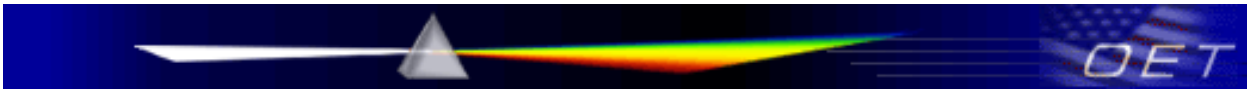

Federal Communications Commission
Office of Engineering and Technology
Laboratory Division

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MEASUREMENT GUIDANCE FOR CERTIFICATION OF LICENSED DIGITAL TRANSMITTERS

1 INTRODUCTION AND APPLICABILITY

As part of the rule changes adopted by the *First Report and Order* FCC 17-93 (docket no. 15-170), Sections 2.910(c) and 2.1041 were amended to include ANSI C63.26-2015, *American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services*, as an acceptable measurement procedure for equipment that operates in authorized radio services covered by the measurement standard, where measurements are required per Sections 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057, also 2.911(c).[1]

Procedures for compliance measurements on digitally-modulated licensed devices are included in ANSI C63.26-2015. Preceding versions of KDB Publication 971168 D01 served as bases in the development of the ANSI C63.26 measurement procedures. As a companion document for use along with ANSI C63.26-2015, besides cross-references to particular measurement procedures in the ANSI document this version of KDB Publication 971168 D01 retains section numbers for and information about FCC rules that are otherwise generally not part of the normative text in documents developed by ASC C63®.[2]

ANSI C63.26-2015 along with KDB Publication 971168 D01 provide general measurement guidance applicable to digital transmitters, operating with wideband (> 1 MHz) digitally modulated RF signals applying for certification under the various licensed rule parts (e.g., Sections 22, 24, 25 (ATC), 27, 90, 95,

[1] ANSI C63.26-2015 was developed by ANSI-Accredited Standards Committee (ASC) C63® to provide equipment authorization applicants, manufacturers, and test laboratories with uniform, reliable, and consistent measurement procedures necessary to demonstrate that transmitters used in licensed radio services comply with FCC's technical requirements. ASC C63® is a standards development organization that includes participants from the wireless industry, test laboratories, and regulators. At present ASC C63® has an open project for developing various updates of ANSI C63.26; information is available at: (http://www.c63.org/documents/misc/matrix/c63_standards.htm).

[2] Further to Section 2.947(a), test data in equipment authorization applications shall be obtained using measurement procedures (measurement methods) provided in OET documents [Section 2.947(a)(1)], in SDO publications (e.g., ANSI, IEEE, TIA) that are identified by FCC as acceptable [Section 2.947(a)(2)], or others identified by FCC as acceptable [Section 2.947(a)(3)]. For variations from Sections 2.947(a)(1) or (a)(2), detailed descriptions of measurement methods or procedures shall be submitted for FCC review [Section 2.947(c)]. Additional supporting information may be required if variant measurement methods or procedures are used [Section 2.947(e)]. Where measurement methods used in an application submission are not in accordance with FCC rules, policies, and uniform procedures, advance acceptance of variations from FCC shall be obtained by an applicant or TCB [Section 2.962(c)(4)].

101).[3] Guidance is provided relative to the minimum certification requirements specified in Section 2.1033(c)(14) along with Sections 2.1046 through 2.1057. Further to Section 2.911(c), the specific limits and any additional requirements to be addressed in equipment authorization applications are given in the applicable individual radio service rule parts.

The associated document KDB Publication 971168 D02 provides details on other measurements and requirements not covered by ANSI C63.26 for digital transmitters in selected specific radio service rules. Lastly, the associated document KDB Publication 971168 D03 provides basic guidance for intermodulation product spurious emission testing of frequency-translating repeater system equipment and similar devices.

The measurement guidance and procedures provided herein supersede those provided in previous versions of KDB Publication 971168 D01.

2 GENERAL MEASUREMENT CONSIDERATIONS

Key provisions on general considerations for measurement instrumentation are provided in Clause 4 of ANSI C63.26-2015.

