):**
- ___ Is the appropriate *de facto* EIRP limit met for fixed, point-to-point operation in the 2.4 GHz band for all proposed antennas? [RF conducted peak output power limit = 30 dBm - ((Gain-6dBi)/3), dropping all fractions.]
- **Note that the output power limit is reduced in order to comply with the *de facto* EIRP limit. If the measured output power is already below the limit, a reduction may not be necessary.**
- **Again, if compliance with the EIRP limit is achieved for various antennas by adjusting the output power at the time of installation, then professional installation of this transmitter is required. The installation manual must contain adequate instructions such that the correct output power can be chosen for any antenna being used.**
- *****No reduction in output power for point to point operation at 5.8 GHz band**
- *****900 MHz band limited to 4 Watt(36 dBm) EIRP.**
- ___ For Smart Antenna System, Use SAS guidelines.


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DTS filing guidance 3 of 5

- **15.247(c):**
- Does the proposed point-to-point system meet the appropriate requirements, and do the installation instructions contain the correct language?
- **Understand the intent behind allowing the EIRP relaxation for point-to-point applications only.**
- **When multiple antennas are listed in the installation manual, those that may only be used in point-to-point applications should be clearly indicated.**
- Are the appropriate installation/user's manual language for point to point systems included?
- Does the device comply with the RF safety requirements? Is the device on the TCB exclusion list?
- Single Sector systems are Point to multipoint systems!
- **15.247(d):**
- Were acceptable test procedures and instrument settings used for both spurious radiated and RF conducted measurements?
- Do the measured spurious RF conducted emission levels comply with the 20 dBc limit, both at the bandedges, and for all other spurious emissions through the 10th harmonic, or 40 GHz (whichever is lower)?
- **RBW may be reduced at the bandedges.**
- **Devices that utilize a permanently attached antenna must demonstrate compliance with the 20 dBc requirement based wholly on radiated measurement results. For radiated emissions not located in a restricted band, a peak detector and a RBW of 100 kHz may be used, and compared to the radiated level of the fundamental, as measured with a peak detector and a RBW of 100 kHz.**


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- Do the measured spurious radiated emission average levels comply with the Section 15.209 limit, for all radiated emissions in restricted bands, as defined in Section 15.205, through the 10th harmonic, or 40 GHz (whichever is lower)?
- A duty cycle correction factor, as defined in Section 15.35(c), may be applied to a measurement made with an average detector, or its equivalent, to further reduce the value.
- Measurements may be performed on the highest gain antenna of each “type”. In other words, if multiple yagi, patch, and dish antennas are proposed, only the highest gain yagi, patch, and dish must be tested.
- Measurements should also be made on the lowest gain antenna, so that the EUT is operating at its highest available output power, in order to test for case radiation.
- Do the measured spurious radiated emission peak levels comply with the Section 15.35(b) limit, for all radiated emissions in restricted bands, as defined in Section 15.205, through the 10th harmonic, or 40 GHz (whichever is lower)?
- Unless the measured peak field strength levels comply with the average limit, then both peak and average data must be submitted.
- Look for consistency in reported peak and average measurements.
- Measurements may be performed on the highest gain antenna of each “type”. In other words, if multiple yagi, patch, and dish antennas are proposed, only the highest gain yagi, patch, and dish must be tested. Measurements should also be made with the EUT operating at its highest available output power, in order to test for case radiation.
- It is likely that compliance with the Section 15.209 field strength limit in the 2483.5-2500 MHz restricted band will determine the maximum output power allowable at the upper bandedge channel for each antenna. The installation manual must make this clear.


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DTS filing guidance 5 of 5

- **15.247(e):**
- ___ Were acceptable test procedures and instrument settings used to measure peak power spectral density?
- **Make sure sweep is not too fast.**
- **EUT must be continuously transmitting.**
- ___ Does the measured peak power spectral density comply with the +8 dBm/3 kHz limit?
- 15.33, 15.35, 15.203, 15.204, 15.205, 15.207, and 15.214:
- ___ Does the direct sequence system comply with these Sections?
- **15.101(a):**
- ___ If the EUT also meets the definition of a personal computer peripheral, then that portion of the EUT must also be authorized, through Verification (if Class A), Certification, or DoC. If Class A use is proposed, then a justification for this rating must be provided. Was this done?

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Smart Antenna Systems (SAS) guidelines 1 of 18

- Use as a guideline for multiple antenna/beam systems.
- Use Note Code SA: Smart antenna system that uses beam steering or beam forming capabilities to form multiple beams.
 - This Note Code was developed to track smart antenna systems operating under the new spread spectrum rules in Section 15.247 and complying with Sections 15.249(c)(2)(i) to (iv). However, the Note Code can also be used for any device that operates in any other rule part as long as the device uses beam forming/steering or can form multiple beams.
- Smart antenna test guidelines in development.
 - Do not use combiner for output power measurements.
 - Make measurements at each antenna port and add up power from all ports
- SAS policies
 - Prohibited Broadcasting does not include occasional broadcast management signals or non-permanent multi-casting.

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Loot at technology/operation of the device rather than marketing
Ensure consistency between approval and user manual.



Smart Antenna System (SAS) Guidelines 2 of 18


- TCB's can only approve these specific systems.
 - FCC approves all others.
- 1) Phased array systems
- 2) Sectorized systems
- 3) Spatial Multiplexing "MIMO*" systems with or without cyclic delay diversity.

- Check the operational description to ensure that the device is one of the above systems. Do not rely on marketing literature alone.
- Only Spatial Multiplexing "MIMO" systems or Phased array "MIMO" can be approved.
- TCB's cannot approve systems using a combination of the above. For example, TCB's cannot approve a Phased array Spatial Multiplexing "MIMO" system.

*It is noted that the term MIMO, an acronym for Multiple Input Multiple Output, has been used to describe some devices that employ phased array technology rather than spatial multiplexing technology. Such devices would fit into the phased array category used in this document.

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Multiple antenna output antenna systems.




Smart Antenna System (SAS) Guidelines -Type of operation 3 of 18

- Because the type of operation determines the applicable requirements (e.g. output power), devices in Section 15.247 or 15.407 must be categorized as one of the following as described in the following pages.
 - Point to point system(P2P),
 - Point to multipoint(P2MP) system
 - Smart antenna system (SAS) under Section 15.247(c)2.
- Therefore, review the filing to ensure that the type of operation is correct.

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Smart Antenna System (SAS) Guidelines
-SAS System 4 of 18

- Section 15.247(c)2 Smart Antenna System (SAS) operation.
 - Operation at 2.4 GHz under 15.247(c)2.
 - More than two beams are formed.
 - Communication to multiple or mobile receivers allowed.
 - Different information is sent to different receivers.
 - Does not include occasional management/control signals or occasional multicasting.
 - Sectorized systems are allowed.
- If not SAS, then system is either P2P or P2MP
- Hoppers at 2.4 GHz can qualify as SAS system.

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Smart Antenna System (SAS) Guidelines
-P2P System 5 of 18


- Point to point (P2P) system. Communication from one fixed point to another fixed point.
 - Includes phased array systems communicating to one fixed receiver at a time.
 - Broadcasting is not allowed.
 - The point to point link should be achieved only by the intended recipient receiving the signal by way of the directional angle of the antenna modified for individual transmissions.
 - Does not include sectorized systems communicating to one receiver at a time except those that qualify as a SAS system.

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Includes phased array systems communicating to one fixed receiver at a time. Broadcasting is not allowed and you transmit to each individual one at a time and the receivers are at known, fixed locations, then the system can be considered point to point and can be authorized. The point to point link should not be obtained through the use of an encoded address similar to tone encoding, but instead should be achieved only by the intended recipient receiving the signal by way of the directional angle of the antenna modified for individual transmissions. Per 15.204 the antenna system must be authorized with the transmitter

Does not include sectorized systems


Part 15 Unlicensed Transmitters communicating to one receiver at a time except



Smart Antenna System (SAS) Guidelines
-P2MP System 6 of 18

- Point to multipoint (P2MP) system.
Communication to multiple or mobile receivers.
 - Includes all Sectorized systems except those that qualify as a SAS systems.


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Smart Antenna System (SAS) Guidelines
-Determine Output power 7 of 18

- Output power limit is determined by....
 - Rule part applied
 - 15.247 or 15.407
 - Frequency band
 - Type operation
 - Point to point (P2P) system
 - Point to multipoint (P2MP) system
 - Smart Antenna (SAS) system
 - Operates under 15.247(c)2i-iv.
 - Directional gain


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Smart Antenna System (SAS) Guidelines
-Directional Gain Computation 8 of 18

- **Phased array systems**
 - Directional gain = gain of antenna element + $10 \log(\# \text{ of TX antenna elements})$
- **Sectorized systems**
 - Directional gain = gain of each antenna
- **Spatial Multiplexing "MIMO" system**
 - For any spatial multiplexing "MIMO" mode in which the elements are always driven incoherently at each frequency...
 - Directional gain = gain of each antenna
 - For all other modes that drive multiple antenna elements, including legacy modes for communicating with non-MIMO devices...
 - Directional gain = gain of antenna element + $10 \log(\# \text{ of TX antenna elements})$

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Smart Antenna System (SAS) Guidelines
-Output power 9 of 18

- Except for devices complying with Section 15.247(c)2i-iv, conducted output power refers to the total power within a given band.
 - The Spread Spectrum bands 902-928, 2400-2483.5 and 5725-5850 MHz and the UNII bands of 5150-5250 MHz, 5250-5350 MHz, 5470-5725 MHz, and 5725-5825 MHz are all considered separate bands—each subject to its own in-band power limit.
 - If a device can transmit simultaneously on the same or different channels within one of those bands, the power must be summed across channels within the band.
- Signal combiners should be avoided because it can produce anomalous results if the summed signals exhibit any correlation

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For example, for a UNII multi-sectored access point transmitting simultaneously on more than one channel, the sum of all output powers must meet the output power limit (e.g. 1 watt).




Smart Antenna System (SAS) Guidelines
-Output power measurement 10 of 18

- **P2MP systems**
 - For each band, Sum power measurements across all transmitter outputs for all simultaneous transmissions on all channels.

- **P2P systems**
 - Sum power across all transmitter outputs.
 - Only one transmitted beam allowed at a time.

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Smart Antenna System (SAS) Guidelines
-Output power measurement 11 of 18

- SAS systems operating under Section 15.247(c)2i-iv
 - Phased array system
 - Single beam power: Measure power to each antenna element during transmission in a single beam, then sum the power measurements across elements.
 - Aggregate power : As above, but measure during transmission in simultaneously transmitted beams.
 - Sectorized system
 - Single beam power: Measure power to antenna for each beam
 - Aggregate power: Sum power measurements across transmitter outputs for simultaneously transmitted beams.
 - Spatial multiplexing MIMO system
 - TCB's cannot approve this system as a SAS system.

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Spatial multiplexing MIMO system

TCB's cannot approve this system as a SAS system.

SAS systems must form multiple beams.

A Spatial multiplexing MIMO system forming multiple beams would require a combination with a phased array or sectorized system.


These combo systems cannot be approved by a TCB.



Smart Antenna System (SAS) Guidelines
-Output power 12 of 18

- Review the filing to ensure that the output power was properly measured and the output power limit was calculated properly based on the type of operation, rule part and directional gain of the antenna.

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Smart Antenna System (SAS) Guidelines
-Power Spectral Density 13 of 18

- Aggregate PSD across transmitters in linear power units across each transmitter output.
- For transmitters operating simultaneously, the combined output must meet the requirement.
 - Check compliances on simultaneous transmitter outputs on the same frequency channels.

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For conducted PSD tests, PSD should be aggregated across transmitters by summing spectra in linear power units.

For sectorized antenna devices, phased array devices, and Spatial Multiplexing MIMO devices, the requirement must be met individually on each transmitter output. In addition, all transmitter outputs that can operate simultaneously must be aggregated through a combiner, and the combined output must also meet the requirement. (The combiner test should be performed on all devices that have multiple simultaneous outputs, but is especially important for devices having simultaneous transmitter outputs on the same frequency channels.)




Smart Antenna System (SAS) Guidelines
-Conducted out of band emissions 14 of 18

- Each transmitter output must comply.
- For simultaneous transmitter outputs, the combined output must also meet the requirement.
 - Check compliance when on simultaneous outputs on different frequency channels

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The requirement must be met individually on each transmitter output.


In addition, all transmitter outputs that can operate simultaneously must be aggregated through a combiner, and the combined output must also meet the requirement. (The combiner test should be performed on all devices that have multiple simultaneous outputs, but is especially important for devices having simultaneous transmitter outputs on different frequency channels.)



