Federal Communications Commission
Office of Engineering and Technology
Laboratory Division

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CERTIFICATION AND TEST PROCEDURES FOR CITIZENS BROADBAND RADIO SERVICE DEVICES AUTHORIZED UNDER PART 96

1. INTRODUCTION

1.1 Background

The Commission recently created rules that permit the use of the 3550-3700 MHz band under the Citizens Broadband Radio Service (CBRS).[1] Devices operating in this band are called Citizens Broadband Radio Service Devices (CBSDs) or End User Devices; and, the rules governing their operations are codified in in Part 96. Existing Part 90 Subpart Z rules were also modified to implement a transition period that allows licensees to continue operations until the deadline at which they must comply with Part 96 rules.

1.2 Objective

This publication provides guidance on measurement and validation procedures for CBSDs and End User Devices to demonstrate compliance to the applicable rules in Part 96.[2]

CBSDs are required to demonstrate compliance with the technical rules and the access requirements based on at least one Spectrum Access System (SAS), which authorizes and manages CBRS spectrum use. Similarly, End User Devices are required to demonstrate the capability to transmit on an in-band frequency only after receiving authorization from a CBSD.

To demonstrate compliance with the rules, the requirements and procedures of this document are divided into three parts:

- **Section 2.** addresses equipment authorization requirements and procedures.
- **Section 3.** specifies CBSD and End User Device verification tests and recommended measurement procedures for demonstrating compliance to the specific radio frequency (RF) requirements and limits. It also specifies verification tests and recommended procedures for demonstrating compliance with the rules governing the connection and interaction between the CBSD and one or more SASs.
- **Section 4.** addresses all the security requirements.

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[1] *See Report And Order And Second Further Notice Of Proposed Rulemaking* in GN Docket No. 12-354, 30 FCC Rcd 3959 (2015; FCC 15-47) and *Order on Reconsideration And Second Report And Order*, 31 FCC Rcd 5011 (2016; FCC 16-55).

[2] CBSDs and End User Devices are currently on the Pre-Approval Guidance (PAG) list (§ 2.964). A CBSD sample must be submitted to the FCC for pre-approval testing prior to approval by a TCB. See KDB Publication 388624 D01 and D02 for detailed PAG procedures.

2. EQUIPMENT AUTHORIZATION

Per Section 96.49, CBSDs and End User Devices require certification. Applications for certification must be filed using the designated Form-731 equipment class codes: **CBD** (for Category A and Category B CBSDs), **CBC** (for Customer Premise Equipment CBSDs) and **CBE** (for End User Devices).[3, 4] Applications for certification must include all supporting documents demonstrating compliance with the rules, including two-way transmission and operation in the entire 3550-3700 MHz band.[5] For more details, see the FAQs at the end of this document.

3. MEASUREMENT PROCEDURES

3.1 Test Mode Requirements

To perform many of the certification compliance tests described in this document, a test mode accessible by test personnel (but not end-use operators) must be incorporated into a CBSD submitted for evaluation. Radio management software must also include software used for CBSD-to-SAS communication, whether directly or through a domain proxy.[6, 7] The software may be the same package as will be available to end users; however administrative privileges must be available. The test mode and radio management software must at a minimum provide the ability and instructions to:

a) Compel the device-under-test (DUT) to operate on a channel selectable by test personnel.
b) Vary the output power from the minimum to the maximum realizable levels and set it to a desired level.
c) As needed, continuously transmit a modulated signal (i.e., with no time bursting or signal gating applied).

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[3] Classification of the device must be consistent with specific requirements found in §§ 96.39, 96.41, 96.43, 96.45, and 96.47. Category A and Category B CBSDs are defined in § 96.3. Where necessary, grant comments must be used; for example: "For outdoor operation, antenna should not exceed 6 meters HAAT"; "This device is limited to outdoor operations." Customer Premise Equipment capable of transmitting at a maximum EIRP above 23 dBm / 10 MHz are considered CBSDs and must meet requirements of §96.39.

[4] Applications for certified transmitter modules (described in KDB Publication 996369) will require a pre-PAG consultation with the Commission staff. The applicant will need to demonstrate how they would retain control to ensure that the final device will comply with all the requirements for a CBSD or an End User Device, as applicable.