3 MODULATION CHARACTERISTICS

The applicant shall provide a detailed description of all modulation formats to be used, including the response characteristics (frequency, phase and amplitude) of any filters provided, and a description of the modulating wavetrain, shall be submitted for the maximum rated conditions under which the equipment will be operated. [Section 2.1033(c)(13)]

The applicant shall provide a curve or other equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed. [Section 2.1047(d)]

These requirements can be satisfied by listing the digital modulation schemes employed along with a brief explanation of the bit/symbol representation.

Subclause 5.3.1 of ANSI C63.26-2015 is essentially the same as the Section 2.1047 requirements.

4 OCCUPIED BANDWIDTH MEASUREMENTS

4.1 General

The occupied bandwidth (OBW), that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 % of the total mean power radiated by a given emission, shall be measured when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation

[3] Other licensed-device measurement procedures guidance is given for example in KDB Publication 940660 for Part 96 Citizens Broadband Radio Service (3550-3700 MHz), and KDB Publication 653005 for the 76-81 GHz Band Radar Service of Part 95 Subpart M.

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with any devices used for modifying the spectrum when such devices are optional at the discretion of the user. [Section 2.1049(h)]

Many of the individual rule parts specify a relative OBW in lieu of the 99 % OBW. In such cases, the OBW is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated by at least X dB below the transmitter power, where the value of X is typically specified as 26.

The relative OBW must be measured and reported when it is specified in the applicable rule part; otherwise, the 99 % OBW shall be measured and reported. The test report shall specify which OBW is reported.

A spectrum/signal analyzer or other instrument providing a spectral display is recommended for these measurements and the video bandwidth shall be set to a value at least three times greater than the IF/resolution bandwidth to avoid any amplitude smoothing. Video filtering shall not be used during occupied bandwidth tests.

The OBW shall be measured for all operating conditions that will affect the bandwidth results (e.g., variable modulations, coding, or channel bandwidth settings).

4.2 Occupied bandwidth – relative measurement procedure

The reference value is the highest level of the spectral envelope of the modulated signal, unless otherwise specified in an applicable rule section.

Subclause 5.4.3 of ANSI C63.26-2015 is applicable.

4.3 Occupied bandwidth – power bandwidth (99 %) measurement procedure

Subclause 5.4.4 of ANSI C63.26-2015 is applicable (wherein the recommendation is to use the 99 % power bandwidth function of a spectrum analyzer).

5 RF OUTPUT POWER

5.1 Peak power measurements

5.1.1 General

Sections 2.1046 (a) and (c) call for conducted power measurements at the RF output terminal(s) of a device.[4] Some radio service rule parts specify RF output power limits in terms of, for example, total peak output power or total peak ERP or EIRP. The total peak power is often implied when the limits specify peak power or peak ERP or EIRP, without additional specification of a reference bandwidth. Also, when the output power limits are specified in terms of total average power or total average ERP or EIRP, it is acceptable to demonstrate compliance using total peak power measurements under the assumption that the measured peak power will always be greater than or equal to the measured average power. The peak output power, which can subsequently be used to determine the peak ERP or EIRP, can be measured with

[4] Various SAR evaluation and test exclusion provisions in KDB Publication 447498 D01 (RF EXPOSURE PROCEDURES AND EQUIPMENT AUTHORIZATION POLICIES FOR MOBILE AND PORTABLE DEVICES) (and references therein) also require conducted power data measured at the RF output port(s).

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a spectrum/signal analyzer, an EMI receiver, or a peak-reading power meter. Guidance is provided below for measurements performed with these instruments.

5.1.2 Peak power measurements with a spectrum/signal analyzer or EMI receiver

Subclause 5.2.3.3 of ANSI C63.26-2015 is applicable.

5.1.3 Peak power measurements with a peak-reading power meter

Subclause 5.2.3.2 of ANSI C63.26-2015 is applicable.

5.2 Average power measurements

5.2.1 General

Some radio service rule parts specify the RF output power limits in terms of total average power or total average ERP or EIRP. Total average power is often implied when the limit is stated as average but no reference bandwidth is specified. When average power measurements are permitted, there may also be a limit imposed on the peak-to-average power ratio (PAPR) of the signal.

