



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

September 28, 2018

DRAFT LABORATORY DIVISION PUBLICATION REPORT

Title: RF Certified Modules

Short Title: RF Certified Modules

Reason: Two new attachments are being added to KDB Publication 996369:

- [996369 D03 OEM Manual v01](#) — Guidance for instructions provided to host manufacturer.
- [996369 D04 Module Integration Guide](#). Guidance to host manufacturers for integrating modules into their products.

Publication: 996369

Keyword/Subject: Modules, Module Certification, 15.212, OEM Manual, Integration Instructions

First Category: Modular Approvals

Second Category: General (Module Approvals)

Question: What is the FCC guidance for equipment authorization of transmitter module devices, and equipment that incorporates transmitter modules?

Answer:

[996369 D01 Module Certification Guide](#). Provides guidance for equipment authorization applications for modular transmitters per Section 15.212.

[996369 D02 Module Q&A v01](#). Provides additional guidance in a question and answer format.

[996369 D03 OEM Manual v01](#) — Guidance for instructions provided by grantees to host manufacturers. *

[996369 D04 Module Integration Guide v01](#). Guidance to host manufacturers for integrating modules into their products. *

Attachment List:

996369 D01 Module Certification Guide

996369 D02 Module Q&A v01

[996369 D03 OEM Manual v01](#) *

[996369 D04 Module Integration Guide](#)*

* Draft document provided for review and comment.

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**GUIDANCE FOR MODULE INSTRUCTION MANUAL
AND CERTIFICATION APPLICATION REVIEWS**

1.0 INTRODUCTION

The purpose of this document is to provide guidance to equipment authorization applicants seeking to certify a modular transmitter and the key elements to be reviewed by the Telecommunication Certification Body (TCB) during the certification process.¹ This guidance includes:

- the integration instructions to be provided by a grantee (applicant) to the host manufacturer;
- a list of key elements to be reviewed by the TCB during the certification process; and
- guidance for grant comments to be included on the grant of certification.

2.0 INTEGRATION INSTRUCTIONS

2.1 General

The following is a list of nine items² to be provided in the integration instructions to host manufacturers (OEM Instruction Manual) for use when integrating a module in a host product. The grantee is encouraged to include information in their instructions for each of these items, even when it is not applicable. For example, trace antenna designs could indicate “not applicable.” This simplifies the TCB’s review process with providing an incisive way for reviewing the modular transmitter certification application.

2.2 List of Applicable FCC Rules

List the FCC rules that are applicable to the module. These are the rules that specifically establish the band of operation, the power, spurious emissions, and fundamental frequencies operations. **DO NOT** List compliance to unintentional-radiator rules (Part 15 Subpart B) since those are not a condition of a module

¹ The TCB shall review the certification application, including integration instructions, for completeness. For example, a filing for a single-chip module that submits only a data sheet would not be sufficient. Also, instructions that do not clearly indicate the specific parts or items necessary for compliance to the FCC requirements would also be inadequate. If the grant conditions are such that the module cannot be sold to other manufacturers then the integration instructions can be placed in the theory of operation exhibit, which can be treated as long term confidential.

² Integration instructions for trace antenna design are required only when the module can use a trace antenna.

grant that is extended to a host manufacturer. See 2.10, regarding the need to notify host manufacturers that further unintentional radiator testing is required.

2.3 Summarize the Specific Operational Use Conditions

Describe use conditions that are applicable to the transmitter rule part, such as limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss then this information must be in the instructions. If this extends to professional users, then it must state that this information also extends to the host manufacturer's instruction manual. For example, certain items such as peak gain per frequency band and minimum gain may be needed, specifically for master devices in 5 GHz DFS bands.

2.4 Limited Module Procedures

If the module is classified as "limited," then the module manufacturer must provide the method and procedures needed by the host manufacturer to demonstrate their alternative means for ensuring compliance.

2.5 Trace Antenna Designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The TCB shall review the integration instructions for the following aspects: layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

- a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna);
- b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered);
- c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout;
- d) Appropriate parts by manufacturer and specifications;
- e) Test procedures for design verification;
- f) Production test procedures for ensuring compliance; and
- g) If confidential, the method used (such as NDA) to keep the information confidential.