Smart Antenna System (SAS) Guidelines
-Radiated emissions 15 of 18

- Single and multiple beam configurations (when applicable) must be considered.
- Multiple simultaneous Channels
 - Check compliance on same and different channels when applicable.
 - Bandedge edge and Restricted bands
- Antenna installation
 - Antenna spacing
 - Beam angle and azimuth (when applicable)
 - Measurements should be performed in a representative sampling of beam positions. For example, for a device with a single steerable beam, it is recommended that tests be performed with a three beam positions—one at each extreme steering angle and one near the middle of the steering range. In any case, ensure that the angle forming the maximum beam is tested.


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Beam Overlap for SAS systems under Section 15.247(c)2i-iv 16 of 18

- A description of compliance with the maximum beam overlap requirement may be sufficient to show compliance.
- Description must specify...
 - 1) Beamwidth. Do 3 dB beamwidths overlap? If 3 dB beamwidths overlap, a measurement is required if the sum of the output power is greater than or equal to the single beam output power limit for the device.
 - 2) Antenna installation.
Describe direction and spacing.
 - 3) Beam angle and elevation when applicable.

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Beam Overlap for SAS systems under Section 15.247(c)2i-iv 17 of 18

- **Radiated Beam Overlap measurement.** Applicable when 3 dB beams can overlap and non-compliance is possible (e.g. device operates within 3 dB of allowed max power on overlapped beams).
- **Beam Overlap defined.** At any point, at a distance “r” from the EUT, the sum of the power received from overlapping beams on the same or different channels must be less than or equal to the Maximum EIRP allowed for a single beam.
- **Measure the field strength E V/m for each beam at the point of overlap at distance “r”. For “n” number of beams.**

$$\frac{((\text{Sum } 1 \text{ to } n; E_1 + E_2 + \dots + E_n) \times r)^2}{30} < \text{EIRP max Watts}$$

*Assumes Gaussian beam. For non-Gaussian beams, please contact the FCC.
- **If EIRP max is exceeded, the power in each beam must be reduced to satisfy the equation. Else, device fails.**


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Smart Antenna System (SAS) Filing Guidelines
-TCB Approval Notes 18 of 18

- Use Smart antenna Note code SA when applicable.
 - Note Code SA: Smart antenna system that uses beam steering or beam forming capabilities to form multiple beams.
- List the maximum single beam aggregate output power on the grant in the technical specification for each frequency band.
- Indicate whether the system is Phased array, Sectorized or Spatial Multiplexing “MIMO”.

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FHSS


- Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Transmitters

<http://www.fcc.gov/oet/ea/eameasurements.html>

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FHSS filing guidance 1 of 7

- **Frequency Hopping Spread Spectrum Systems- 15.247**
- **15.247(a):**
- Does the EUT meet the definition of a frequency hopping spread spectrum system, based on the technical description of the EUT? (See Section 2.1)
- **15.247(a)(1):**
- Is the frequency hopping channel separation at least 25 kHz, or the 20 dB bandwidth (see below) of the emission, based on either the technical description or on measured data?*
- **This applies to all channels used in a specific transmission event, not necessarily to all available channels.**
 - *Alternatively, 2.4 GHz FHSS systems have separation of 25 kHz or 2/3 of the 20 dB bandwidth. 125 mW power applies
- Is the hopping sequence pseudorandom, based on the technical description? (See the definition of a Frequency Hopping System in Section 2.1)
- **Fixed channel increments are not allowed.**
- Is each channel used equally on average, based on the technical description?
- **Beacon channels are permitted for isochronous systems only, not for asynchronous systems or dual-mode systems.**
- Does the associated system receiver have a compliant input bandwidth, based on the measured 20 dB emission bandwidth? (See below)
- **The required equivalent input bandwidth may be realized in either hardware or software.**
- Does the associated system receiver have the ability to hop in synchronization with the transmitter, based on the technical description?
- **Fast scanning between hops is permitted.**


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FHSS filing guidance 2 of 7

- **15.247(a)(1)(i),(ii) and (iii):**
- Were acceptable test procedures and instrument settings used to measure the 20 dB bandwidth and the dwell time?
- **A RBW of at least 1% of the emission bandwidth may be used.**
- Does the measured 20 dB bandwidth comply with the appropriate limit?
- Does the dwell time (average time of occupancy) per channel comply with the 0.4 second limit?
- **This refers to total transmit time within the period of investigation.**
- Is the proper number of hopping channels employed, in all modes of operation? (This is determined by the measured 20 dB bandwidth and the frequency range)
- **This includes various paging and/or acquisition modes.**
- **15.247(b):**
- Were acceptable test procedures and instrument settings used to measure the peak output power?
- **A peak power meter is the preferred measuring instrument. If an analyzer is used, be sure the RBW is greater than the occupied bandwidth. The hopping function must be disabled.**
- Does the measured peak output power comply with the appropriate limit? (The output power depends on the frequency range and the number of hopping channels)
- **Look for consistency throughout the test report, user's manual, and technical descriptions wrt the various measured and/or stated output power levels.**


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FHSS filing guidance 3 of 7

- 15.247(b)(4):
- Does the measured peak output power, in conjunction with the stated antenna gain, comply with the *de facto* +36 dBm EIRP limit for all proposed antennas?
- Note that the output power limit is reduced in order to comply with the *de facto* EIRP limit. If the measured output power is already below the limit, a reduction may not be necessary.
- If compliance with the EIRP limit is achieved for various antennas by adjusting the output power at the time of installation, then professional installation of this transmitter is required. The installation manual must contain adequate instructions such that the correct output power can be chosen for any antenna being used.
- 15.247(c):
- Is the appropriate *de facto* EIRP limit met for fixed, point-to-point operation in the 2.4 GHz band for all proposed antennas? [RF conducted peak output power limit = 30 dBm - ((Gant-6dBi)/3), dropping all fractions.]
- Note that the output power limit is reduced in order to comply with the *de facto* EIRP limit. If the measured output power is already below the limit, a reduction may not be necessary.
- Again, if compliance with the EIRP limit is achieved for various antennas by adjusting the output power at the time of installation, then professional installation of this transmitter is required. The installation manual must contain adequate instructions such that the correct output power can be chosen for any antenna being used.
- ***No reduction in output power for point to point operation at 5.8 GHz band
- ***900 MHz band, 1 dB reduction below power limit for every 1 dB over 6 dBi antenna gain.
- ***For Smart Antenna Systems (SAS) see also smart antenna system guidelines


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FHSS filing guidance 4 of 7

- **15.247(c):**
 - Does the proposed point-to-point system meet the appropriate requirements, and do the installation instructions contain the correct language?
 - **Understand the intent behind allowing the EIRP relaxation for point-to-point applications only.**
 - **When multiple antennas are listed in the installation manual, those that may only be used in point-to-point applications should be clearly indicated.**
 - Are the appropriate installation/user's manual language for point to point systems included?
- **15.247(d):**
 - Were acceptable test procedures and instrument settings used for both spurious radiated and RF conducted measurements?
 - Do the measured spurious RF conducted emission levels comply with the 20 dBc limit, both at the bandedges, and for all other spurious emissions through the 10th harmonic, or 40 GHz (whichever is lower)?
 - **RBW may be reduced at the bandedges, however, potential high frequency spurs created by the hopping function must be compliant. The hopping function must be disabled for all other tests.**
 - **Devices that utilize a permanently attached antenna must demonstrate compliance with the 20 dBc requirement based wholly on radiated measurement results. For radiated emissions not located in a restricted band, a peak detector and a RBW of 100 kHz may be used, and compared to the radiated level of the fundamental, as measured with a peak detector and a RBW of 100 kHz.**


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FHSS filing guidance 5 of 7

- Do the measured spurious radiated emission average levels comply with the Section 15.209 limit, for all radiated emissions in restricted bands, as defined in Section 15.205, through the 10th harmonic, or 40 GHz (whichever is lower)?
- **A correction factor, based on the total channel dwell time in a 100 ms period, may be mathematically applied to a measurement made with an average detector, or its equivalent, to further reduce the value.**
- **Measurements may be performed on the highest gain antenna of each "type". In other words, if multiple yagi, patch, and dish antennas are proposed, only the highest gain yagi, patch, and dish must be tested.**
- **Measurements should also be made on the lowest gain antenna, so that the EUT is operating at its highest available output power, in order to test for case radiation.**
- Do the measured spurious radiated emission peak levels comply with the Section 15.35(b) limit, for all radiated emissions in restricted bands, as defined in Section 15.205, through the 10th harmonic, or 40 GHz (whichever is lower)?
- **Unless the measured peak field strength levels comply with the average limit, then both peak and average data must be submitted.**
- **Look for consistency in reported peak and average measurements.**
- **Measurements may be performed on the highest gain antenna of each "type". In other words, if multiple yagi, patch, and dish antennas are proposed, only the highest gain yagi, patch, and dish must be tested.**
- **Measurements should also be made on the lowest gain antenna, so that the EUT is operating at its highest available output power, in order to test for case radiation.**


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FHSS filing guidance 6 of 7

- **15.247(g):**
 - ___ Does the design of the frequency hopping system allow it to comply with all pertinent requirements when presented with a lengthy data stream? (i.e., is it designed to be more than a frequency agile system designed to always transmit all information in a single hop?)
 - **Systems that employ short transmission bursts must still use all channels equally, on average. This typically means that each new transmission event must start on the next channel in the hop sequence, and may not reset to the first channel for the next transmission event.**
- **15.247(h):**
 - ___ Does the frequency hopping system comply with the non-coordination requirement?
 - **Coordination, from a single central intelligence, may not occur if the intent is to avoid collisions. Coordination for other purposes is permitted (e.g., the time of transmission, for TDD or TDMA purposes).**
- **15.247(i):**
 - ___ Does the device comply with the RF safety requirements? Is the device on the TCB exclusion list?


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FHSS filing guidance 7 of 7

- 15.33, 15.35, 15.203, 15.204, 15.205, 15.207, and 15.214:
- ___ Does the frequency hopping system comply with these Sections?
- 15.101(a):
- ___ If the EUT also meets the definition of a personal computer peripheral, then that portion of the EUT must also be authorized, through Verification (if Class A), Certification, or DoC. If Class A use is proposed, then a justification for this rating must be provided. Was this done?


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15.247 related KDBs

- KDB# 453039
 - Hybrid, DTS and FHSS systems.
- KDB# 520657
 - Multiple transmitters sharing common antenna
- KDB# 543300
 - Point to point versus point to multipoint
- KDB# 192659
 - Antennas with vertical and horizontal elements
- KDB# 205122
 - Passive tag policies for FHSS readers in 15.247233

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15.249

- General use
- Operating frequencies
902-928, 2400-2483.5, 5725-5875 MHz
24.0-24.25 GHz
- Requirements: *(Check current rules for details and any changes)*
- The limit on both the fundamental and harmonics are stated in 15.249(a) and (b).
- Point to point systems in 24 GHz allowed more field strength.
- Out of band emissions except harmonics must be 50 dB below harmonics or to limits in 15.209 whichever is the lesser attenuation
- Quasi-peak detector below 1 GHz and average above
- Couple the general checklist with the following frequent compliance issues

- Use quasi-peak limits within the 902-928 MHz band
- Cordless phones
 - Compliance with 15.214
 - Privacy label per 15.214(c)
 - Minimum of 256 security codes

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In band spurious limits for 15.249

- The limit for spurious emissions under Sec. 15.249 is 50 mV/m, as measured at 3 meters with a quasi-peak detector, anywhere within the 902-928 MHz band. The limits for emissions outside of the 902-928 MHz band are the 15.209 limits. The spurious emissions may not exceed the level of the fundamental emission.

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15.249 related KDBs

- KDB# 433442
 - Spurious emissions in 15.249
- KDB# 720338
 - Measurement info on fundamental measurement


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15.250

- Operation of wideband systems within the band 5925-7250 MHz.
- BW requirement
- Operation aboard aircraft or Satellite prohibited
- No toys
- Fixed infrastructure not allowed
- Check for all operational restrictions or prohibitions.


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15.251

- General use
- Operating frequencies
- 2.9-3.26, 3.267-3.332 , 3.339-3.3458 and 3.358-3.6 GHz
- Equipment Class "EAV"
Requirements: *(Check current rules for details and any changes)*
- Operation limited to Automatic Vehicle Identification Systems (AVIS) which use swept frequency techniques for the purpose of automatically identifying transportation vehicles.
- Fundamental 3000 uV/m per MHz. at 3 meters in any direction
 - When in operating position 400 uV/m per MHz at 3 meters in any direction within \pm 10 degrees of the horizontal plane.
 - Spurious 100 uV/m per MHz at 3 meters from 30 MHz to 20 GHz.
 - Limits are average. Peak limit in 15.35 applies.
 - Minimum sweep of 4000 sweeps/second. Maximum sweep of 50,000 sweeps/second.
 - Directional antenna
 - AVIS signal can only occur when vehicle is in radiated field.
 - Additional labeling requirement
 - Additional measurement requirements in 15.251(g) 1-4.
- Couple the general checklist with the following frequent compliance issues
 - Ensure operations is limited to AVIS systems.
 - Check for additional measurement requirements in 15.251(g) 1-4.