When average limits are specified, the averaging is to be performed only over durations of active transmissions at maximum output power level (i.e., averaging over the symbol transitions particular to the applied modulation scheme). For licensed digital transmitters, average measurements do not include averaging over periods when the transmitter is quiescent or when operating at reduced power levels. Thus, for burst transmissions, the EUT must either be configured to transmit continuously at full power while the compliance measurement is performed, or the measurement instrumentation must be configured to acquire data only over durations when the EUT is actively transmitting at full power. A spectrum/signal analyzer, an EMI receiver or an average-reading power meter can be used to perform this measurement as long as the above condition can be realized.

Additionally, when using a spectrum/signal analyzer to perform an average power measurement, the number of measurement points in each sweep must be set greater than or equal to twice the span divided by the RBW (# measurement points $\geq 2 \times$ span / RBW). This will ensure a bin-to-bin spacing that is less than or equal to the RBW / 2, so that narrowband signals are not lost between frequency bins.

5.2.2 Procedure for use with a spectrum/signal analyzer when EUT can be configured to transmit continuously or when sweep triggering/signal gating can be properly implemented

Subclause 5.2.4.4.1 of ANSI C63.26-2015 is applicable.

5.2.3 Procedures for use with a spectrum/signal analyzer when EUT cannot be configured to transmit continuously and sweep triggering/signal gating cannot be properly implemented

5.2.3.1 General

Subclause 5.2.4.3.4 of ANSI C63.26-2015 is applicable for determining the transmitter duty cycle.

5.2.3.2 Constant burst duty cycle

Subclause 5.2.4.4.2 of ANSI C63.26-2015 is applicable.

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5.2.3.3 Non-constant burst duty cycle

Subclause 5.2.4.4.3 of ANSI C63.26-2015 is applicable.

5.2.4 Average power measurement with average-reading power meter

Subclause 5.2.4.2 of ANSI C63.26-2015 is applicable.

5.3 Peak power spectral density measurements with a spectrum/signal analyzer or EMI receiver

Some licensed rule parts specify the RF output power limits in terms of peak power spectral density (PSD) or peak ERP or EIRP spectral density (i.e., the power or ERP or EIRP limits are defined over a specified reference bandwidth, often 1 MHz). In addition, measured peak-PSD levels can be used to demonstrate compliance to average-PSD limits under the assumption that the peak-PSD will always be greater than or equal to the average-PSD.

Subclause 5.2.3.5 of ANSI C63.26-2015 is applicable.

5.4 Average power spectral density measurements with a spectrum/signal analyzer or EMI receiver

Subclause 5.2.4.5 of ANSI C63.26-2015 is applicable.

5.5 Power adjustments for devices with multiple output ports

Subclause 5.2.5.3 of ANSI C63.26-2015 is applicable.[5]

5.6 Determining ERP and EIRP from conducted RF output power measurement results

Subclause 5.2.5.5 of ANSI C63.26-2015 is applicable, along with the following provisions. For personal/portable radios utilizing an integral antenna, the factor L_C is typically negligible. However, in a fixed station transmit system that utilizes a long cable run between the transmitter and the transmitting antenna, this factor can be significant. The minimum cable loss should be used in this equation.

The relevant equation for determining the ERP or EIRP from the conducted RF output power measured using the guidance provided above is:

$$\text{ERP or EIRP} = P_{Meas} + G_T - L_C$$

where:

ERP or EIRP = effective radiated power or equivalent isotropically radiated power, respectively (expressed in the same units as P_{Meas}, typically dBW or dBm);
P_{Meas} = measured transmitter output power or PSD, in dBm or dBW;
G_T = gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP);
L_C = signal attenuation in the connecting cable between the transmitter and antenna, in dB.

[5] Subclause 5.2.5.3 of ANSI C63.26-2015 also cross-references the procedures in 6.4 of that document for combining emissions and computing directional gain for multiple-output devices. Subclause 6.4 of ANSI C63.26-2015 was adapted from and is updated compared to KDB Publication 662911 v02r01 (Oct. 2013); the ANSI C63.26.2015 version should be used rather than KDB Publication 662911 v02r01.