[5] Note that existing Part 90 Subpart Z devices may continue to operate under their current certification until the end of the transition period, which is defined by the wireless license, and are exempted from the two-way operation and band-wide operability requirements during the transition period. Grantees of existing certifications under Part 90 Subpart Z may file a new original application to re-certify the device and add the applicable equipment class code, under the same FCC ID, if they demonstrate compliance with all the requirements for the category of CBSD.

[6] If a CBSD is managed through a domain proxy or a management server for connection to a SAS, the applicant must include the information in the operational description of the equipment application.

[7] Devices may use the SAS emulator developed by Wireless Innovation Forum ("WInnForum") to demonstrate compliance, if the CBSD also uses the protocol developed by WInnForum. The protocol standard, test specifications, and other relevant standards can be found at http://www.cbrs.wirelessinnovation.org/. The WInnForum test software and test harness are publicly available at https://github.com/Wireless-Innovation-Forum/Citizens-Broadband-Radio-Service-Device. The test laboratory submitting data using the WInnForum test software must be recognized by WInnForum as an entity to perform such tests. Devices that do not use the WInnForum interface protocol, or have not been tested with the SAS emulator, must identify a specific SAS and demonstrate compliance using the indicated SAS.

d) Enter all required SAS registration information.
e) View all information provided to the radio by the SAS.
f) Force the DUT to stop operations on a specific channel and/or move to another channel.

3.2 Technical Requirements

The following list identifies the key requirements for compliance with Part 96 rules. In cases where test procedures or test cases have not been specified, the application for certification must include a detailed description of how the device complies with the requirements.[8]

a) Section 96.39 general requirements:

1) Geo-location—Devices must determine their location to an accuracy of ±50 m horizontal and ±3 m of elevation. Non-professionally installed devices must report any location changes exceeding ±50 m horizontal and ±3 m of elevation within 60 s.
2) Operability (Two-way communication)—Devices must be capable of two-way operation on any authorized frequency assigned by an SAS.
3) Registration with SAS—The CBSD must provide the required information to the SAS and obtain a successful registration. The management software must be able to collect the data listed in Table 1. Confirm that the DUT will not operate unless a successful registration and authorization is received from SAS.

Table 1—Required data collection capabilities for CBSD management software

All CBSDs:	Category B Devices:
- Geographic location - Antenna height AGL (m) - CBSD class (Category A or B) - Requested authorization status (PAL or GAA)[9] - FCC ID - Call sign (PALs only) - User contact info - Air interference technology - Serial # - Sensing capability (if supported)	- Limited to Outdoor operation - Antenna gain - Antenna Beam-width - Antenna Azimuth - Antenna Down tilt angle

4) Signal level reporting—A CBSD must report to a SAS received signal strength in its occupied and adjacent frequencies, received packet error rates, or other common standard metrics of interference for itself and its associated End User Devices as directed by SAS.
5) Frequency reporting—If directed by the SAS, a CBSD that receives a range of available frequencies or channels from an SAS must promptly report to the SAS which of the available channels or frequencies it will utilize.

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[8] Devices that implement a specific protocol, like the WInnForum Interface Specification, may reference the tests performed based on the specific protocols and test specifications to demonstrate the compliance with the general and technical requirements. The reference must include the identification of the versions of the protocol and test specifications with explanation of any exceptions to test specifications.

[9] PAL (Priority Access License) and GAA (General Authorized Access) are defined in § 96.3.

b) Section 96.41 General radio parameter requirements

1) Power limits and power management—All CBRS equipment must meet both the maximum EIRP (equivalent isotropically radiated power) limit and the maximum PSD (power spectral density) limit, listed in Table 2. CBRS equipment must operate across a 150 MHz band, thus measurements shall be performed and reported for low, mid, and high channels. Applications for certification must declare all channel-size configurations to be authorized (e.g., 5 MHz, 10 MHz, 20 MHz, 40 MHz, etc.) and the test reports should demonstrate device compliance in all channel-size configurations.