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15.252

- Operation of wideband vehicular radar systems within the bands 16.2-17.7 GHz and 23.12-29.0 GHz.
- Check for proper operation.

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Section 15.253 and 15.255

- High frequency /millimeter wave rule sections.
- Frequencies 15.253, 46.7-46.9 GHz and 76-77 GHz
- Frequencies 15.255, 57-64 GHz
- Ensure compliance with all applicable rules.
 - Limits may be based on type of operation (in motion or not in motion, forward looking versus rear looking vehicle mounted tx), frequency of operation or bandwidth
- Operation is limited and Certain uses prohibited.
 - 15.253 limited to vehicle mounted field disturbance sensors used as vehicle radar systems.
 - 15.255 Operation not permitted for equipment on aircraft or satellites. Also not permitted for Field disturbance sensors unless for fixed operation.
- High frequency testing
 - Use millimeter wave test procedure as guideline.
 - Check for far field measurements.
 - Check for required frequency range of radiated measurements.
 - Check to make sure equipment and test setup will have enough sensitivity to measure required limits.
 - For millimeter wave devices, since each antenna must also comply with peak power density requirements and also the shape and size of the antenna will affect the measurement distance (far field), **data for all antennas submitted for millimeter wave devices should be submitted in the equipment authorization filing.**


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15.253 and 15.255 related KDBs

- KDB# 622265
 - 15.255 Millimeter wave testing with multiple antennas.
- KDB# 754309
 - 15.253 Vehicle mounted Field disturbance sensor
- KDB# 200443
 - Millimeter Wave test procedures


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15.257

- Operation within the band 92-95 GHz.
- Devices limited to indoor use.
- High frequency testing
 - Use millimeter wave test procedure as guideline.
 - Check for far field measurements.
 - Check for required frequency range of radiated measurements.
 - Check to make sure equipment and test setup will have enough sensitivity to measure required limits.
 - For millimeter wave devices, since each antenna must also comply with peak power density requirements and also the shape and size of the antenna will affect the measurement distance (far field), **data for all antennas submitted for millimeter wave devices should be submitted in the equipment authorization filing.**


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Millimeter wave test procedure

- **MILLIMETER WAVE TEST PROCEDURES**
 - <http://www.fcc.gov/oet/ea/eameasurements.html>


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Millimeter wave filing guidelines 1 of 6

- **Vehicle Radar Systems (47 C.F.R. Section 15.253)**
- 15.253(a):
 - Does the EUT meet the definition of a vehicle-mounted field disturbance sensor, as its primary mode of operation, based on the technical description?
- 15.253(b):
 - Were acceptable test procedures and instrument settings used to measure the radiated power density of the fundamental emission?
 - Does the measured power density comply with the appropriate limit, as determined by the frequency band of operation, the position of the EUT with respect to the vehicle, and whether or not the vehicle is in motion?
- 15.253(c):
 - Do all out-of-band emissions meet the definition of spurious emissions?
- 15.253(c)(1):
 - Were acceptable test procedures and instrument settings used to measure unwanted radiated emission levels below 1 GHz?
 - Do the measured unwanted radiated emission levels comply with the Section 15.209 field strength limit?


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Millimeter wave filing guidelines 2 of 6

- 15.253(c)(2):
 - Were acceptable test procedures and instrument settings used to measure the radiated power density of spurious emissions?
 - Was the correct frequency range investigated?
 - Do the measured spurious power densities comply with the appropriate limit, as determined by the frequency band of operation, the frequency of the spurious emission, and the position of the EUT with respect to the vehicle?
- 15.253(c)(3)
 - If applicable, does the FDS operating in 76-77 GHz comply with 1000pW/cm² limit at 3 meters for spurious emissions above 200 GHz?
- 15.253(c) (4)
 - If applicable, was the FDS operating in 76-77 GHz investigated up to 231 GHz.
- 15.253(d):
 - Were acceptable test procedures and instrument settings used to determine the peak levels of the measured radiated power densities of all emissions?
 - Do the peak levels of the measured power densities comply with the limit of Section 15.35(b)?


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Millimeter wave filing guidelines 3 of 6

- 15.253(e):
- ___ Was an acceptable test procedure used to measure frequency stability?
- ___ Does the measured frequency stability data indicate that the fundamental emission will be maintained within the band of operation under all conditions of normal operation, as specified in the user's manual?
- 15.203 and 15.204:
- ___ Does the EUT comply with these Sections?
- *Test procedures for mm wave devices are, as of yet, undocumented. When a "recommended" test procedure is released by the OET Lab, or by some industry group, guidance will be provided as to what is considered "acceptable test procedures".
- *Convert power density limits to EIRP levels, then to equivalent field strengths at the measurement distance. Measured field strengths may then be compared to these values.
- *Determine whether measurements are made in the far field or not, so that a proper distance correction factor may be applied.
- *In re 15.253(d)- a test or a calculation may be used to determine the peak level of the emission, as determined by the emission characteristics.
- *In re 15.253(e)- a plot of the emission at the bandedge, with the EUT tuned to a bandedge channel, may be required for devices that do not utilize a standard carrier which may be measured.

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Millimeter wave filing guidelines 4 of 6

mm-Wave Systems - Section 15.255

- 15.255(a):
 - Does the EUT operate in a manner which is not excluded by this Section, based on the technical description, user's manual, or any advertising literature which has been submitted?
- 15.255(b)(1) and (2):
 - Were acceptable test procedures and instrument settings used to measure the peak radiated power density and the occupied bandwidth of the fundamental emission?
 - Were acceptable methods used to calculate the average radiated power density of the fundamental emission?
 - Does the measured peak power density comply with the appropriate limit, as determined by the type of operation, the occupied bandwidth, and the frequency of the emission?
 - Does the calculated average power density comply with the appropriate limit, as determined by the type of operation, the occupied bandwidth, and the frequency of the emission?
- 15.255(b)(3):
 - Were acceptable test procedures and instrument settings used to measure the peak output power and the peak radiated power density of the fundamental emission?
 - Do the measured peak output power and peak radiated power density comply with the appropriate limit?
- 15.255(c)(1):
 - Do all out-of-band emissions meet the definition of spurious emissions?
- 15.255(c)(2):
 - Were acceptable test procedures and instrument settings used to measure unwanted radiated emission levels below 1 GHz?
 - Do the measured unwanted radiated emission levels comply with the Section 15.209 field strength limit?


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- 15.255(c)(3):
 - Were acceptable test procedures and instrument settings used to measure the radiated power density of spurious emissions?
 - Was the correct frequency range investigated?
 - Do the measured spurious power densities comply with the 90 pW/cm² limit?
- 15.255(c)(4):
 - Does the EUT comply with Section 15.215(b)?
- 15.253(d):
 - Are all emissions in the 59.0-59.05 GHz band either spurious, or related to a publicly accessible coordination channel?
- 15.253(e):
 - Were acceptable test procedures and instrument settings used to measure the peak output power and emission bandwidth?
 - Does the measured peak output power comply with the appropriate limit, as determined by the emission bandwidth?
- 15.255(f):
 - Was an acceptable test procedure used to measure frequency stability?
 - Does the measured frequency stability data indicate that the fundamental emission will be maintained within the band of operation under all conditions of normal operation, as specified in the user's manual?
- 15.255(g) RF safety compliance?
- 15.255(h):
 - Does the applicant state that the EUT will not be equipped with external phase-locking inputs that permit beam-forming arrays to be realized?
- 15.255(i):
 - If applicable, does the applicant state that the EUT transmits the required identification feature?
 - Does the required identification feature contain all of the necessary information?
 - Is a method specified whereby interested parties can obtain sufficient information, at no cost, to enable them to fully detect and decode this transmitter identification information?


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Millimeter wave filing guidelines 6 of 6

- 15.203, 15.204, and 15.207:
- ___ Does the EUT comply with these Sections?
 - *Convert power density limits to EIRP levels, then to equivalent field strengths at the measurement distance. Measured field strengths may then be compared to these values.
 - *Determine whether measurements are made in the far field or not, so that a proper distance correction factor may be applied.
 - * In re 15.255(f)- a plot of the emission at the bandedge, with the EUT tuned to a bandedge channel, may be required for devices that do not utilize a standard carrier which may be measured.


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UPCS Part 15, Subpart D

- Unlicensed Personal Communications Service Devices.
- Operating frequencies 1920-1930 MHz.
- Equipment Class
 - PUB Part 15 Unlicensed PCS Base Station
 - PUE Part 15 Unlicensed PCS portable Tx held to ear
 - PUF Part 24 Licensed Portable transmitter held to face
 - PUT Part 24 Licensed Portable Transmitter worn on body
- Scope:A3
- TCB approval possible. Use TCB exclusion list
- Use the latest test measurement procedure of ANSI C63.17.


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UPCS Part 15, Subpart D

- Annex A in ANSI C63.17 can be used as a checklist to ensure that all the UPCS tests and information is included in the filing.
- The UPCS test report should be in accordance with the test report guidelines Section 9 of ANSI C63.17.
- In addition, the manufacturer's declarations and descriptions in Section 4.11 of ANSI C63.17 should be in the report.
- All filings must have the UTAM affidavit. This includes filings for change in identifier filings.

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UPCS

- Section 15.307 UTAM affidavit.
 - Applicant certifies UTAM membership
 - WWW.UTAM.org
 - Phone no. 1-800-429-8826
 - Submit copy of Affidavit. Example on Next page
 - Changes to UTAM requirements on April 5, 2005
 - Nomadic devices allowed
 - Description of Automatic disabling mechanism for relocation not needed
 - UTAM labeling not required.
 - Effectively eliminated Sec. 15.311 & 15.307(c)-(g).

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UPCS affidavit example

UTAM, Inc.

● **SECTION 15.307(b) AFFIDAVIT**

I, Michael Stima, Managing Director of UTAM, Inc., hereby swear and affirm that:

_____ is a participating member of UTAM, Inc. in good standing for purposes of Section 15.307(b) of the FCC rules.


Subscribed to and sworn this
___ day of _____, 200_

Michael Stima, Managing Director
UTAM, Inc.
1170 U.S. Hwy 22
P.O. Box 8126
Bridgewater, New Jersey 08807
Tel: (508) 526-3636

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UPCS Section 15.319(f)


● Section 15.319(f) requires the following:

"(f) The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude transmission of control and signaling information or use of repetitive codes used by certain digital technologies to complete frame or burst intervals."

- Reference to the Annex A of ANSI C63.17-2006 shows that the evaluation method for this item is "Declaration with explanation".

1. What is the criteria for "absence of information to transmit"?
 - Intent is to prevent continuous occupation of the band when there is no data to send. When there is no data, transmission must automatically cease.
2. What is the criteria for "operational failure"?
 - Intent is to require transmission to discontinue when there is an operational failure (e.g. Power, communication failure)


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UPCS Subpart D related KDBs

- KDB# 377704 DECT CAT-iq system
 - Indicates how compliance with the UPCS rule Section 15.323(c)(5) is met

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UNII devices Subpart E

- Use New UNII test procedure
 - http://nraunifoss.fcc.gov/edocs_public/attachmatch/DA-02-2138A1.pdf

Equipment Class: NII
Frequencies: 5.15-5.35, 5.47-5.725 and 5.725-8.825 GHz.

- Dynamic Frequency Selection (DFS) for devices in the 5.25-5.35 GHz band and 5.47-5.725 GHz band.
- Interim DFS Test procedure is in the Appendix of the Rules.
- Transmit power control(TPC) 5.47-5.725 GHz band.
 - Only a statement that the device has TPC is required to be submitted in the filing. No test required.


Frequent issues

15.407 (c)-(g)

- (c) automatic shutoff
- (d) integral antenna.
 - NO LONGER REQUIRED!
- (e) indoor use for 5.15-5.25 GHz
 - Use grant condition and manual statements.
 - KDB # 388407
 - Operation in a plane is considered indoors
 - » Not prohibited by Section 15.407 in the UNII rules.