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5.7 Peak-to-average power ratio

5.7.1 General

Many rule parts that permit the measurement of average power levels for comparison to the applicable RF output power limit also specify a limit on the peak-to-average power ratio (PAPR). If peak power or power density is used to demonstrate compliance, a PAPR measurement is not required. The following two procedures offer guidance for measuring the PAPR.

5.7.2 Peak power in a broadband noise-like signal from CCDF measurements

Subclause 5.2.3.4 of ANSI C63.26-2015 is applicable.

5.7.3 Alternative procedure for PAPR

Subclause 5.2.6 of ANSI C63.26-2015 is applicable.

5.8 Radiated measurement considerations for RF output power

5.8.1 General

The guidance provided in the preceding subclauses assumes that the measurements are performed on a conducted-signal basis (i.e., power referenced to the antenna terminals) via a coaxial cable connection between the EUT transmit antenna port and the measurement instrumentation. In addition to Section 2.1046 conducted power test data, further to Section 2.911(c) radiated power measurements may be needed for some devices when an applicable radio service rule specifies ERP or EIRP limits. However, for some EUTs, for example portable or handheld devices having one or more transmitting integral antennas, measurements cannot be performed in a conducted signal configuration. In such cases, it becomes necessary to perform compliance measurements in a radiated test arrangement.[6] Although the basic guidance for instrumentation and settings given above is equally applicable in a radiated test arrangement, the following guidance pertains specifically to performing radiated measurements when used along with the procedures in the preceding subclauses. Subclause 5.2.7 of ANSI C63.26-2015 also may be used.

5.8.2 Test site requirements

Radiated measurements are typically performed on an open-area test site (OATS) or within a semi-anechoic or fully-anechoic chamber. KDB Publication 414788 provides general guidance for radiated emission test site requirements. Current FCC Laboratory policy [2.1041, 2.947(a)(3)] requires that final radiated measurements shall use substitution methods as described in TIA-603-E (see also KDB Publication 442401).[7]

5.8.3 EUT placement, measurement distance, and amplitude maximization

The EUT shall be arranged for measurement as described in TIA-603-E or ANSI C63.26.

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[6] Further to Sections 2.1041 and 2.947(a)(3), radiated measurements may be acceptable for some integral-antenna devices for Sections 2.1046 and 2.1051 compliance purposes.

[7] ANSI/TIA-603-E-2015, *Land Mobile FM or PM Communications Equipment Measurement and Performance Standards*, Telecommunications Industry Association.

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The distance between the EUT and the test antenna shall be adequate to ensure that the measurements are performed in the radiated far-field. The maximum amplitude of the radiated output power must be found by employing a volume search comprising both the horizontal (azimuth) and vertical (elevation) planes. The polarization of the measurement antenna must also be matched with the EUT to determine the maximum amplitude. The procedures given in ANSI C63.26 for ensuring that the radiated amplitude is maximized shall be used.

5.8.4 Measurement quantity conversions

It is often more convenient to measure the field strength in a radiated measurement and then mathematically convert the measured level to an equivalent power level for comparison to the applicable limit. The following relationships can be used to facilitate using radiated measurement data to demonstrate compliance to the relevant conducted output power limits (assuming that all radiated data was collected in the far-field region of both transmit and receive antennas):

a) E (dBμV/m) = Measured amplitude level (dBμV) + Cable Loss (dB) + Antenna Factor (dB/m).
b) E (dBμV/m) = Measured amplitude level (dBm) + 107 + Cable Loss (dB) + Antenna Factor (dB/m).
c) E (dBμV/m) = EIRP (dBm) – 20 log D + 104.8; where D is the measurement distance in meters.
d) EIRP (dBm) = E (dBμV/m) + 20 log D − 104.8; where D is the measurement distance in meters.
e) ERP = EIRP – 2.15 (dB); where ERP and EIRP are expressed in consistent units.
f) EIRP = ERP + 2.15 (dB); ERP and EIRP are expressed in consistent units.

Note that the antenna factor is typically only provided for standard measurement distances (e.g., 1 m and/or 3 m), and thus may be a deciding factor in choosing what measurement distance to use.