Table 2—EIRP and PSD limits for CBRS equipment

| Device	Maximum EIRP (dBm/10 MHz)	Maximum PSD[10] (dBm/MHz)
End User Device	23	n/a
Category A CBSD	30	20
Category B CBSD	47	37

2) Maximum EIRP—The procedure in Section 5.2 of ANSI C63.26-2015 is acceptable for performing power measurements. Measurements can be made using either a peak or average (RMS) detector, as long as the appropriate procedure is followed.

3) Maximum PSD—The rules require "maximum power spectral density" measurements, where the intent is to measure the maximum value of the time average of the power spectral density measured during a period of continuous transmission. To perform this measurement, the DUT must be configured to transmit continuously at full power. The procedure in Section 5.2 of ANSI C63.26-2015 is acceptable.

4) Peak-to-average power ratio (PAPR)—In addition to the power limits in Section 96.41, CBSDs need to meet a PAPR limit. For this measurement, the procedure in Section 5.2.6 of ANSI C63.26-2015 is acceptable.

5) Emission and interference limits—Confirm that the device satisfies the emission limits specified in Section 96.41(e) for all declared channel sizes, at the lowest and highest edges of the band, and in the middle of the band.

6) Emissions outside the fundamental—The limits for emission outside the fundamental are as follows.

- within 0 MHz to 10 MHz above and below the **assigned channel** ≤ −13 dBm/MHz
- greater than 10 MHz above and below the **assigned channel** ≤ −25 dBm/MHz
- any emission below 3530 MHz and above 3720 MHz ≤ −40 dBm/MHz

i) Measurements must be performed for low, mid, and high channels. It is acceptable to apply the procedures in Section 5.7 of ANSI C63.26-2015 using the following settings, per Section 96.41(e)(3)—resolution bandwidth:[11] 1% of fundamental for measurements within 1 MHz immediately outside the authorized channel; and 1 MHz for beyond 1 MHz outside the authorized channel.

ii) Consistent with basic guidance in KDB Publication 971168 D01, when antenna-port conducted measurements are performed to demonstrate compliance to the applicable unwanted emission limits (Section 2.1051), a separate radiated measurement is required to

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[10] Maximum PSD values are radiated. Measurements can be done conducted and add antenna gain back in.

[11] A narrower RBW is permitted in all cases to improve measurement accuracy, provided the measured power is integrated over the full reference bandwidth.

detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation (Section 2.1053). The Section 96.41(e) limits generally also apply to radiated unwanted emissions.

iii)   Note that unwanted emissions for CBSDs are relative to the authorized channel, as assigned by the SAS. Emission limits for example SAS-assigned channels are shown in Figure 1.
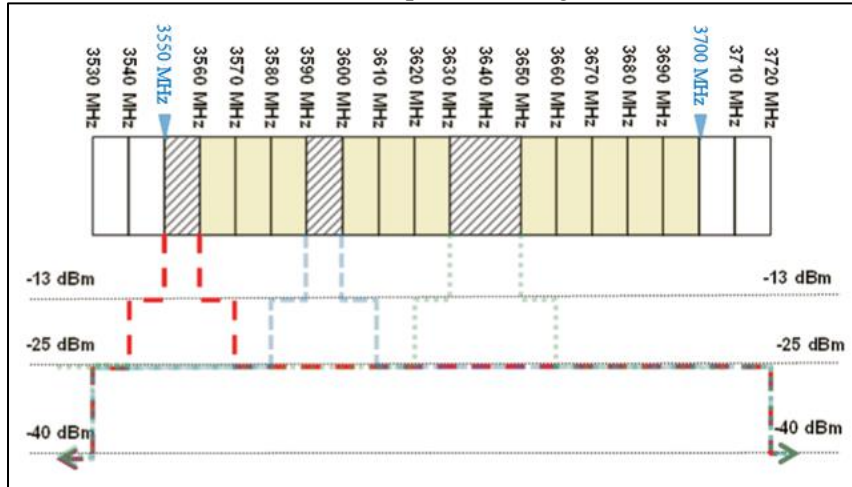
Figure 1—Emission limits for example SAS-assigned channels

7) Section 96.41(f) is a requirement for licensees and not a requirement for equipment authorization of a CBSD. Therefore, it does not need to be included in the test report.