(f) RF safety
(g) frequency stability

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DFS policies

- - Removing or adding the 5.2 GHz DFS UNII band can be done with a Class II permissive change if it is a software only change (no hardware) and the software change is implemented by the grantee. This would allow the modified unit to be marketed after the second deadline of July 20, 2007.
- DFS and Requirements do not apply to the 5.15-5.25 and 5.725-5.825 GHz UNII bands.
- - Modular approvals. All DFS UNII modular approvals need to be Limited Modular Approvals. Most likely these would be approved as limited to hosts with external antennas. For modular approvals with internal antennas, it is important to understand that the different hosts will affect DFS compliance. Therefore, the module would be limited to the specific host used for the DFS tests. If different hosts are applied for with a Class II permissive change, DFS testing is required if the new host provides more attenuation of the signal compared to the approved host. (Does not apply to Client devices without ad hoc and without radar capabilities)
- * Reminder: that DFS testing is required when any new antenna with lower gain than the original is used.
- **A cover letter indicating that removing the band is done through software only (no hardware changes) and only by the grantee. End User modification of software for non SDR device is not allowed.**

- Removing or adding the 5.2 GHz DFS UNII band can be done with a Class II permissive change if it is a software only change (no hardware) and the software change is implemented by the grantee. This would allow the modified unit to be marketed after the second deadline of July 20, 2007. Use note code ND below.
 - Allowed only for software change implemented by OEM.
 - End user software change requires SDR approval.
 - Any hardware change requires **NEW AUTHORIZATION**

- **ND** This UNII device complies with the Transmit Power Control (TPC) and Dynamic Frequency Selection (DFS) requirements in Section 15.407(h).

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In band spurious emissions for UNII devices

- In band spurious emission limit is general the same as fundamental limit. However, in no case can the level of any spurious emission exceed the level of the fundamental.
- For UNII devices under Section 15.407...
 - a transmitter operating at 5.2 GHz can emit at the level specified in 15.407(a)(1) anywhere in the 5.15-5.35 GHz range.
 - a transmitter operating at 5.3 GHz can emit at the level specified in 15.407(a)(2) anywhere in the 5.25-5.35 GHz range.
 - a transmitter operating at 5.3 GHz can emit at the level specified in 15.407(a)(1) anywhere in the 5.15-5.25 GHz range if it's indoor-only with an integral antenna or at -27 dBm/MHz in the 5.15-5.25 GHz range if it operates outdoors or does not have an integral antenna.
 - a transmitter operating at 5.8 GHz can emit at the level specified in 15.407(a)(3) anywhere in the 5.725-5.825 GHz range.

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GUIDANCE FOR REVIEWING OF COMPLIANCE SUBMISSIONS FOR UNII DEVICES:

- **SEE UNII test procedures at**
– http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-02-2138A1.pdf
- 15.401:
- 1) Does the EUT meet the definition of a UNII device, based on the technical description of the EUT? (See Section 15.403(i))
- Modulation must be digital. While “high data rate” is not specifically defined, policy requires a minimum data rate of **1 Mbps**.
- 15.407(a):
- 2) Were acceptable test procedures and instrument settings used to measure the peak transmit power, emission bandwidth, peak power spectral density, and peak excursion of the modulation envelope? (See Sections 15.403(e), (c), and (d))
- 15.407(a)(1):
- 3) Does the measured peak transmit power comply with the appropriate limit, based on the measured emission bandwidth?
- **Look for consistency throughout the test report, user’s manual, and technical descriptions, wrt the various measured and/or stated transmit power levels.**
- 4) Does the measured peak power spectral density (psd) comply with the +4 dBm/MHz limit?
- 5) Does the measured peak transmit power, in conjunction with the stated antenna gain, comply with the *de facto* EIRP limit (calculated peak transmit power limit + 6 dBi) for all proposed antennas?
- Note that the transmit power **limit is reduced in order to comply with the *de facto* EIRP limit. If the measured transmit power is already below the limit a reduction may not be necessary.**


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GUIDANCE FOR REVIEWING OF COMPLIANCE SUBMISSIONS FOR UNII DEVICES:

- If compliance with the EIRP limit is achieved for various antennas by adjusting the transmit power at the time of installation, then professional installation of this transmitter is required. The installation manual must contain adequate instructions such that the correct transmit power can be chosen for any antenna being used.
- **6)** Does the measured peak power spectral density, in conjunction with the stated antenna gain, comply with the *de facto* +10 dBm EIRPower spectral density (EIRPsd) limit for all proposed antennas?
 - Note that the psd limit is reduced in order to comply with the *de facto* EIRPsd limit. If the measured psd is already below the limit a reduction may not be necessary.
 - 15.407(a)(2):
- **7)** Does the measured peak transmit power comply with the appropriate limit, based on the measured emission bandwidth?
 - Look for consistency throughout the test report, user's manual, and technical descriptions, wrt the various measured and/or stated transmit power levels.
- **8)** Does the measured peak power spectral density comply with the +11 dBm/MHz limit?
- **9)** Does the measured peak transmit power, in conjunction with the stated antenna gain, comply with the *de facto* EIRP limit (calculated peak transmit power limit + 6 dBi) for all proposed antennas?
 - Note that the transmit power limit is reduced in order to comply with the *de facto* EIRP limit. If the measured transmit power is already below the limit a reduction may not be necessary.
- If compliance with the EIRP limit is achieved for various antennas by adjusting the transmit power at the time of installation, then professional installation of this transmitter is required. The installation manual must contain adequate instructions such that the correct transmit power can be chosen for any antenna being used.
- **10)** Does the measured peak power spectral density, in conjunction with the stated antenna gain, comply with the *de facto* +17 dBm EIRPsd limit for all proposed antennas?
 - Note that the psd limit is reduced in order to comply with the *de facto* EIRPsd limit. If the measured psd is already below the limit a reduction may not be necessary.


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GUIDANCE FOR REVIEWING OF COMPLIANCE SUBMISSIONS FOR UNII DEVICES:

- 15.407(a)(3):
- 11) Does the measured peak transmit power comply with the appropriate limit, based on the measured emission bandwidth?
- Look for consistency throughout the test report, user's manual, and technical descriptions, wrt the various measured and/or stated transmit power levels.
- 12) Does the measured peak power spectral density comply with the +17 dBm/MHz limit?
- 13) Does the measured peak transmit power, in conjunction with the stated antenna gain, comply with the *de facto* EIRP limit (calculated peak transmit power limit + 6 dBi) for all proposed antennas?
- Note that the transmit power limit is reduced in order to comply with the *de facto* EIRP limit. If the measured transmit power is already below the limit a reduction may not be necessary.
- If compliance with the EIRP limit is achieved for various antennas by adjusting the transmit power at the time of installation, then professional installation of this transmitter is required. The installation manual must contain adequate instructions such that the correct transmit power can be chosen for any antenna being used.
- 14) Does the measured peak power spectral density, in conjunction with the stated antenna gain, comply with the *de facto* +23 dBm EIRPsd limit for all proposed antennas?
- Note that the psd limit is reduced in order to comply with the *de facto* EIRPsd limit. If the measured psd is already below the limit a reduction may not be necessary.
- 15) Does the measured peak transmit power, in conjunction with the stated antenna gain, comply with the *de facto* EIRP limit (calculated peak transmit power limit + 23 dBi) for all proposed antennas to be used solely in point-to-point applications?
- Note that the transmit power limit is reduced in order to comply with the *de facto* EIRP limit. If the measured transmit power is already below the limit a reduction may not be necessary.
- If compliance with the EIRP limit is achieved for various antennas by adjusting the transmit power at the time of installation, then professional installation of this transmitter is required. The installation manual must contain adequate instructions such that the correct transmit power can be chosen for any antenna being used.


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GUIDANCE FOR REVIEWING OF COMPLIANCE SUBMISSIONS FOR UNII DEVICES:

- **16)** Does the measured peak power spectral density, in conjunction with the stated antenna gain, comply with the *de facto* +40 dBm EIRPsd limit for all proposed antennas to be used solely in point-to-point applications?
- Note that the psd limit is reduced in order to comply with the *de facto* EIRPsd limit. If the measured psd is already below the limit a reduction may not be necessary.
- **17)** Does the proposed point-to-point system meet the appropriate requirements, and do the installation instructions contain the correct language?
- Understand the intent behind allowing the EIRP relaxation for point-to-point applications only.
- When multiple antennas are listed in the installation manual, those that may only be used in point-to-point applications should be clearly indicated.
- 15.407(a)(6):
- **18)** Does the ratio of peak modulation envelope excursion to peak transmit power meet the 13 dB/MHz limit?
- The comparison between the two measured levels is made within the same 1 MHz segment.
- 15.407(b)(1)-(3):
- **19)** Were acceptable test procedures and instrument settings used to measure the EIRP of emissions outside of the frequency bands of operation, both within and outside of the passband of all proposed antennas?
- **20)** Do the measured unwanted emission EIRP levels comply with the appropriate limits, as determined by the frequency band of operation and the frequency of the spurious emission, up to 40 GHz, for all proposed antennas?
- These limits are on the Effective Isotropic Radiated Transmit Power. The same measurement settings used to measure the transmit power of the fundamental emission may be used here.
- Within the passband of the antenna an RF conducted measurement may be made. This level, added to the stated antenna gain for each proposed antenna, must comply with the limit.


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GUIDANCE FOR REVIEWING OF COMPLIANCE SUBMISSIONS FOR UNII DEVICES:

- Outside of the passband of the antenna a radiated measurement must be made, as the gain of the antenna outside of its passband is uncertain, or, the emission may radiate from the case of the EUT. This measured field strength must then be converted to an equivalent EIRP for comparison to the limit.
- It is likely that compliance with the unwanted emission EIRP limit, particularly at the bandedges, will determine the maximum transmit power allowable at bandedge channels for each antenna. The installation manual must make this clear.
- 15.407(b)(5):
 - **21)** Were acceptable test procedures and instrument settings used to measure unwanted radiated emission levels below 1 GHz, and AC line conducted emissions?
 - Use ANSI C63.4 as a guide.
 - **22)** Do the measured unwanted radiated emission levels comply with the Section 15.209 field strength limit?
 - *In order to demonstrate compliance with this particular requirement, measurements may be performed on the highest gain antenna of each "type". In other words, if multiple yagi, patch, and dish antennas are proposed, only the highest gain yagi, patch, and dish must be tested.*
 - Measurements should also be made on the lowest gain antenna, so that the EUT is operating at its highest available output power, in order to test for case radiation.
 - **23)** Do the measured AC line conducted emission levels comply with the Section 15.207 limit?
- 15.407(b)(6):
 - **24)** Were acceptable test procedures and instrument settings used to measure the field strength of all unwanted radiated emissions in restricted bands, as defined in Section 15.205?
 - **25)** Do the measured unwanted radiated emission average levels comply with the Section 15.209 field strength limit, up to 40 GHz?
 - *In order to demonstrate compliance with this particular requirement, measurements may be performed on the highest gain antenna of each "type". In other words, if multiple yagi, patch, and dish antennas are proposed, only the highest gain yagi, patch, and dish must be tested.*


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GUIDANCE FOR REVIEWING OF COMPLIANCE SUBMISSIONS FOR UNII DEVICES:

- A duty cycle correction factor, as defined in Section 15.35(c), may be applied to a measurement made with an average detector, or its equivalent, to further reduce the value.
- Measurements should also be made on the lowest gain antenna, so that the EUT is operating at its highest available output power, in order to test for case radiation.
- **26)** Do the measured unwanted radiated emission peak levels comply with the Section 15.35(b) field strength limit, up to 40 GHz?
- In order to demonstrate compliance with this particular requirement, a true peak measurement must be made- instrument settings used to measure the peak transmit power may not be used. (i.e. $VBW \geq RBW$)
- In order to demonstrate compliance with this particular requirement, measurements may be performed on the highest gain antenna of each "type". In other words, if multiple yagi, patch, and dish antennas are proposed, only the highest gain yagi, patch, and dish must be tested.
- Measurements should also be made on the lowest gain antenna, so that the EUT is operating at its highest available output power, in order to test for case radiation.
- Unless the measured peak field strength levels comply with the average limit, then both peak and average data must be submitted.
- Look for consistency in reported peak and average measurements.
- Section 15.407(b)(7):
- **27)** Was the device also adjusted to the channels closest to the upper and lower bandedges when measuring for compliance with the emission limits?
- If the peak power measurement was performed with $VBW > 1\text{MHz}$ and no other averaging, the peak excursion test is not required.
- 15.407(c):


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GUIDANCE FOR REVIEWING OF COMPLIANCE SUBMISSIONS FOR UNII DEVICES:

- 28) Does the EUT discontinue transmission under the proper conditions, based on the technical description?
15.407(d):
- 29) Does the EUT use an integral transmitting antenna if it operates in the 5.15-5.25 GHz band, based on the technical description and photographs?
An antenna that attaches with a connector inside of the case is acceptable, provided that there is no need for the user to ever open the case. Check the user's manual.
15.407(e):
- 30) Will the EUT will be restricted to indoor operation if it operates in the 5.15-5.25 GHz band, based on the technical description, user's manual, and any advertising literature provided?
15.407(f):
- 31) UNII devices are subject to the radio frequency exposure requirements specified in 1.1307(b), 2.1091, and 2.1093. How does the device comply?
For TCB applications, follow the TCB RF exposure procedure.
15.407(g):
- 32) Was an acceptable test procedure used to measure frequency stability?
- 33) Does the measured frequency stability data indicate that the fundamental emission will be maintained within the band of operation under all conditions of normal operation, as specified in the user's manual?
A plot of the emission at the bandedge, with the EUT tuned to a bandedge channel, may be required for devices that do not utilize a standard carrier that may be measured.
15.33, 15.35, 15.203, and 15.204:
- 34) Does the UNII system comply with these Sections?
15.101(a):
- 35) If the EUT also meets the definition of a personal computer peripheral, then that portion of the EUT must also be authorized, through Verification (if Class A), Certification, or DoC. If Class A use is proposed, then a justification for this rating must be provided. Was this done?