6 UNWANTED EMISSIONS AT ANTENNA TERMINALS

6.1 General

The spurious (unwanted) emission limits specified in the individual FCC rule parts applicable to licensed digital transmitters (typically under the heading “emission limits”) normally apply to any and all emissions that are present outside of the authorized frequency band/block, and apply to emissions in both the out-of-band domain and the spurious domain. In some rule parts, the unwanted emission limits are specified by an emission mask that defines the applicable limit as a function of the frequency range relative to the authorized frequency block.

Typically, licensed radio-service rule parts have requirements for unwanted emissions to be attenuated below the transmitter power by a factor of at least X + 10 log P dB, where P represents the transmitter power expressed in watts, and X is a specified scalar value (e.g., 43). This specification can be interpreted in one of two equivalent ways. First, the required attenuation can be construed to be relative to the transmitter output mean power, with the resultant of the equation X + 10 log P being expressed in dBc (dB relative to the maximum carrier power). Alternatively, the specification can be interpreted as an absolute limit when the specified attenuation is actually subtracted from the maximum permissible transmitter power [i.e., 10 log P – {X + 10 log P}], resulting in an absolute level of −X dBW [or (−X + 30) dBm].

Normally, the applicable rule part specifies the reference bandwidth for measuring unwanted emission levels (typically, 100 kHz if the authorized frequency band/block is at or below 1 GHz and 1 MHz if the

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authorized frequency band/block is above 1 GHz),[8] effectively depicting the unwanted emission limit in terms of a power spectral density. In those cases where no reference bandwidth is explicitly specified, the values in the preceding sentence should be used.[9]

Typically, a measurement (resolution) bandwidth smaller than the reference bandwidth is allowed for measurements within a specified frequency range at the edge of the authorized frequency block/band (e.g., within the first Y MHz outside of the authorized frequency band/block, where the value of Y is specified in the relevant rule part). Some FCC out-of-band emission rules permit the use of a narrower RBW (typically limited to a minimum RBW of 1 % of the OBW) for measuring the out-of-band emissions without a requirement to integrate the result over the full reference bandwidth. Beyond the specified frequency range in which this relaxation of the uniform reference bandwidth is permitted, it typically is also acceptable to use a narrower RBW (again limited to a minimum of 1 % of OBW) to increase accuracy, but the measurement result must subsequently be integrated over the full reference bandwidth.

Some rule parts specify that the unwanted emission limits are expressed in terms of peak or average power or PSD. When no explicit signal characteristic specification is made (e.g., peak, average, power averaging (rms)), then it should be assumed that the unwanted emissions are to be measured in a manner consistent with how the power or PSD in the fundamental emission is measured (e.g., if peak power or PSD measurements were performed to demonstrate compliance to the fundamental power limit, then the peak power or PSD of the unwanted emissions shall be measured for comparison to the applicable emission limits). In any case, the same detector function used to determine the in-band reference level should also be used for the out-of-band signal measurements.

The power measurement procedures provided in Clause 5 (in particular, 5.3 and 5.4) are generally also applicable for measurements of unwanted emissions, with some minor modifications. In addition, the requirements associated with the procedures are also applicable when used to measure unwanted emission levels (e.g., the requirement to perform average measurements only during active bursts, and the minimum required number of measurement points). Modifications to the procedures include the following.

Instead of setting a center frequency, set the start and stop frequency to accommodate the frequency range over which the unwanted emissions measurement is to be performed. At the frequency block/band edge, it is acceptable to employ a start frequency or stop frequency such that the 3 dB point of the RBW coincides with the block/band edge frequency (e.g., start/stop frequency can be set equal to the block edge frequency ± RBW / 2). The span of the measurement can be set to encompass the frequency range under examination, subject to the minimum measurement point requirement (minimum of one measurement point per RBW for peak-PSD measurements and two measurement points per RBW for average-PSD measurements).