3.3   Test Cases for Section 96.39 CBSD General Requirements

The following is a list of test cases that should be used, as appropriate for the device type, to demonstrate compliance with the requirements of the rule parts; the device will also need to demonstrate compliance with all the other general requirements in Part 2. In some cases, the test may not apply due to how the requirement was implemented; in these situations, a description must be included to show how it complies with the specific requirement. It is expected that in some cases testing may require configuring the device into a normal operating mode. For all test cases, reports should include detailed test descriptions, test setup parameters, and device configuration information.

a) CBSDs

1) Confirm that the device will only transmit after it receives authorization from a SAS.
2) Check the device registration and authorization with the SAS – determine if the device behaves appropriately for successful and unsuccessful registrations. The device should not be transmitting without authorization from the SAS.
3) Confirm that the device changes its operating power and/or channel in response to a command from the SAS.
4) Confirm that the device correctly configures based on the different license classes.
5) Confirm that the device transmits at a power level less than or equal to the maximum power level approved by the SAS.
6) Confirm that the device transmits with a bandwidth less than or equal to the SAS specified bandwidth.

7) Confirm that the device transmits on the SAS specified frequency.
8) Confirm that the device stops transmission in response to a command from the SAS, within a period as required by Part 96.
9) Confirm that the device sends measurements data in response to the command from the SAS.
10) For devices with geo-location, confirm that it notifies the SAS of a new location when it is beyond the required distance parameter (±50 m) within the required time frame.
11) Confirm that the device is capable of reporting the signal level (measurement data) and frequency to SAS.
12) When CBSDs communicate through a management system, confirm compliance with all requirements.
13) When communication between the CBSD and SAS is lost:
    i) Describe how the CBSD would react if the communications between the device and the SAS is lost. Confirm that the CBSD stops transmission once it loses the link to the SAS.
    ii) Describe the process for re-establishment of the communications and confirm that the CBSD acts accordingly.
    iii) Confirm power-on restart process for registration (re-registration) occurs as expected.
    iv) Confirm the process for de-registration occurs as expected.

b) End User Devices

1) Confirm that the device will transmit only after it receives authorization from an associated CBSD.
2) Confirm that the device discontinues operation, changes frequency, and changes its operational power level within 10 s of receiving instructions from its associated CBSD.

4. SAS AND DEVICE SECURITY REQUIREMENTS

Applications for certification of CBSDs must identify at least one of the SAS databases operated by an approved SAS Administrator or demonstrate compliance to WInnForum Interface Specification and affirm that the device will conform to the communications security methods used by the SAS. When demonstrating compliance to the WInnForum Interface Specification, applicants must use a test lab that has been recognized by WInnForum. The device operational description if communicating directly to a SAS, or to a domain proxy that manages multiple devices, must include detailed explanations for the following items for each SAS the device is expected to work with:

a) What communication protocol is used between the SAS and the CBSD?
b) How are communications initiated?
c) How does the CBSD validate messages from the SAS?
d) How does the device handle failure to communicate or authenticate the SAS?
e) How does the SAS validate messages from a CBSD?
f) What encryption method is used?
g) How does the SAS ensure secure registration of protected devices?

Applications for certification of End User Devices must identify and include test results for operation with at least one authorized CBSD to show compliance with the authorization and operation requirements.

5. FREQUENTLY ASKED QUESTIONS (FAQS)

Question 1: What are the effective dates for the CBRS rules adopted by the Commission on April 17, 2015, in GN Docket No. 12-354 (FCC 15-47)?

Answer 1: The new Part 96 rules became effective on July 23, 2015, and the modified rules on August 25, 2016.[12]

Question 2: When is the FCC going to start certifying Part 96 devices?

Answer 2: For devices that comply with all requirements, including the SAS interface requirements, pre-TCB KDB inquiries[13] and/or TCB PAG KDB inquiries[14] can be submitted at this time.