2.6 RF Exposure Conditions

It is critical for the module grantee to clearly and explicitly state the RF exposure conditions that permit a host manufacturer to use the module. There are two types of instructions required for RF exposure information: (1) to the host manufacturer, to define the application conditions (mobile, portable – XX cm from a person's body); and (2) additional text needed for the host manufacturer to provide end users in their product manuals. If this statement and condition of use is not provided, then the host manufacturer will be required to take responsibility of the module through a change in FCC ID (new application) or must perform an RF exposure compliance analysis.

2.7 Antennas

A list of antennas included in the application for certification must be provided in the instructions. This must also include any professional installer instructions that were included as part of the limited module approval. If this extends to professional users, then it must state that this information also extends to the host manufacturer's instruction manual. For example, this includes antenna types (monopole, PIFA, dipole, etc. (note an omni-directional antenna is not an "antenna type")).

2.8 Label and Compliance Information

The grantee is responsible for the continued compliance of their module to the FCC rules. This includes advising the host manufacturer that they need to provide a physical or e-label "Contains FCC ID" with their finished product. See [Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748](#).

2.9 Information on Test Modes and Additional Testing Requirements

For host system evaluation, guidance on additional testing is given in KDB Publication 996369 D04. These test modes take into consideration different operational conditions for a stand-alone module in a host, versus with multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host system evaluation (additional testing guidance is found in KDB Publication 996369 D04) for different operational conditions for a stand-alone module in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host. Where the host manufacturer is the same as the module manufacturer, limited documentation is required to be provided based on the modular approval (i.e., limited modular approval applies).

2.10 Additional Testing, Part 15 Subpart B Disclaimer

The grantee should include a statement that the module is **only** FCC authorized for the specific rule parts (FCC transmitter rules) and that the host manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered in the module grant. If the grantee markets their module as being Part 15 Subpart B compliant (since it also contains unintentional digital circuitry), then the grantee shall provide a notice stating that the assembly is not authorized to be used in a host and assume that the host remains Part 15 Subpart B compliant without further testing.

3.0 MODULAR TRANSMITTER APPLICATION REVIEW

The following is a list of items that shall be addressed by the TCB when reviewing an application for certification of a modular transmitter.

- a) *Cover Letter Request for Module Certification*. Provides a module request cover letter identifying the conditions that are met or not met as required in Section 15.212. Clearly indicate that the module will be a single, limited, split, or limited-split module.

Note: Split modules require Pre-Approval Guidance (PAG). It is recommended to check through the FCC Inquiry system prior to a PAG to determine if a Split Module approach is appropriate. Split modules require approval for authentication and software approved on case-by-case bases.

- b) *RF Exposure Information.* Provides the RF exposure justifications as required in KDB Publication 447498. For example, this may be either MPE calculations with associated separation distances, or specific host SAR reports.
- c) *Internal Photos.* Photos clearly delineating the module. For example, showing a host evaluation board containing the module without clearly delineating the module is not acceptable.
- d) *User Manual—Integration Instructions.* Determine that each individual item from 2.0, Guide for OEM Instructions, and is adequately provided in the manual with the integration instructions.

Note: The TCB shall review and decide on the completeness of the integration instructions. For example, a filing for a single chip module that submits only a data sheet would be considered not adequate. Also, instructions that do not clearly indicate the specific parts or items necessary for FCC compliance would be considered inadequate. If the grant conditions are limited such that the module cannot be sold to other manufacturers, it is permitted to place the instructions in the theory of operation exhibit folder for long term confidentiality. In this case, a statement shall be placed in the user manual exhibit folder indicating that the module is not for sale and the user manual integration instructions are internal confidential manufacturing documents.

- e) *Test Set-Up Photos.* Photos must be consistent with the description of the device.
- f) *Test Reports.* Must clearly identify the physical test set-up, test board details, and conditions that the module is being tested under; and whether the module was tested as a standalone device or in a specific host device.
- g) *External photos.* External photos must clearly show the module.
- h) *Label.* Required information is provided on the module label.

4.0 GRANT NOTES

Specify correctly whether the module is a modular approval vs. a limited modular approval and other appropriate restrictions (e.g., separation distances, co-transmission restrictions, if reference antenna trace requirements exist, etc.).