In licensed rule parts in general, the unwanted emission limit is expressed in terms of "average" power. The use of "Max Hold" will not result in a true average power measurement. Instead, the proper trace

[8] Per Recommendation ITU-R SM.1541, "reference bandwidth" is the bandwidth required for uniquely defining (thus standardizing) an out-of-band domain emission limit. Where test procedures specify or allow a measurement bandwidth (i.e., usually known as resolution bandwidth in spectrum analyzers) that differs from the specific emission limit's reference bandwidth, generally the results should be converted to be in terms of the reference bandwidth, for uniform compliance demonstration and reporting purposes.

[9] Recommended reference bandwidths are per Recommendation ITU-R SM.329. ITU-R recommendations are freely available at (https://www.itu.int/pub/R-REC).

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mode for performing an average measurement is the "trace average" mode. Alternatively, a single sweep measurement can be used with the sweep speed set such that a relatively long dwell is realized in each trace bucket (typically at least 1 ms per trace point).

Consult the applicable rule part to determine the specific details applicable to the measurement of unwanted emission levels. Subclause 5.7 of ANSI C63.26-2015 also may be used.

6.2 Radiated measurement considerations for spurious emissions at antenna terminals

See 5.8 for details.

7 FIELD STRENGTH OF SPURIOUS RADIATION

When antenna-port conducted measurements (per Section 2.1051) are performed to demonstrate compliance to the applicable unwanted emission limits, a separate radiated measurement (per Section 2.1053) is required to 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.[10] Note that when radiated measurements are performed to demonstrate compliance to the unwanted emission limits (e.g., for an EUT with integral transmit antenna), this measurement is not required.

These measurements are performed with the transmit antenna port(s) terminated. Unless otherwise specified in the applicable rule section, the same limits applicable to spurious (unwanted) emissions at the antenna terminals also apply to radiated spurious emissions.[11,12] For example, the out-of-band emission limit of Section 24.238(a) has been generally applied for conducted and radiated unwanted emission test data for equipment authorization compliance reporting purposes.

In addition, for all Part 96 CBRS equipment, when antenna-port conducted measurements (Section 2.1051) are performed to demonstrate compliance to Section 96.41(e), a separate radiated measurement (Section 2.1053) is also required to 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. The Section 96.41(e) limits generally also apply to radiated unwanted emissions.

The considerations and requirements specified in 5.8 apply. Subclause 5.5 of ANSI C63.26-2015 also may be used.

[10] See 47 CFR §§ Sections 2.911(c) and 2.1033(c)(14).

[11] A KDB inquiry should be submitted if applicable limits for some equipment types might be unclear.

[12] The requirement to use the same limit for conducted and radiated emissions generally does not apply for example to broadcast transmitters subject to Supplier's Declaration of Conformity (SDoC) per Section 73.1660, unless the responsible party chooses to apply for a grant of certification. Section 73.622(h) specifies that out-of-channel emission levels from DTV stations are to be measured at the transmitter output terminals; thus a uniform limit on emissions radiated from the cabinet of such a transmitter has not been established, and the responsible party is not required to measure cabinet emissions as part of its SDoC testing.

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8 FREQUENCY SPECTRUM TO BE INVESTIGATED

The frequency spectrum that must be examined for evaluating unwanted emission levels (Sections 2.1051 and 2.1053) for compliance to any applicable radio-service rule limits is specified in Section 2.1057. In all cases, the spectrum shall be investigated from the lowest radio frequency generated by the EUT without going below 9 kHz up to the following:

a) If the EUT operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
b) If the EUT operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.
c) If the EUT operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower.

Further to Section 15.33(a)(4), the Section 2.1057 frequency ranges also apply for composite-system equipment,[13] for example a personal computer (digital-device unintentional radiator) containing a CMRS transmitter; see KDB Publication 896810 for other guidance.

The amplitudes of unwanted emissions that are attenuated more than 20 dB below the applicable limit are not required to be reported (Section 2.1057(c)).

9 FREQUENCY STABILITY

The frequency stability of the transmitter shall be measured while varying the ambient temperatures and supply voltages over the ranges specified in Section 2.1055. The specific frequency stability limits are provided in the relevant rules section(s).