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UNII Subpart E related KDBs

- KDB# 905462 Procedures for U-NII Devices with DFS
- KDB# 594340
 - FCC recommendations or requirements for special operational modes for testing Part 15E UNII devices with DFS and radar detection capability
- KDB# 848637
 - Specifies additional testing for UNII client devices operating in the DFS bands without radar detection capability.
- KDB# 388407
 - Indoor operation consideration
- KDB# 463842
 - Electronic scanning/beam steering antennas used with UNII devices
- KDB# 898477
 - UNII operation at 5.25 GHz.
- KDB# 594280 Country selection for master devices not permitted unless filed as SDR
 - Must comply with Section 15.15 and 15.202
 - Include compliance methods in application

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Dynamic Frequency Selection (DFS) Equipment Authorization information

● Andy Leimer, OET, FCC, EAB

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DFS General Information

- U-NII Frequency Bands:
5.15-5.35, 5.47-5.725, and 5.725-5.825 GHz
- Dynamic Frequency Selection (DFS) and Transmit Power Control (TPC):
5.25-5.35 GHz and 5.47-5.725 GHz band
- R&O: U-NII/DFS Rules (FCC 03-287)
http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-03-287A1.pdf
- R&O: Compliance Measurement Procedures for U-NII Devices Incorporating DFS (FCC 06-96)
http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-06-96A1.pdf
 - Also available in KDB905462:
<http://webapp01.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?id=27155&switch=P>


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DFS TCB Exclusions

- TCBs can only authorize DFS client devices without radar detection capability
 - Must not have an “ad-hoc” or “peer-to-peer” mode
 - Note: External software (ie: operating systems, drivers) can force the device into "ad-hoc" mode operation as defined in 802.11
 - Check the User’s Manual and ask questions
- Clients require the following DFS tests
 - Channel Closing Transmission Time
 - Channel Move Time
- For master devices and client devices - consult FCC for devices which have different operational characteristics than 802.11 or use MIMO multiple antenna configurations


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Equipment Authorization

- Equipment Class – NII
- Note code ND – This device complies with the TPC and DFS requirements in Section 15.407(h)
 - Used is optional
- Part 15 non-channelized radio service – Grant must list lowest and highest carrier frequency for each band
- Operational description:
 - IP or Frame Based
 - EUT: master or client and ancillary equipment
- Test setup description
 - Radar Simulation: alternative hopping setup
 - Radar Simulation verification
 - Channel loading
 - Master and client configurations


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DFS Device Types

- 802.11 based
 - DFS Standard 802.11n (MIMO) finalized
- Frame Based Systems (Proprietary point-to-point systems)
 - Fixed talk/listen ratio of 45%/55% (FCC 06-96)
 - Tolerance +/- 10%
 - Fixed & dynamic talk listen ratio: stream movie
 - Verify that manufacturers recommended talk/listen ratio does not exceed 45%/55%
 - If it does contact the FCC


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DFS Test Setup

- Must use NTIA approved Matlab-based program, hopping sequence file, and media file or NTIA/FCC approved alternative radar generation test software:
<http://ntiacsd.ntia.doc.gov/dfs/>
- Must use NTIA approved MPG video file or WAV file (for devices that cannot stream video)
- Contact the FCC for devices that cannot stream MPG or WAV files
 - Alternative streaming methods must be approved by NTIA
- No restriction on choice of media player


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DFS Test Setup (Cont.)

- Approval for alternative radar generation or alternative streaming must be included in the application. If NTIA files are used include a statement in the test report.
- DFS threshold is based on highest EIRP of all of the bands
 - The same threshold applies to all bands
- Radiated Testing vs. Conducted Testing
 - Threshold not correct
 - Must account for cable losses & manufacturer's tolerance in antenna gain
 - Include minimum gain antenna w/ sample requests
 - It is highly recommended that a Bin 1 signal be used for a radiated test to verify that the threshold is correct before proceeding with conducted tests

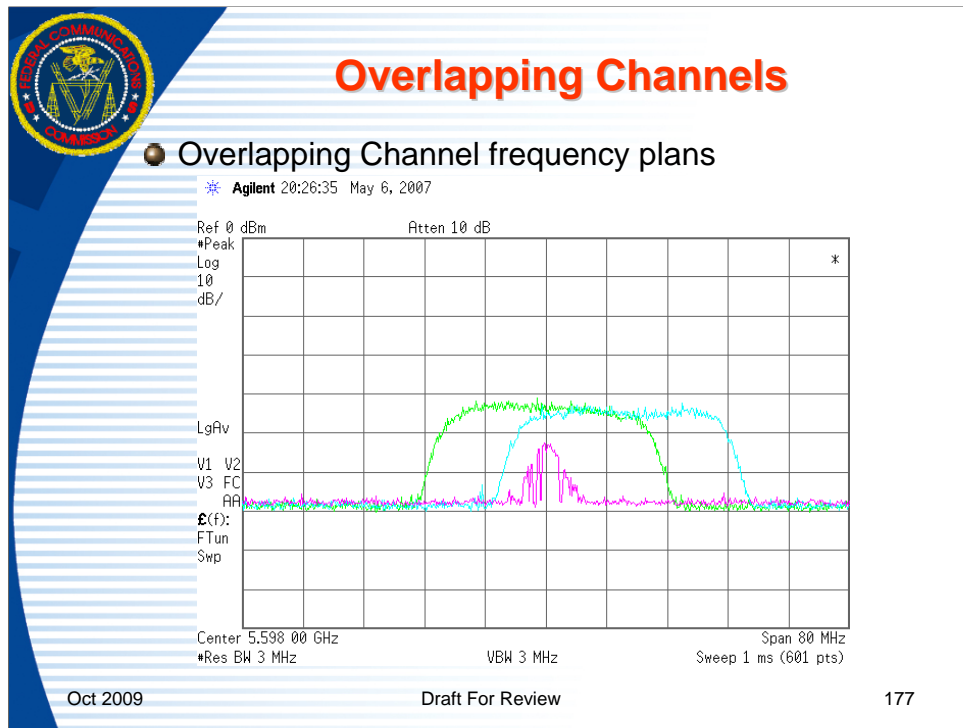
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DFS Test Frequencies

- Radar test frequencies
 - Device must respond to radars within the 80% Power BW which is the minimum permissible radar detection BW
 - FCC Lab typically tests at any radar frequency at least 1 MHz within the 80% power BW and the center channel of 40 MHz devices
 - FCC Lab also changes radar frequencies for statistical tests (Bin1 to Bin6)
- Statistical tests
 - Include test frequencies used for statistical performance tests in the Test Report
 - Do not test perform all statistical tests with the radar on-tune with the master device and then expect to pass FCC testing

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Overlapping Channels (Con't.)

- The plot shows the radar and device channel frequency set to 5598 MHz. The radar was detected and the channel frequency moved to 5608 MHz.
- Section 15.407(h)(2): avoid co-channel operation with radars
- Channel: the amount of spectrum used by a master device and any associated client device (Reference FCC 06-96)
- Must meet the In-Service Monitoring requirements of Section 15.407(h)(2)(ii) - The U-NII device may start using the channel if no radar signal with a power level greater than the interference threshold values listed in paragraph (h)(2) of this part, is detected within 60 seconds.


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Overlapping Channels (Con't.)

- Tested by blocking all channels except for two overlapping channels and then rebooting in normal mode. The single radar burst was transmitted, detected, and the overlapping channel selected as an available channel. The radar burst was retransmitted 45 seconds later. The device detected it and blocked the overlapping channel.
- Conclusion: This device was compliant with the overlapping channel frequency plan

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Channel Loading

- Test the device at the minimum data rate which streams data smoothly and provides consistent statistical test data
 - This utilizes the maximum transmission time
 - Video smooth streaming: 29 frames/sec. w/ no pixilation
 - Any codec/media player is acceptable
 - Bin 1 used to determine statistical data consistency
- Detection percentage decrease noticed when data transmission rate is less than 25 Mbps

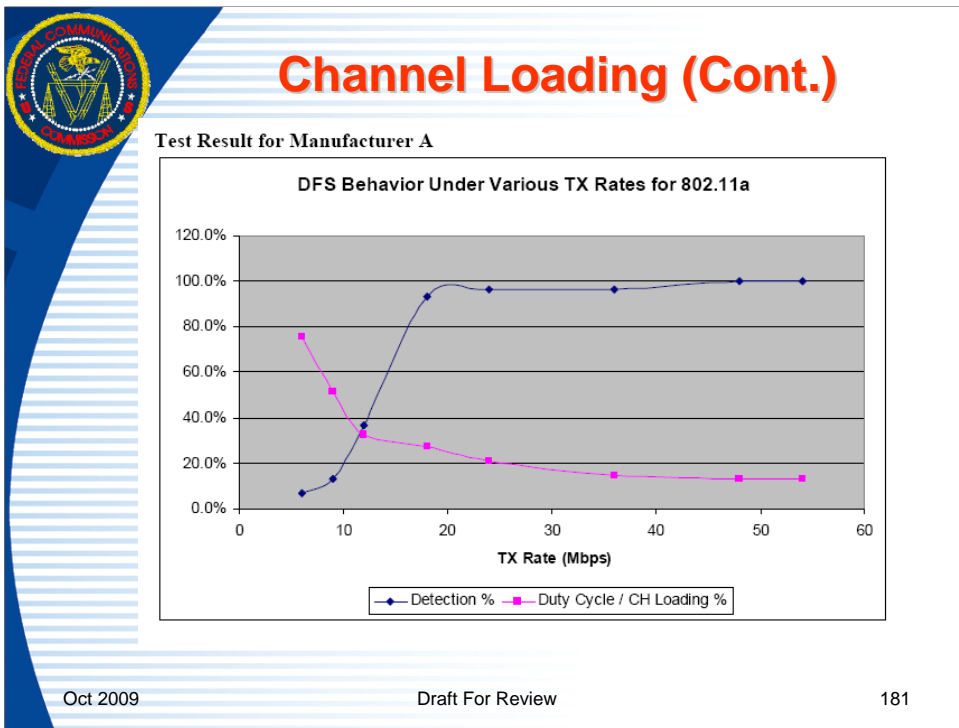
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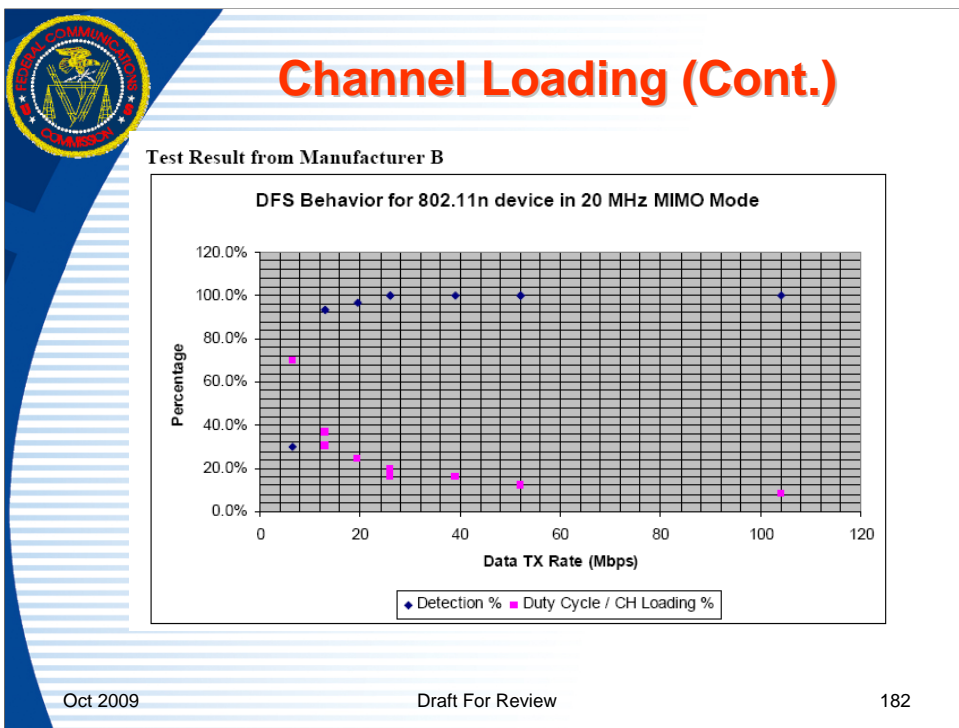
Channel Loading:

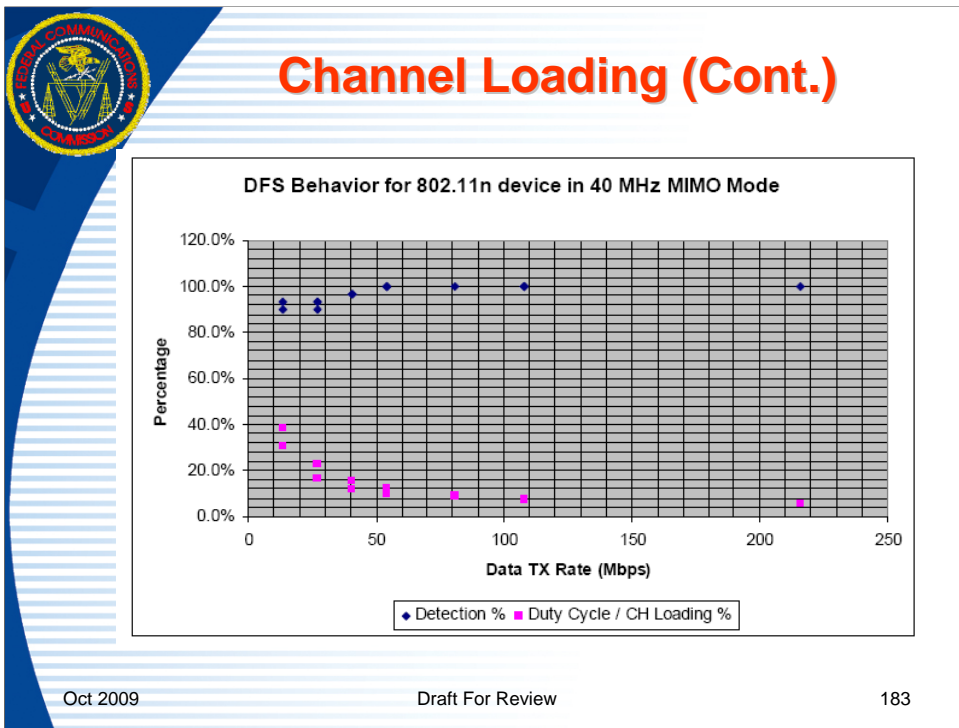
Streaming Movie (TCP way): Setup file sharing in windows and open the media file on the server attached to the master – A TCP connection is established, but will request packet repetition when error occur, also prone to slow start problem.


Streaming Movie (UDP way) Setup file broadcasting in VLC player and have the client receive UDP packets – UDP packets were broadcasted, no re-transmission whatsoever from server once error occurs; therefore this is the true streaming.

Either method is acceptable but the master and client must be “associated” with each other when specified in the test procedure. This means that the master device must be in control of the client and the client must change channel when the master detects a radar and instructs the client.










DFS In-Service Monitoring

- In-Service Monitoring Limits
 - Channel Closing Transmission Time: < 200 ms
 - Plot required with sweep not to exceed 600 ms
 - Channel Move Time: < 10 sec.
 - Bin 1 through 5 – sweep of approximately 12 sec.
 - Bin 6 (Long Pulse) – sweep approximately 22 sec.
 - Aggregate Transmission Time (Non-occupancy): < 60 ms over remaining 10 sec period
 - Not required for client devices

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Multiple BWs and MIMO

- Multiple Bandwidths
 - Non-MIMO: ALL BWs to be tested in full (Radar detection BW and statistical tests)
- MIMO
 - ALL BWs to be tested in full (Radar detection BW and statistical tests)
 - Only required to have one transmission chain operating
- Remaining tests performed in either BW (channel move time, CAC tests, 30-min non-occupancy, etc.)

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DFS Modular Approval

- Modular or Limited Modular Approval (case-by-case basis) – additional testing may be required
 - Modular TX must be the same in each host/enclosure
 - New host/enclosure must not provide additional signal attenuation (Fundamental tested for comparison)
- Single Grant for master and client provided that:
 - Module certified as a master
 - Module meets operational requirements as a client both with and without radar detection
- DSF Modular approval adds layers of complexity to the equipment authorization process

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Question 1) Is it possible to get modular approval for DFS devices?


Answer 1) In general, if the device meets the requirements specified in DA 00-1407, it can be granted modular approval. However, depending on specific implementation, this may require a limited modular approval. This will have to be determined on a case-by-case basis. Some of the considerations are:

The FCC laboratory may not require additional DFS testing to be performed for a different host/enclosure under the following conditions:

- a) The approved modular transmitter is identical in each host/enclosure.
- b) The new host/enclosure does not provide additional attenuation of the signal. This can be done by comparing the field strength of the fundamental between the original modular approval and the transmitter in the new host/enclosure. If the field strength of the fundamental of the modular transmitter in the new host/enclosure is greater than or equal to the field strength of the fundamental of the modular transmitter used for DFS compliance testing, then the received signal level of the modular transmitter is not reduced by the new host/enclosure and DFS compliance testing will not be affected.

Question 2) Can a single Grant of equipment authorization be obtained for a module that can serve as both a master and client device?


Answer 2) This can be done if the module is certified as a master. The device in which the module is installed must determine if the module is to be a master or client. If the device is intended for either operation, it must also be tested to see that it meets the requirements as a client for that application, this includes appropriate test to ensure compliance with or without the radar detection functions. The test reports must make clear which modes are supported and tested. The requirements for master and client devices are specified in the DFS Report and Order (FCC 03-287) Appendix C. The modular approach to DFS, while possible, adds layers of complexity to the certification process. Not only must you meet the modular requirements, you must also meet the technical requirements for a master and client device. Currently, all DFS applicants for devices with radar detection functions are required to submit a pre-Grant sample to the FCC for testing. You will have to provide modular configurations for both the master and client modes as well as operating instructions. For module use with multiple antennas, you will have to test the device for the lowest gain antenna for DFS requirements (due to the receiver threshold). For all bands, the device will have to be tested for EMC requirements with the highest gain antenna for each antenna type. Ensure also that the configuration with the highest output power in all bands should also be tested. The antenna will have to be supplied with the module and meet the antenna requirements of Section 15.203. TCBs are not authorized to certify DFS devices at this time.



DFS Class II Permissive Change

- Antenna Changes – KDB 178919
 - https://fjallfoss.fcc.gov/oetcf/report_detail.cfm?report_uri=/kdb/GetAttachment.html?id=29296
 - DFS – lowest gain antenna
 - EMC – highest gain antenna
- Do the clients without DFS radar detection capability have to be retested if a lower gain antenna is used in a Class II permissive change?
 - No, but the DFS detection threshold must be verified (Recommend the Radar Detection BW test)
 - Section 15.204(c) applies

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DFS Issues

- FCC Lab performs ONLY radiated tests on master devices using the minimum cable length specified by the manufacturer
- Uniform Spreading
 - No test defined or required
 - Manufactures attestation statement required
- Channel Closing Transmission Time
 - Test procedure requires Bin1 and Bin 5
- Verify that client does not have an ad-hoc mode (if there is an ad-hoc mode the client must be tested as a master device)

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DFS Issues (Con't.)

- DFS software security - appropriate security required for both master devices and client devices
- Professional installers cannot have access to any DFS settings except for the capability to block channels that are potential interference problems
 - the block channels must be based on any interference received since radar frequencies are not public information
 - Professional installers cannot have access to country code settings

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DFS Issues (Con't.)

- Country selection for master devices not permitted unless filed as SDR – KDB594280:
<https://fjallfoss.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?id=39498&switch=P>
 - Must comply with Section 15.15 and 15.202
 - Include compliance methods in application
- Antennas and Reflectors – KDB420149:
<https://fjallfoss.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?id=39056&switch=P>
 - Must be authorized as an antenna in the application


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DFS Client Beacon Test Procedure

- Client Beacon Test KD848637:
<https://fjallfoss.fcc.gov/oetcf/kdb/forms/FTSSeArchResultPage.cfm?id=34859&switch=P>
- 802.11 clients not permitted to transmit beacons on DFS frequencies
 - Test required since Oct. 11, 2007
- Part 1: Non-associated test (Stand-alone client)
 - No testing required
 - The application must include a letter exhibit from the manufacturer stating that the client software and associated drivers will not permit transmission of beacon signals on DFS frequencies


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DFS Client Beacon Test Procedure (Cont.)

- Part 2: Associated test (Client link established with the master on a test frequency)
 - Associate the client and master and stream the movie as specified for non-occupancy test
 - Transmit Radar Bin1
 - Monitor the test frequency to make sure no beacons have been transmitted for 30 min.
 - Note: If the client moves with the master, nothing should show up on the client non-occupancy test and the device is compliant. For devices that shut down (rather than moving channels), no beacons should appear
 - Analyzer plot must be in the Test Report
 - Single 30 min. sweep on original client test frequency


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Expedited Review Candidates – Required Information

FCC ID(s) of Previously Granted DFS Devices	FCC ID of New Application
Technology: (i.e.; 802.11x, frame based, MIMO, smart antenna, etc.)	
Bandwidth information and differences	
Antenna information and differences for the minimum gain antennas	
Differences in DFS functioning, circuitry, software, etc.	
Differences between the products such as TX power, modulation, receivers, processing circuitry, etc.	
Names of the test labs for the various Grants	


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UNII & DFS Reminders

- Uniform Spreading – manufacturer's attestation statement required
- For a Class II permissive change the power cannot be increased when adding new bands
- The 5.15-5.25 and 5.25-5.35 bands require two line items
- UNII undesired emissions must be measured with a Peak Detector (Section 15.407(b))


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Test Modes

- Test Modes - KDB594340:
<https://fjallfoss.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?id=34085&switch=P>
- Test Procedure (FCC 09-96) Section 7.1
- Upon radar detection, the test mode should disable the 30 minute non-occupancy period and return the device to the original test frequency within a few seconds.
- Display radar detections
- Easily switch between normal and test mode
- Device should be setup to start on a known frequency in normal mode

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DFS Sample Test Data

● Test Parameters

- Device: (Manufacturer) U-NII Master
- Power: 500 mW
- Protocol: IP Based
- DFS Detection Threshold: -64 dBm
- Radar Simulator Level (Threshold + 1 dB): -63 dBm
- Radar Test Frequency (Bin 1-5) = 5300 MHz
- Client Device Used for Test Configuration:
(Manufacturer) Client PCMCIA FCC ID: XXXXX
- Alternative Hopping Method: NTIA Approved
- File Data Transfer: NTIA Approved Data Stream


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DFS Sample Test Data (Cont.)