Example grant comments:

- The host integrator must follow the integration instructions provided by the module manufacturer.
- The module antenna(s) must be installed to meet the RF exposure compliance separation distance of “xx cm” and any additional testing and authorization process as required.
- The module grantee is responsible for providing the documentation to the system integrator on restrictions of use, for continuing compliance of the module.

996369 D04 Module Integration Guide

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MODULE INTEGRATION GUIDE – GUIDANCE FOR HOST MANUFACTURERS

1.0 INTRODUCTION

Many modern products are taking advantage of wireless transmitter modules that have been FCC certified by a module manufacturer to demonstrate compliance with the FCC rules. Wireless modules today are integrated transmitter circuits that are imbedded in both simple and complex host products. When using certified modules, it is necessary for the host manufacturer/host integrator to have a good understanding of RF engineering, electromagnetic compatibility (EMC), and knowledge of FCC regulations. Leveraging the certification of a module has several advantages including reducing FCC filing requirements, but there are limits for the host manufacturers in making modifications or changes to the module and the types of antennas that can be used in the final product. The host manufacturer is still responsible to follow the integration guidance from the module manufacturer and ensuring compliance of the end product.

2.0 GENERAL GUIDANCE

It is strongly recommended that host manufacturers using a certified module address the following items.

- a) Account for all FCC compliance requirements, including those for digital circuitry (unintentional radiators) and transmitters. The host manufacturer needs to also consider the FCC requirements for certified modules being used in the host product, and maintain documentation on how the host product with the certified wireless modules complies with the FCC rules.
- b) Review the module integration instructions provided for the certified module(s) and ensure that the module is appropriately integrated into the host product.³
- c) If the module is granted as a limited module, the integration instructions for full compliance must be followed to ensure that the conditions which limited the original module grant are clearly addressed. If the instructions are inadequate, the integrator must work with the module grantee to address the issues.
- d) Confirm that the integration instructions for RF exposure requirements are followed for the host product. The integration instructions should provide instructions equivalent to one of the following:

³ Most final products today are regulated under multiple FCC rules and may be authorized under different equipment authorization procedures. For example, a product could be authorized under Parts 22, 24, and 27 for cellular frequencies, Part 15 for Wi-Fi and Bluetooth, using certified modules, and SDoC for the digital circuitry (unintentional radiator) portion of the device.

- i) The host operating conditions must be such that there is a minimum separation distance of 20 cm (or possibly greater than 20 cm) between the antenna radiating structures and nearby persons. The host manufacturer is obligated to confirm the use conditions of the product to ensure that the distance specified in the instructions is met. In this case the host application is classified as either a mobile or fixed device for RF exposure purposes; or
 - ii) The module is authorized to be used in a specific type of host platform and installed such that it can be operated at closer than 20 cm to users or nearby persons. The modules may also be certified to be used with other specific certified modules which transmit simultaneously.⁴ In this case the integration instructions will be very detailed about the specific host conditions and which modules may be used together. See KDB Publication 447498 for RF exposure compliance guidance.
- e) Obtain the required equipment authorization for the applicable unintentional radiator functions (Part 15 Subpart B), and if required any additional testing and certification for any other included transmitters or devices not authorized as a certified module.
- f) Perform testing on the product with all transmitters operating to confirm that the host product meets the FCC requirements. This investigation of the final product can be done by spot checking emissions from the device while operating the host as a composite device (all of the transmitters operating simultaneously).⁵ This testing is performed with the final product configured in typical operational modes to check the fundamental emission and spurious emissions for compliance with any of the applicable rules.
- g) Label the product appropriately; see [KDB Publication 784748](#).

If the integration instructions do not contain clear directions with limited modules or for RF exposure compliance, the host manufacturer must contact the module manufacturer responsible for the FCC Certification. Alternatively, an inquiry may be submitted to the FCC through the Knowledge Database at <http://www/fcc/gov/labhelp>.

If any items listed above are not resolved the host manufacturer has some options depending on the situation: (1) request that the module manufacturer file for a Class II permissive change to address the issue; (2) the host manufacturer can file a Change in FCC ID and then file a Class II permissive change; or (3) the host manufacturer can file for their own approval (new FCC ID) as either a module or for the entire end product. This procedure is further described in KDB Publication 996369 D02 (Question 1).