10 NUMBER OF TEST FREQUENCIES

The frequencies used in EMC/radio parameter testing on licensed devices must include allocated and licensable frequencies under the applicable licensed radio-service rule. Supporting information and operating descriptions must be clear and consistent across an application about device frequency capabilities, frequencies tested, and frequencies available at the time of the certification grant for subsequent FCC licensed operations.[14]

In general, FCC has required EMC/radio parameters to be tested at minimum on a single frequency in each band (tuning range) for each rule part applied under,[15] and the device must be capable of and qualified for operating on the tested frequency(ies) under each rule part. This requirement may lead to testing on multiple frequencies. Testing on only a single frequency may be acceptable when multiple bands for a rule part with a continuous frequency range have a split range listing on the application form to remove a conflict with other rules, and where the technical requirements in the split bands are the same.

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[13] Composite system equipment requirements include Sections 2.947(f), 2.947(g), 15.31(k).

[14] See also KDB Publication 634817.

[15] As licensed-service RF device technologies continue evolving with multiple various operating bandwidths and transmit power ranges, testing at multiple frequencies per operating band (tuning range) may be appropriate; for example, see 5.1.2 of ANSI C63.26-2015.

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In addition, testing at more than one frequency per band is required for devices subject to service-rule out-of-band (band edge) unwanted emission limits (i.e., test at each lower and upper band edge).

11 SELECTED KDB PUBLICATION REFERENCES

- KDB Publication 414788, Test Sites for Radiated Emission Measurements.
- KDB Publication 442401, Radiated emission measurements for licensed radio equipment.
- KDB Publication 634817, Frequency ranges and frequency listings in equipment authorization applications.
- KDB Publication 822428, Antenna calibration procedure.

CHANGE NOTICES

10/27/2017: 971168 D01 Power Meas License Digital Systems v02r02 is replaced by 971168 D01 Power Meas License Digital Systems v03.

Note: on 04/04/2017: 971168 D01 Power Meas License Digital Systems DR03-42830 released for draft review as candidate replacement of 971168 D01 Power Meas License Digital Systems v02r02.

Substantive modifications include the following:

- Updated standards references in footnotes.
- Inserted subheadings “General” in several subclauses, for resolving hanging paragraphs.
- Updated steps in procedures per any differences with ANSI C63.26-2015, where procedures overlap across the documents.
- Added line and footnote in 5.1 about conducted power.
- Added references to KDB Publications 414788, 442401.
- Omitted “upper band/block edge” words from Clause 8.
- The former 5.4.1 and 5.4.2 are omitted, being replaced (as redundant) by the fourth paragraph of 5.4 in this version (similar as with 5.2.4.5 of ANSI C63.26-2015).
- Added appendix listing correspondences between 971168 D01 and ANSI C63.26-2015 subclauses.
- Citations added for FCC 17-93 and ANSI C63.26.
- Text in numerous subclauses is replaced by cross-references to corresponding text in ANSI C63.26.
- Various generic and rules-specific text is retained, for continuity and readability purposes.
- Miscellaneous format/style editorial changes (change from “§” to “Section,” etc.).
- Footnote in 5.6 is moved to body text.
- Added references to KDB Publications 634817, 822428.
- Clause 10 is added to reiterate policies on the number of test frequencies to be used in application filing compliance demonstrations for licensed-services devices.

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4/09/2018: 971168 D01 Power Meas License Digital Systems v03 is replaced by 971168 D01 Power Meas License Digital Systems v03r01.

- Minor rewording for clarifications in 6.1, including footnote citation of ITU-R references.
- Footnote added in Cl. 7 about radiated emissions for some types of broadcast-services transmitters.
- Changed footnote 3 to cite KDB Publication 940660 (CBRS equipment) rather than the now expired KDB Publication 965270 (3650-3700 MHz Part 90).
- Specific requirement for Part 96 CBRS equipment to report conducted and radiated unwanted emission test data added in Cl. 7.
- Added footnote to clarify applicability of ANSI C63.26 vs. KDB Publication 662911.
- Added cross-reference to KDB Publication 896810 (SDoC) in Cl. 8.

