



**Federal Communications Commission
Office of Engineering and Technology
Laboratory Division**

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**BASIC EQUIPMENT AUTHORIZATION GUIDANCE FOR
ANTENNAS USED WITH PART 15 INTENTIONAL RADIATORS**

I. INTRODUCTION AND SCOPE

This document summarizes rules and policies on technical information and test data to include in equipment authorization applications for antenna(s) used with part 15 intentional radiator devices (part 15 transmitter devices). This publication addresses information related to the product antenna needed to demonstrate compliance with the EMC requirements. It may also be necessary to consider the impact of changes to the product antenna on the RF exposure requirements.¹ Other basic guidance for miscellaneous related considerations is also provided in a frequently-asked question and answer format.²

Other FCC rules and KDB publications should also be consulted about further technical information and test data requirements for antennas used with part 15 transmitters, including but not limited to the following:

- Sections 2.1033(b)(4), 15.203 15.212, 15.217, 15.219, 15.255 and 15.256
- KDB Publication 178919 Permissive changes
- KDB Publication 558074 DTS device measurements
- KDB Publication 602159 Part 15 amplifiers and repeaters
- KDB Publication 662911 Multi-antenna and MIMO devices
- KDB Publication 789033 U-NII device measurements
- KDB Publication 905462 U-NII DFS compliance procedures

II. BASIC RULE AND POLICY REQUIREMENTS FOR ANTENNAS USED WITH PART 15 TRANSMITTERS

A. ANTENNA REQUIREMENTS—Section 15.203

- 1) The purpose of Section 15.203 is to prevent attaching any other antenna(s) [other than one(s) approved with the device] to a Part 15 transmitter. All antennas for use with the approved device must be listed in the application.

¹ See KDB Publication 178919 for additional guidance on permissive changes. For instance, for a specific antenna change, if an EMC requirement allows a Class I permissive change but the RF exposure evaluation requires a Class II permissive change, then a Class II permissive change shall be approved prior to the antenna change.

² This document consolidates and supersedes guidance previously contained in KDB Publications 144180, 189073, 239743, 268277, 353028, 420149, 450420, 622265, 816806, 817132, and 963678. Also selected information is repeated from the 2009 Consolidated Unlicensed Devices FCC-TCB training presentation; see: (<https://apps.fcc.gov/eas/comments/GetPublishedDocument.html?id=14&tn=901085>).

- 2) The following describes the three ways that can be used to demonstrate compliance to Section 15.203:
 - a) Antenna permanently attached.
 - i) Antenna soldered to a printed circuit board.
 - ii) Antenna permanently glued with epoxy to a standard connector.
 - (1) Specify the type of adhesive to be used.
 - (2) Confirm that the adhesive will be applied at the factory (prior to shipment).
 - b) Unique (non-standard) antenna connector.
 - i) Antenna connectors not readily available to general public.
 - ii) FCC has 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) Allow 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) 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, where such disassembly is not normally required. The user manual must not show that user has access to the connector.
 - (4) BIOS lock—Radio card and host (*e.g.*, laptop computer) exchange code to ensure only the authorized transmission system works in the host.
 - c) Professional installation
 - i) Professional installation must be justified in the filing, and grant condition must state “This device must be professionally installed.”
 - ii) Professional installation does not permit use of any antenna with the transmitter; the permitted types of antenna must be specified.
 - iii) The applicant should address the following items when justifying professional installation.
 - (1) To qualify for professional installation, the applicant must explain why the hardware is not readily available to average consumer.
 - (2) Marketing—Device cannot be sold via retail to the general public or by mail order; it must be sold to authorized dealers or installers only.

- (3) Filing must show that intended use is not for consumers and general public; rather device is generally for industrial/commercial use.
 - (4) Explain what is unique, sophisticated, complex, or specialized about the equipment that REQUIRES it to be installed by a professional installer?
- iv) Other professional installation requirements.
- (1) Installation must be controlled.
 - (2) Installed by licensed professionals (*e.g.*, device sold to dealer who hire installers).
 - (3) Installation requires special training (*e.g.*, special programming, access to keypad, field strength measurements made).

B. ANTENNA CHANGES AND ANTENNA MODIFICATIONS—Section 15.204

- 1) All part 15 intentional radiator grants must be for complete transmitter systems only.
- 2) Part 15 intentional radiator devices must be marketed to end users as complete transmitter systems, with the following exceptions allowed.
 - a) Standalone amplifier that has been certified as part of a transmitter system, per Section 15.204(d).
 - b) Device may be OEM installed but device must be complete system to end user.
 - i) Grant condition: OEM installation only.
 - ii) User manual must not have user installation instructions.
 - c) BIOS lock—Radio card and host (*e.g.*, laptop computer) exchange code to ensure only the authorized transmission system works in the host.
 - i) Grant condition: “This device must utilize a BIOS lock mechanism which ensures use only with hosts as specified in the Certification filing.”
 - ii) User-installable plug-in radio cards (*e.g.*, mini-PCI, PCIe-Minicard) that operate with antennas built in laptop and can be used in any laptop computer with standard form-factor plug-in slot should not be granted.