- Radar Detection BW
 - Detection BW (15 MHz) > 80% Power BW (13.12 MHz from EMC Test Report) **PASS**
- Performance Requirement Checks
 - 30 Minute Non-Occupancy: **PASS**
 - Initial Channel Availability Check Time:
No transmissions at 5300 MHz for 61.5 sec. **PASS**
 - Radar Burst at Beginning of Channel Availability
Check Time:
No transmissions at 5300 MHz **PASS**
 - Radar Burst at End of Channel Availability
Check Time:
No transmissions at 5300 MHz **PASS**

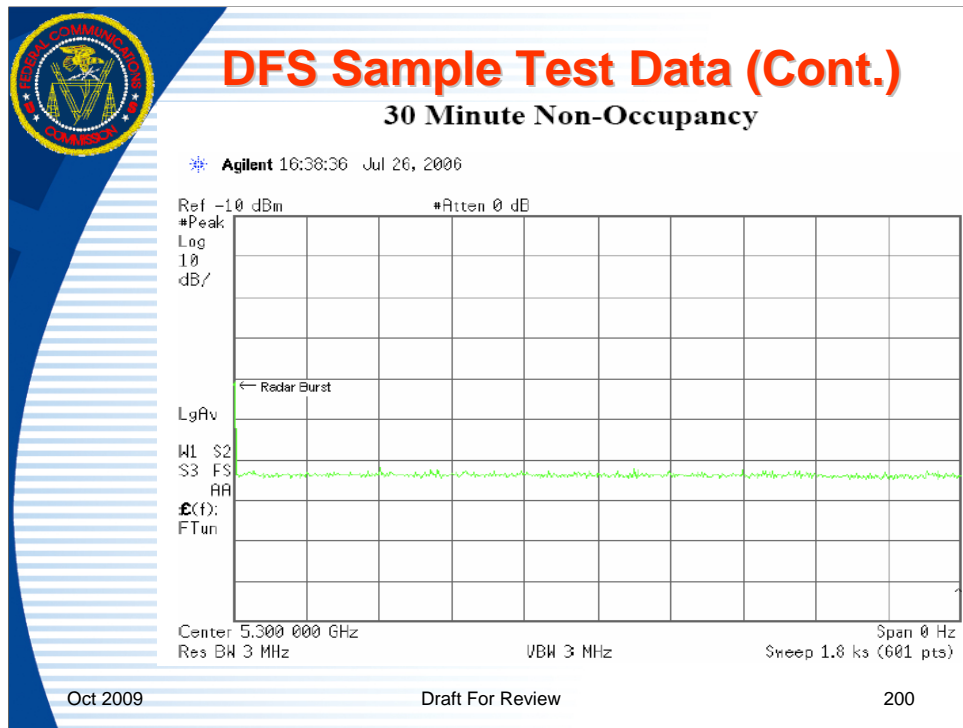
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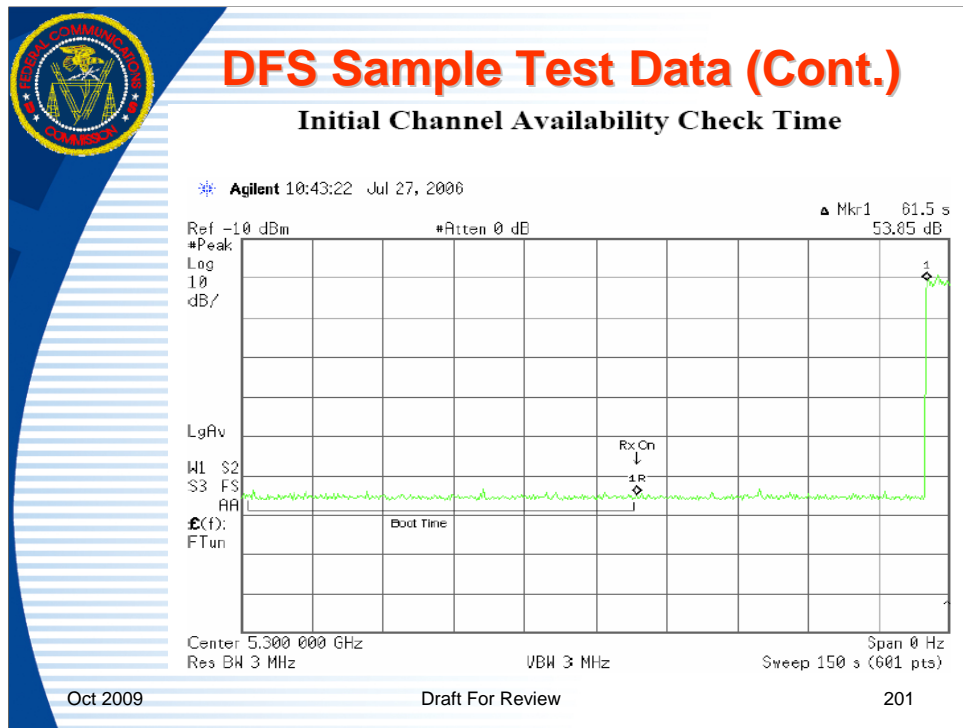


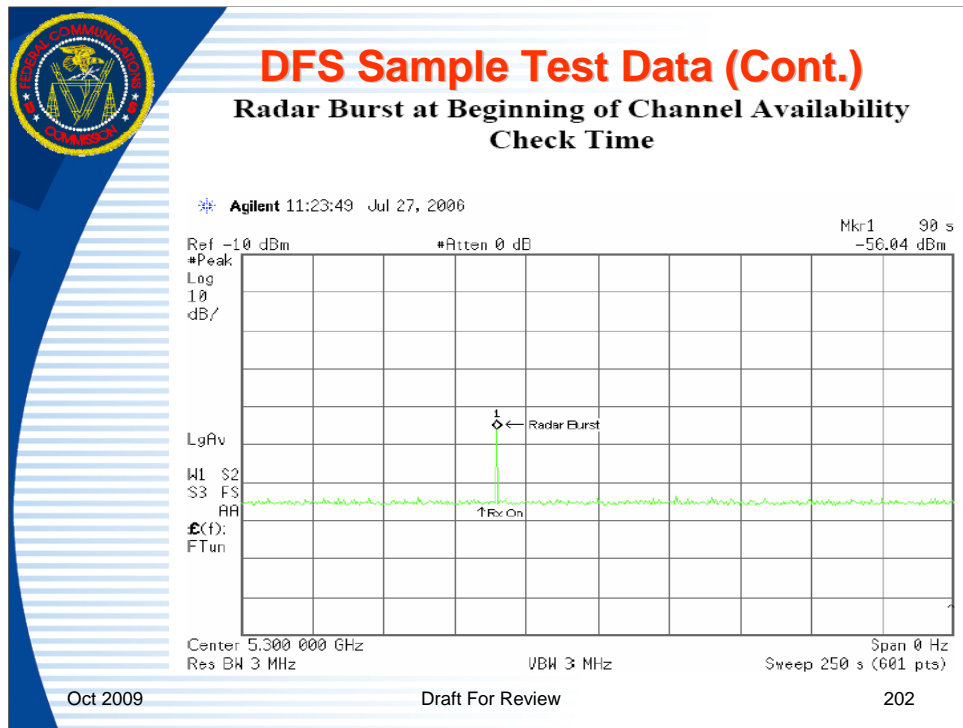
DFS Sample Test Data (Cont.)

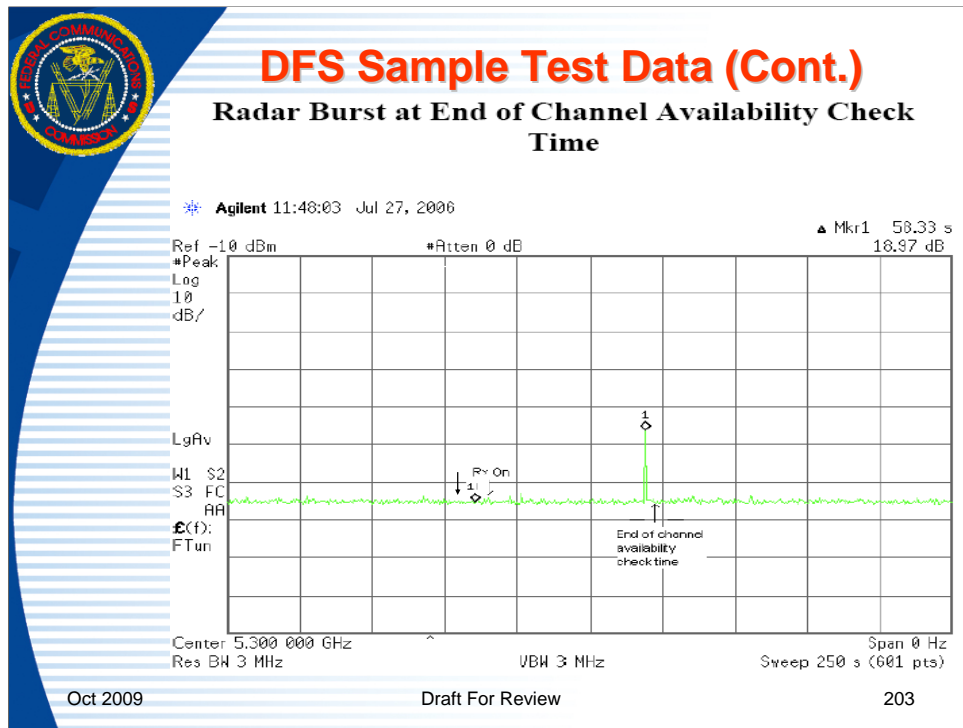
- In-Service Monitoring
 - Channel Closing Transmission Time: <10 ms **PASS**
 - Channel Move Time: 2.08 sec. **PASS**
 - Aggregate Transmission Time: 222 μ s **PASS**
- Statistical Performance Check
(Percentage of successful radar detections)
 - Bin 1 90% **PASS**
 - Bin 2 86.6% **PASS**
 - Bin 3 83.3% **PASS**
 - Bin 4 93.3% **PASS**
 - Bin 5 100% **PASS**
 - Bin 6 93.3% **PASS**
 - Aggregate (Bin 1-4) 88.3% **PASS**
 - **Aggregate is the average of Bin 1 through Bin 4 in %**

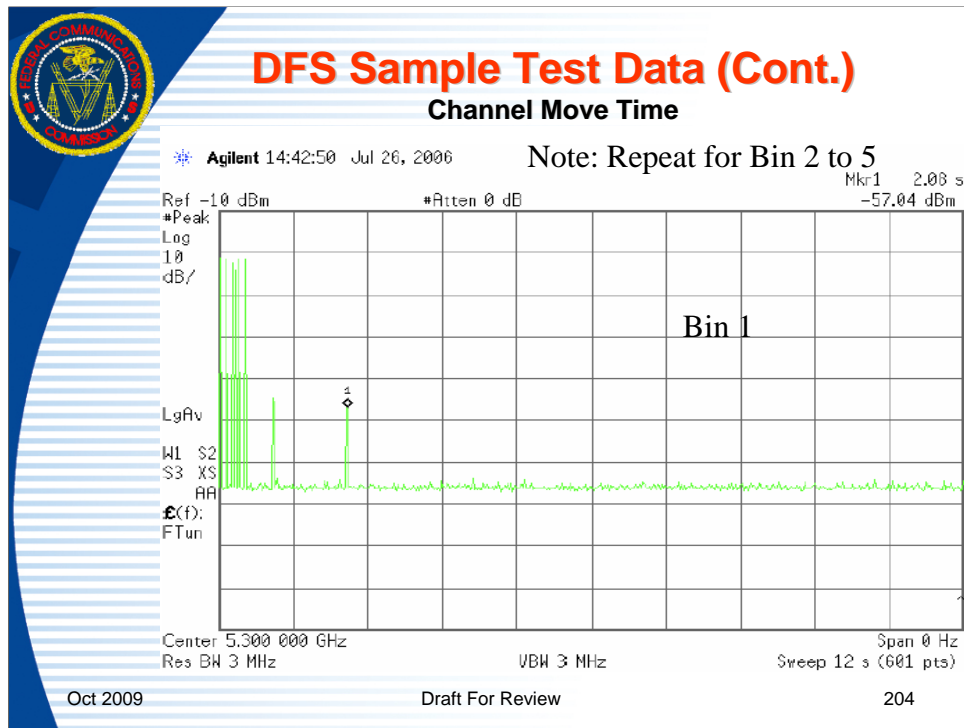
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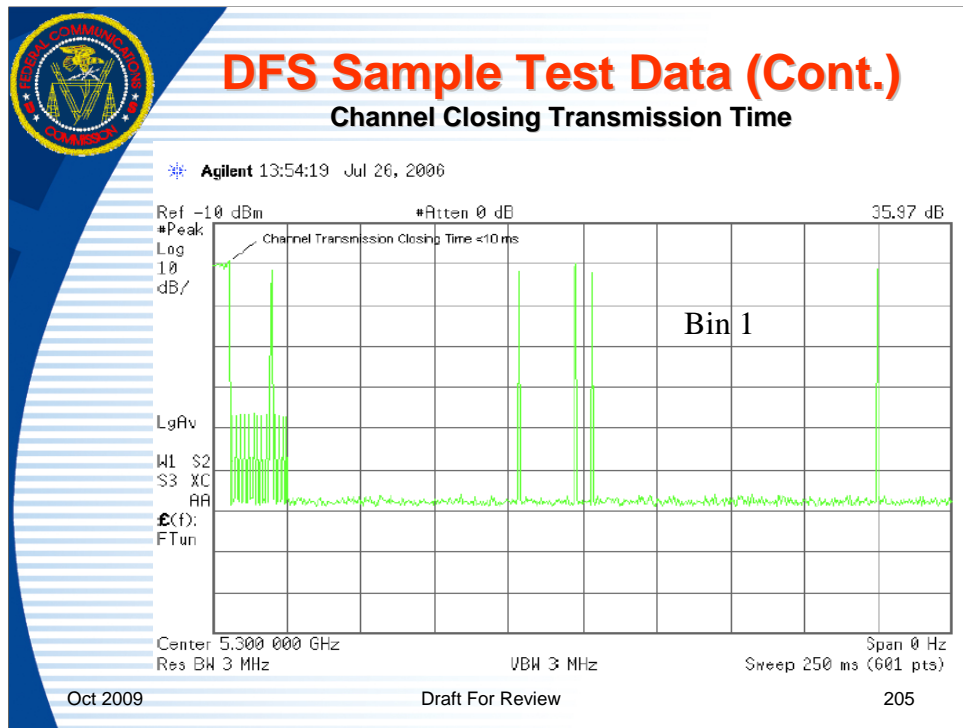