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APPENDIX A
GENERAL CORRESPONDENCE BETWEEN SELECTED SUBCLAUSES OF KDB PUBLICATION 971168 D01 WITH ANSI C63.26-2015 SUBCLAUSES

KDB Publication 971168 D01 v04	ANSI C63.26-2015
2.1 Transmitters employed in network communications	5.2.1 RF power measurement instrumentation considerations
2.2 Measurement instrumentation considerations	4.2.3 Spectrum analyzer
2.2 Measurement instrumentation considerations	5.2.2 RF signal type considerations
3 MODULATION CHARACTERISTICS (general compared to ANSI C63.26-2015)	5.3 Modulation characteristics
4 OCCUPIED BANDWIDTH MEASUREMENTS	5.4.2 Typical modulation configurations (5.4 Occupied bandwidth)
4.1 Occupied bandwidth – relative measurement procedure	5.4.3 Occupied bandwidth—Relative measurement procedure
4.2 Occupied bandwidth – power bandwidth (99%) measurement procedure	5.4.4 Occupied bandwidth—Power bandwidth (99%) measurement procedure
5.1 Peak power measurements, 5.1.1 General	5.2.3.1 General
5.1.2 Peak power measurements with a spectrum/signal analyzer or EMI receiver	5.2.3.3 Measurement of peak power in a narrowband signal with a spectrum/signal analyzer or EMI receiver
5.1.3 Peak power measurements with a peak-reading power meter	5.2.3.2 Measurement of peak power with a peak power meter
5.2 Average power measurements, 5.2.1 General	5.2.4.1 General (includes “decision process” for method, narrowband vs. broadband)
5.2.2 Procedure for use with a spectrum/signal analyzer when EUT can be configured to transmit continuously or when sweep triggering/signal gating can be properly implemented	5.2.4.4.1 General
Procedures for use with a spectrum/signal analyzer when EUT cannot be configured to transmit continuously and sweep triggering/signal gating cannot be properly implemented, 5.2.3.1 General	5.2.4.3.4 Measurement of the transmitter (EUT) duty cycle
5.2.3.2 Constant burst duty cycle	5.2.4.4.2 Alternative procedure for measuring average power of a broadband signal with a constant duty cycle using a spectrum/signal analyzer or EMI receiver
5.2.3.3 Non-constant burst duty cycle	5.2.4.4.3 Alternative procedure for measuring average power of a broadband signal with a non-constant duty cycle using a spectrum/signal analyzer or EMI receiver
5.2.4 Average power measurement with average-reading power meter	5.2.4.2 General procedure for measuring average power with an average power meter
5.3 Peak power spectral density measurements with a spectrum/signal analyzer or EMI receiver	5.2.3.5 Measurement of peak power spectral density with a spectrum/signal analyzer or EMI receiver
5.4 Average power spectral density measurements with a spectrum/signal analyzer or EMI receiver	5.2.4.5 Procedures for measuring the average power spectral density with a spectrum/signal analyzer or EMI receiver
5.5 Power adjustments for devices with multiple output ports	5.2.5.3 Power adjustments for EUTs with multiple transmit antenna output ports
5.6 Determining ERP and EIRP from conducted RF output power measurements	5.2.5.5 Determining ERP and/or EIRP from conducted RF output power measurements
5.7 Peak-to-average power ratio	5.2.6 Peak-to-average power ratio
5.7.2 Peak power in a broadband noise-like signal from CCDF measurements	5.2.3.4 Measurement of peak power in a broadband noise-like signal using CCDF
5.8 Radiated measurement considerations for RF output power	5.2.7 Radiated power measurements
6 SPURIOUS EMISSIONS AT ANTENNA TERMINALS	5.7.1 General
6 SPURIOUS EMISSIONS AT ANTENNA TERMINALS { X+10logP }	6.4.4.2 Relative emission limits; 6.4.5.4 Directional gain calculations for conducted out-of-band and spurious measurements; see also 5.7 of ANSI C63.26-2015
7 FIELD STRENGTH OF SPURIOUS RADIATION	5.5 Radiated emissions testing
8 FREQUENCY SPECTRUM TO BE INVESTIGATED	5.1.1 Frequency spectrum to be investigated
9 FREQUENCY STABILITY	5.6 Frequency stability testing