For user-installed radios used with integrated antennas in laptops, we require a software or hardware two-way authorization method 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 for the specific part 15 complete transmission system.

III. MISCELLANEOUS QUESTIONS AND ANSWERS ABOUT ANTENNAS AUTHORIZED WITH PART 15 TRANSMITTERS

A. Question: Can an applicant submit test results for a representative set of antennas, instead of each possible antenna that can be used with a Part 15 transmitter?

Answer: When submitting test data for part 15 transmitters to be used with multiple antennas, we require testing for the highest gain of each type of antenna (*e.g.*, highest gain for each patch, yagi, grid, dish, monopole, etc.). The following are guidelines for submissions.

- 1) For systems that can operate at different power levels, test data with the highest output power must be submitted.³
- 2) Applications must contain an exhibit listing each antenna, the antenna gain, antenna type, and antenna manufacturer/vendor and output power that can be used for the device. If the antenna list exhibit includes antennas of the same type but with different manufacturers/vendors, test data for only one manufacturer version needs to be submitted.
- 3) After an initial grant under an FCC ID, new antenna types can be added as a Class II permissive change considering Section 15.204(c)(1). However test data must be submitted for the new antennas with the highest gain for each type of antenna, even if the antennas have lower gain than those listed in the original application.
- 4) For devices that are approved under the U-NII rules in Section 15.407 that incorporate DFS, a Class II permissive change must always be filed whenever an antenna is used with lower gain than as previously approved, even if the antenna is of the same type.⁴
- 5) The provision of item 4) does not change or remove any precedence of RF exposure evaluation and compliance requirements. For example, an antenna that permits a device to be used in a portable device exposure condition, but that was originally approved as a fixed device, still must submit an RF exposure evaluation.
- 6) Although test data for all antenna configurations may not be required for submission, the device must comply with the rules using all antenna configurations.

B. Question: Can antennas not listed in an equipment authorization approval for a part 15 transmitter be marketed and used without further approval?

Answer: Except as noted below, an antenna not listed in an equipment authorization that is the same type [Section 15.204(c)(4)] with equal or lower gain (same physical arrangement, generates the same

³ Per Section 15.204(c)(2), compliance testing shall be performed using the highest gain antenna for each type of antenna to be certified with an intentional radiator; during this testing [*i.e.*, compliance testing for any intended antennas, not just the highest-gain antenna testing], the intentional radiator shall be operated at its maximum available output (conducted) power level. The Section 15.204(c)(2) requirement can be paraphrased that for any one antenna type, the highest gain shall be tested, and among all intended antennas, whichever gain gives highest conducted power shall also be tested (*e.g.*, may be lowest gain within any one antenna type). For determining maximum output and worst-case emissions conditions, Section 15.204(c)(2) testing must also address variations due to antenna connecting-cable attenuation and mismatch standing waves if any.

⁴ Per Section 15.407(h)(2), for radiated compliance testing of Radar Detection Function of Dynamic Frequency Selection devices, the device shall be tested with the lowest gain antenna assembly listed in the application, regardless of antenna type.

in-band and out-of-band characteristics in all spatial directions) may be marketed and used with a part 15 transmitter.

- 1) Example permissible types of lower gain antennas—If a device was certified with a 26 dBi parabolic reflector (dish) type antenna, then other smaller parabolic reflector antennas are allowed without additional equipment authorization. The physical construction must be similar, such that the in-band and out-of-band characteristics in all directions are lower than the originally authorized equipment. In addition, the antenna must comply with all applicable FCC rules, operating requirements and grant conditions for the specific FCC ID.
- 2) Other exceptions that may apply:
 - a) Any certified transmitter which is required to monitor the bandwidth that it is intended to transmit on can only use antennas approved with the device. Part 15 device examples include:
 - i) Subpart D Unlicensed Personal Communications Service devices.
 - ii) Subpart E Unlicensed National Information Infrastructure devices (U-NII) devices certified with Dynamic Frequency Selection (DFS).
 - b) Portable devices subject to SAR limits may require additional SAR testing if the antenna is changed; see also KDB Publication 178919.

C. Question: What are the requirements for approving a different antenna with an approved modular transmitter?

Answer: The permissive change requirements for modifying a certified modular transmitter are given in Sections 2.1043 (b)(4) and (f), which specify that the original grantee of Certification is the only party that can request a permissive change to a part 15 device.

Grantees can file for a Class II permissive change to add a new antenna. If the manufacturer or seller of the device is not the original grantee, and the original grantee is unwilling to file a Class II permissive change, a new application for certification is required under a different FCC ID number. See KDB Publication 996369 for further guidance on antenna specifications to be provided by the grantee to the host integrators.