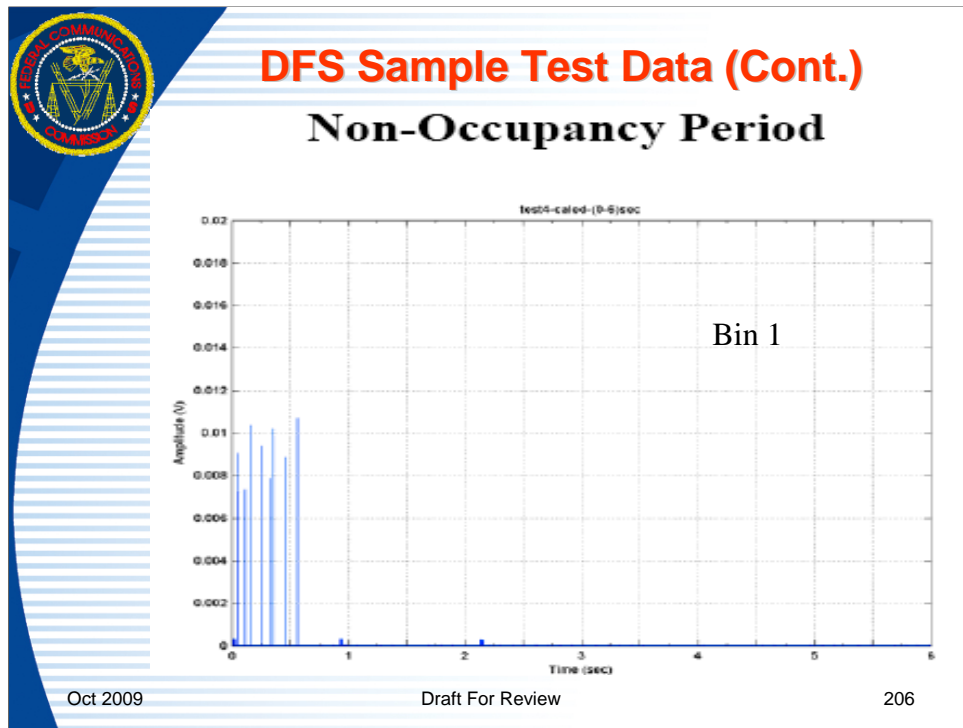


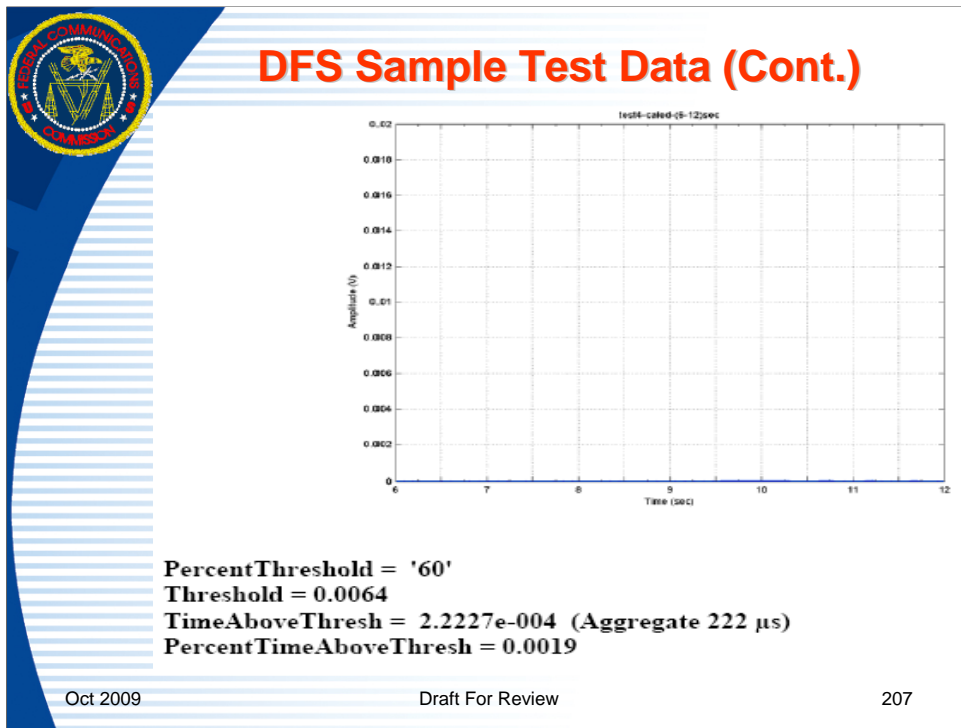
















UWB Subpart F

- TCB cannot approve UWB devices at this time
- For test labs measuring an UWB for an EAS filing, an interpretation letter can be obtained at....
- <http://gullfoss2.fcc.gov/prod/oet/cf/kdb/forms/FTSSearchResultPage.cfm?id=20253&switch=P>

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UWB

- UWB RO&O, Allowed operation of devices in Restricted bands.
- The Commission established technical standards and operating restrictions for three types of UWB devices based on their potential to cause interference. These three types of devices are:
 - 1) imaging systems including GPRs, wall imaging systems, through-wall imaging systems, surveillance systems and medical imaging devices;
 - 2) vehicular radar systems;
 - 3) communications and measurement systems consisting of indoor-only devices and hand held devices that may be operated anywhere.
- Limits and requirements are based on type of device and operating frequency range.


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UWB

- Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems
 - FCC 04-285 ET Docket No. 98-153
 - Adopted 12-15-2004, Published 2/9/05, effective 3/11/05
 - http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-04-285A1.doc
 - Improve automotive safety and tracking systems that could be employed for personnel location, such as hospital patients and emergency rescue crew, as well as for such functions as inventory control.
 - Certain Non-UWB devices permitted use of peak emission levels, similar to the levels applied to UWB devices, for wideband emissions in the 5925-7250 MHz, 16.2-17.7 GHz and 23.12-29.0 GHz bands.
 - Allows certain measurements for vehicular radar systems employing gating to be measured with gating active. Normally continuous transmission required.

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RMS measurements for UWB devices

Website:
<http://gulfoss2.fcc.gov/prod/oet/cf/kdb/forms/FTSSearchResultPage.cfm?id=20288&switch=P>

- The first option is to use an analyzer that incorporates an RMS detector. Check analyzer specifications.
- Set integration time properly.
 - In order to obtain the maximum 1 millisecond (mS) integration time, the ((sweep time) / number of bins), should be less than or equal to 1 mS. The default number of bins(also referred to as points) on some analyzers is 601 points (pts).
 - Do not use trace averaging or average detector.
- Alternatively
 - When an analyzer does not incorporate a true RMS detector, there is also a method described in Appendix F, paragraph (3) in the First Report and Order (FCC 02-48)
 - Detailed in the interpretation letter at the above website.
 - When obtaining RMS values in either manner, describe and/or provide the formula used to post-process the data with the Certification filing.

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UWB Subpart F related KDBs

- KDB# 393764
 - UWB Compliance and measurement info

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Subpart G Access Over Broadband Power lines (Access BPL)

- TCB cannot Certify at this time.
- Measurement guidelines can be found at
 - <http://www.fcc.gov/oet/ea/eameasurements.html>
- Summary of rules
 - BPL devices are “carrier current systems” **[15.3(f)]**
 - Part 15 interference requirements
 - Must not cause harmful interference
 - Must accept interference from other devices
 - Emission limits
 - AC-Line Conducted limits **[15.107]**
 - Devices operating < 30 MHz: 1000 uV in 535 – 1705 MHz
 - Devices operating > 30 MHz: Same as digital device limits
 - » 150 kHz – 30 MHz
 - Radiated limits
 - < 30 MHz Intentional radiator limits **[15.209]**
 - » 1.705-30 MHz: 30 uV/m at 30 m)
 - > 30 MHz Unintentional radiator limits **[15.109]**
 - » 30-88 MHz: 90 uV/m at 10 m (Class A); 100 uV/m at 3 m (Class B); etc.
 - Field strength measurements are “in situ”
 - Minimum of 3 installations that are “representative of typical installation sites”

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BPL Subpart G related KDBs

- KDB# 384352
 - BPL measurement distance
- KDB# 741000
 - BPL measurement guideline

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End of Part 15 unlicensed transmitters


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Appendix A

- Part 15 unintentional radiators.
 - Radar detectors
 - Scanning receivers
 - TV interface devices
- EAS, Emergency Alert Systems (Part 11)
- Part 18 Consumer ISM devices.


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Radar detectors

- RO&O ET Docket 01-278
http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-02-211A1.pdf
- Equipment Class "CRD"
- Conducted Section 15.107
- Radiated Section 15.109(h)
- Frequent compliance issues.
 - Block diagram must have all applicable frequencies such as for the sweep generator frequency, IF frequency and local oscillator frequencies.
- The device must comply with the general radiated emissions limits of Section 15.109 of the Rules in the 11.7 to 12.2 GHz VSAT band. No radiated emissions tests need to be performed in other bands other than the specified 11.7 to 12.2 GHz.
- Test procedure at
See KDB# 214146

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Scanning receivers

- Section 15.121
- Requirements (*Check current rules for details and any changes*)
- Tuning Range 30-824, 849-869, 894-960 MHz
- Equipment Class- **CSR**
- Incapable of operating in cellular frequencies
- Line conducted Section 15.107
- Radiated Section 15.109
- R&O: ET Docket 98-76 Released 3/31/99
- Image rejection : 38 dB minimum
- Label: warning against modifications to allow cellular reception
 - 1.Statement assessing the vulnerability of the scanning receiver to possible modifications and describing the design features that prevent modification of the scanning receiver to receive cellular transmissions
 - 2.Statement describing the design steps taken to make tuning, control and filtering circuitry inaccessible
 - 3.Test data and description of the procedure used to demonstrate 38 dB rejection ratio compliance
- 4.Label with the required warning against modifications to allow cellular reception. (15.121(f))

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Scanning receivers

- Frequent compliance issues
 - Must indicate the how tuning, control and filtering circuitry is inaccessible and if modification will render inoperable.
 - In lieu of testing per 15.31(m), We require testing at three frequencies for each local oscillator in lieu of testing per 15.31(m).
 - Also, test scanning receiver in scan mode.
 - Pursuant to Part 0.457(d)(1)(ii), portions of scanner application will not be made available for public inspection (held confidential)
Schematic diagram, block diagram, operational description, internal photos
*** Mark these exhibits confidential.

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Scanning Receiver related KDBs

- KDB# 175505
 - Scanning receiver policies

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EAS(Part 11)

- Emergency Alert Systems
- Subject to EAS protocol
- Test report. Compliance with Class A radiated and conducted limits.
- Equipment Class. “EAD”
- Very few filings.

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Part 18 Consumer ISM devices

- Consumer ISM devices are subject to DOC or Certification.*
 - RF lighting devices, Jewelry cleaners, Microwave oven's...
 - * Exception (Consumer Ultrasonic equipment <500 Watts, <90 kHz VERIFIED)
- Technical report requirements in 18.207
- Limits in Part 18 Subpart C, Technical standards are based on frequency of operation, type of device.
 - Unlimited radiated energy in ISM bands listed in 18.301.
- Compliance Information in Section 18.212
- Information to users in 18.213
 - Interference potential
 - Maintenance of system
 - Measures to correct interference
 - Advisory statement for RF lighting devices.
- AC line conducted limits in 18.307
 - Use "CE" or "O5" note code except for RF lighting devices.
- Encouraged to use MP-5.
- Frequent compliance issues
 - Missing compliance information and/or information to users.

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Part 18 related KDBs

- KDB# 162908
 - Magnetic Field Cancellation
- KDB# 227764
 - Regulations for Nuclear Quadrupole Resonance(NQR) techniques using RF to detect explosives.

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