⁴ Modules are typically tested in a stand-alone mode and thus the simultaneous transmission conditions have to be evaluated by the integrator. Evaluating compliance for a host using certified modules and/or a standalone product requires: addressing EMC requirements specified in Section 2.947(f) for composite system testing and for simultaneous transmission.

⁵ A composite system is a device or end product that incorporates different transmitters and RF devices and each may be operating under different FCC rules. For example, this may include a host product using one module certified under Section 15.247 integrated in an unintentional radiator device under Part 15 Subpart B.

3.0 HOST DEVICE TESTING GUIDANCE

3.1 General

Testing of the final host device with all of the transmitters installed is recommended to verify that the final product continues to meet the FCC rules. The radio spectrum is to be investigated with all the transmitters in the system functioning to determine that no emissions exceed the highest limit permitted for any one individual device as required by Section 2.947(f). This investigation does not require a formal application for certification. The host manufacturer is responsible to ensure that when their product operates as intended it does not have any emissions present that are out of compliance that were not present when the transmitters were tested individually.⁶

The following paragraphs provide some guidance and suggestions to the manufacturer of the host product when installing a certified transmitter module, of how they may verify the intentional radiator (transmitter) compliance of the final composite product.

If the transmitter module has been fully tested by the module vendor on the required number of channels, modulation types and modes, it should not be necessary for the host installer to re-test all the available transmitter modes or settings. It is recommended that the host product manufacturer, installing the module, perform some investigative measurements to confirm that they have not created a composite device which exceeds the spurious emissions limits or band edge limits (where a different antenna may be causing additional emissions).

The testing should check for emissions that may occur due to the intermixing of emissions with other transmitters, digital circuitry or due to physical properties of the host device (housing). This investigation is especially important when integrating multiple modules since modules are certified by testing them in a stand-alone environment. It is important to note that host manufacturers should not assume that since the module is certified that they do not have any responsibility for final product compliance.

If the investigation finds a problem the manufacturer is obligated to fix the issue. Currently a host device using modules is subject to the individual rules as well as to the general conditions of operation in Sections 15.5 and 15.29 to not cause interference. The operator of the host device will be obligated to stop operating the device until the interference has been corrected.

3.2 Frequency Spectrum to be Investigated

For host products with certified modules, the frequency range of investigation of the composite spectrum is specified by rule in Section 15.33(a)(1) through (a)(3) or the range applicable to the digital device, as shown in Section 15.33(b)(1), whichever is the higher frequency range of investigation. For example:

A host with a clock frequency of 30 MHz and dual band Wi-Fi would require an investigation up to 10 times the 5 GHz or around 60 GHz or the lower value of 40 GHz as permitted by Section 15.33(a)(1). In this case the Wi-Fi fundamental frequency of the module is the highest frequency used.

A host with a 13.5 MHz transmitter and a clock at 28 MHz would require an investigation from the table in Section 15.33(b)(1): 1.705-108 MHz, to 1 GHz. Using the highest investigation frequency determined by Section 15.33(a)(1) through (a)(3) or the table in Section 15.33(b)(1). In this case the digital clock rate of the host is the highest frequency used.

⁶ If the final product uses any transmitters that have not been FCC certified as modules, it is necessary to obtain the required certification for that transmitter.

3.3 Operating the Host Product

When testing the host product, have all the transmitters operating. The transmitters can be enabled by using the published driver (do not use a diagnostic tool) and turned on so the transmitters are active. In certain conditions it might be appropriate to use a technology call box where accessory devices are not available.

When testing for emissions from the unintentional radiator, the transmitter shall be placed in the receive mode or idle mode, if possible. If receive mode only is not possible then the radio shall be passive (preferred) and/or active scanning. In these cases, this would enable activity on the communication BUS (i.e., PCIe, SDIO, USB) to ensure unintentional circuitry is enabled. Testing laboratories may need to add attenuation or filters depending on the signal strength of any active beacons (if applicable) from the enabled radio(s). See ANSI C63.4 and ANSI C63.10 for further detail.