D. Question: Can a part 15 transmitter be marketed without an antenna, and instead only supply a list of approved antennas?

Answer: A part 15 transmitter cannot be marketed to end users with only a list of approved antennas. Section 15.204(b) states that an approved “transmission system” must always be marketed as a complete system, *i.e.*, including the antenna.

However, for professionally installed part 15 transmitters, if the grantee ensures and controls the professional installation of the device, the professional installer may choose the proper antenna for the installation. The grantee may use contracted installers, who install their equipment and ensure the proper antenna is used.

The grantee would need to justify professional installation (for marketing, installation, and use restrictions; follow the professional installation justification guideline) and ensure that the installation is done by a professional installer under the grantee’s control. The professional installer must be provided the proper instructions for output power/cable/antenna configurations that meet the

rules. These instructions are not given to the end user, and in no case can the end user still have controls to adjust power.

- E. Question:** Is there a way to measure or characterize an antenna separately from the module for Part 15 intentional radiator devices?

Answer: No; Section 15.204(c)(2) requires that compliance testing use the actual antennas to be certified with the part 15 intentional radiator. All devices (*e.g.*, radio card, module) must be tested with the antennas connected to the device.

- F. Question:** Can passive reflectors be used with an approved part 15 transmitter? 2) Are passive billboards or other metallic reflectors located at significant distances from a part 15 transmitter acceptable for use?

Answer: Passive reflectors can only be used when the passive reflector has been authorized as an antenna for the approved part 15 transmitter. When used with part 15 transmitters, passive reflectors are considered part of the antenna assembly of the device, per Section 15.204(c). 2) Passive repeaters such as billboard reflectors that are located at significant distances from a part 15 transmitter, and are used to change the direction of a microwave path to overcome obstructions, are acceptable if there is no increase in resulting antenna gain and there is no interference.

- G. Question:** Is the antenna connector the only part of a transmitter required to comply under Section 15.203?

Answer: Both the intentional radiator portion and the antenna must comply with Section 15.203. Note that an external power amplifier, authorized pursuant to Section 15.204, must meet the requirements of Section 15.203 as well (see also KDB Publication 602159). The complete transmission system must be tested as it will be marketed and operated.

- H. Question:** Would a locking antenna connector that can “snap-on”, but is not removable without breaking either the connector or PC board, qualify as an integral antenna connector?

Answer: Section 15.203 of the FCC Rules contains the requirements for an antenna attached to an intentional radiator operating under part 15. A permanent locking antenna connector is acceptable unless it can be removed with a special tool available to the end user. As long as the end user is unable to replace the antenna with another antenna, under any circumstances, the locking antenna connector is acceptable.

- I. Question:** Is it acceptable to use a transmitter antenna sensing circuit instead of a unique antenna connector to satisfy the requirements of Section 15.203? Can this circuit also be used to automatically adjust output power for different type antennas?

Answer: Yes, an antenna sensing system may be acceptable to meet the intent of Section 15.203 by ensuring that the transmitter will only operate when appropriate antennas are attached. Because the system is also designed to automatically adjust the output power for varying loads, it must be capable of accurately and reliably maintaining the output power level within prescribed limits for all normal environmental conditions and variations in antenna cable lengths and antenna gains.

When testing such a system for preparing an equipment authorization application, compliance must be demonstrated with all pertinent requirements under the following operating conditions: when the

highest and lowest gain antennas are used, and when the minimum and maximum recommended feed-line lengths are used.

J. Question: Is a list of non-standard antenna connectors that comply with Section 15.203 available?

Answer: The FCC does not publish a list of “non-standard” or unique RF connectors.

K. Question: When testing a device operating in the 57 GHz to 64 GHz band under Section 15.255, does only the highest gain of each type of antenna used with the device, as well as, the antenna using the highest output power need to be tested?

Answer: No, as specified in Section 15.255(b)(1)(ii), compliance testing shall be performed using the highest gain and the lowest gain antennas for which certification is sought and with the intentional radiator operated at its maximum available output power level.

L. Question: May cable loss be considered when determining output power delivered to the antenna of a part 15 intentional radiator?

Answer: Yes. In cases where the antenna is permanently attached to the cable, or if the antenna is professionally installed, the cable loss can be subtracted from the output power at the transmitter terminal to calculate the output power at the antenna input for determining compliance with the output power and any EIRP limit for the antenna. In such a case, the output power at the transmitter terminal, the cable loss, and the output power at the antenna must all be documented in the test report. The grant must list the output power at the antenna, and which cannot exceed the applicable limit.

Also, the cable must not be easily removed by the end user, which could inadvertently allow connection of the antenna directly to the transmitter with operation in excess of the conducted output power or EIRP limits.