The Part 96 rules are in effect at present, and all devices subject to Part 96 must show compliance with all the technical requirements, which includes communications with at least one authorized SAS. As of publication date of this document, FCC has not authorized any SAS. WInnForum has also developed a SAS protocol and test procedures; applicants must work with a test lab certified by WInnForum to clearly demonstrate compliance with all the requirements specified in their test specifications. For more information on WInnForum standards and specifications, visit http://www.cbrs.wirelessinnovation.org/. If an applicant believes their test lab has tested to an authorized SAS and can demonstrate compliance to all the requirements in the rules, device information and test data may be submitted in a KDB inquiry. After evaluation of the KDB inquiry information, FCC will advise whether application submission to a TCB may proceed.

Question 3: What are the transition dates for already-certified devices under Part 90 Subpart Z?

Answer 3: Transition dates for device importation, marketing, and operation are not defined in the rules. A transition period is defined for Grandfathered Wireless Broadband Licensees ("90Z licensees") and are dependent on each individual license term. We expect all 90Z licensees to comply with the Part 96 rules once their transitions are complete. At that point, use of legacy equipment that does not operate across the entire 150 MHz band could hinder a former Part 90 licensee's flexibility with respect to other GAA operations in the band.

Question 4: What are the options for existing Part 90 Subpart Z devices?

Answer 4: Part 90 Subpart Z devices that are used by Grandfathered Wireless Broadband Licensees may continue to operate beyond the license term as long as they meet all Part 96 requirements, with the exception of the band-wide operability. A new Part 96 certification for these devices must be filed prior to operation under the Part 96 rules. The new certification can be added to the existing FCC ID (as a composite Form-731 application) under the new a CBRS equipment class.

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[12] Rules were modified to change the limits of non-rural Category B CBSDs, remove maximum conducted power limits for all CBSDs, and to allow RMS-detection or peak-detection when performing emission power measurements.

[13] KDB Publication 388624 D01 v11r01, II. MANUFACTURER / TEST LABORATORY TESTING GUIDANCE PRIOR TO SUBMISSION TO TCB.

[14] KDB Publication 388624 D01 v11r01, III. TCB PRE-APPROVAL GUIDANCE.

Question 5: For non-composite grants, how can a new equipment class be added to the FCC ID?

Answer 5: For Part 90 Subpart Z and Part 96 grants that are not already composite applications, the grantee should contact the TCB that issued the original grant of certification and request the TCB to modify the original grant to be a composite-application grant. The TCB may need to contact the FCC for assistance with this request. After the original grant has been modified to be a composite grant, any TCB may process a new composite-application original grant under the original FCC ID, and then issue the new composite-application grant under the new CBRS equipment class (CBD or CBE).

Question 6: How is the EIRP limit of Section 96.41 applied for devices with bandwidths less than 10 MHz, or bandwidths larger 10 MHz, or with channel aggregation?

Answer 6: The limit for smaller bandwidths is still per 10 MHz. The measurement results and/or limits should NOT be adjusted based on the lesser operating bandwidth. In cases where actual bandwidth is larger than 10 MHz or with channel aggregation, the EIRP limit shall apply to any 10 MHz portion of the bandwidth.

Question 7: How should the maximum output power be listed on the 731 Form?

Answer 7: The total output power should be listed as the power over the entire bandwidth on the grant. This value should also match what is in the test report.

Question 8: May Customer Premises Equipment (CPE) operating in the Citizens Broadband Radio Service (CBRS) obtain an equipment authorization that allows it to operate temporarily up to the power levels permitted for a CBRS device (CBSD; e.g., base station (BTS-CBSD)) when it is unable to connect with a Spectrum Access System (SAS) except through the BTS-CBSD and no other means?

Answer 8: Yes, under specific conditions. See KDB 940660 D02 CBSD – CBSD Handshake Procedures.

Change Notice

04/19/2019: 940660 D01 Part 96 CBRS Eqpt v02 replaces 940660 D01 Part 96 CBRS Eqpt v01. Changes to the document include the following:

- Added equipment class CBC for Customer Premise Equipment CBSDs.
- Added section 3.2 – (b) (6) (ii) on spurious emissions.
- Added footnote 10.
- Added section 3.2 – (b) (7) for clarification on 96.41(f).
- Removed section 3.3 – (a) (12).
- Added Questions 7 and 8.