3.4 Emission Measurements

- a) Measure the fundamental and unwanted/spurious emissions with the module(s) operating in a normal mode.
- b) Perform testing on unwanted radiated spurious emissions on the worst-case modulation and channel per frequency range as shown in original filing.
- c) Where the module power is based on ERP/EIRP or field strength the host manufacturer should ensure that installation of the module has not affected the transmitter ERP/EIRP or field strength of the module. It should not be necessary to re-test the transmitter output power of any module which has been certified based on conducted power.
- d) When there is no power listed on the FCC Grant it should be assumed that the limit is based on field strength and that information will be in the associated test report in the module application. The host manufacturer may want to create a matrix based on module test results from original testing and compare that with the results of the digital device testing to create a list of the parameters to test.

3.5 Antenna Gain

- a) In cases where the transmitter module is certified based on the conducted output power, a change in antenna gain is possible through a Class II permissive change by contacting the module grantee, or filing for a change in FCC ID,⁷ based on the new emissions testing. However, in cases where the transmitter module is certified based on the ERP/EIRP or radiated field strength, it may not be possible to increase the antenna gain without a corresponding reduction in conducted transmitter power.
- b) Perform testing on frequency bands where the antenna gain is highest, worst-case band-edges based on original filing, and only on frequency bands where the antenna gain is highest.
- c) For DFS master devices it may be necessary to update the detection threshold.

3.6 Common Operational Configurations

The following list gives some suggestions for the most common technology types, on how the host manufacturer may operate their product during such investigative measurements. In setting up the

⁷ See last paragraph in section 2.0 GENERAL GUIDANCE for host manufacturer's options for making changes.

following configurations, if the pairing and call box options for testing does not work then the host manufacturer should work with the module manufacturer for access to test mode software.

3.6.1 Bluetooth

The product under test is placed into a normal ‘paired’ mode with another Bluetooth device, as per the normal intended use of the product. For example, data transfer, music playing, etc.

Alternatively, a Bluetooth test set may be used (although these may not allow full control of the BT module, i.e., power, channel, and data rate).

3.6.2 Wireless LAN

The product under test is set into a link/association with a partnering WLAN device, as per the normal intended use of the product. To ease testing, the product under test is set to transmit at a high duty cycle, such as by sending a file or streaming some media content.

Alternatively, a Wi-Fi test set may be used.

3.6.3 ZigBee

The product under test is placed into a normal ‘paired’ mode with another ZigBee device, as per the normal intended use of the product. For example, transferring data.

Alternatively, a ZigBee test set may be used.

3.6.4 Cellular (e.g., 2G, 3G, 4G, 5G)

The product under test is placed into a call with a base station simulator to configure the user equipment (“UE”) in a known transmitter configuration. A base station simulator allows the UE to be configured to specific frequency bands, RF channels, and transmitter power levels. If a base station simulator is not available, it is possible to connect the UE to commercial wireless service as to provide a UE connection in either an OATS environment or by coupling the commercial service into an anechoic chamber to radiate the wireless coverage inside the controlled environment. The limitation of using commercial service is the test setup may not be able to control the technology, RF channel, or frequency band and uplink activity, however, filters and attenuators may be used to control the uplink and downlink levels to provide some deliberate controls over the RF connection. This should be taken into consideration by the manufacturer when deciding if they the test results are appropriate for the desired testing.

3.7 Summary

- a) The host product manufacturer should have access to the transmitter module’s test reports, as these are publicly available on the FCC website. For example, they will be able to see if the installation of the module into the host has caused the transmitter emissions to degrade or remain unchanged. Also, it may be important to identify if the only emissions from the module are harmonics of the transmitter. This may be useful in cases such as licensed cellular transmitters, where it may be necessary to test the device outdoors. Testing outdoors is challenging due to ambient emissions, but it may not be a problem when specifically checking cellular harmonic levels.
- b) The above test modes are provided as only suggestions for a simple way for the host product manufacturer to perform their investigative measurements. However, if the host product

manufacturer finds during these investigative measurements that the transmitter emissions from their product are high and likely to exceed the limit, it may be necessary for the host product manufacturer to work with the module manufacturer to consider a more thorough investigations and mitigation measures.

- c) Finally, if the host product manufacturer does find that the composite system of host product and radio module does exceed the spurious emissions or output power limit; it is the responsibility of the host product manufacturer not to market the product in the U.S. Where possible, the host manufacturer and module manufacturer should work together to ensure compliance.