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Title: Guidance for Radar Devices Under §15.255

Short Title: Meas 15.255 Radars

Reason: New Publication for Report and Order (FCC-23-35, docket no. 21-264)

Publication: 364244

Keyword/Subject: Radar Devices, §15.255,

Question: What Guidance is provided for certifying radar devices under the provisions of §15.255 of the FCC rules?

Answer:

Attachment 364244 D01 Meas 15.255 Radars v01, below provides Guidance for Radar Device certification under the Provisions of §15.255.

Attachment List:

[364244 D01 Meas 15.255 Radars v01](#)

364244 D01 Meas 15.255 Radars v01

Guidance for Radar Devices Certifying Under the Provisions of §15.255

A. Introduction

On March 18, 2023, the Commission released a Report and Order (FCC-23-35, docket no. 21-264) that amended the §15.255 rules to allow for non-fixed, short-range, millimeter-wave radar operations. Radar devices intended for operation in the 57-71 GHz (60 GHz) frequency band now have several options for FCC equipment authorization, each with corresponding technical requirements and limitations that are codified in §15.255.

The amended rules no longer limit operation to fixed locations, enabling vehicular and other mobile applications, including limited usage in unmanned aircraft.

This publication will provide initial guidance regarding information to be provided in Pre-Approval Guidance (PAG) inquiries to the FCC laboratory and recommended measurement procedures for obtaining the data necessary to demonstrate compliance with the applicable technical requirements for certification.

B. Frequency Ranges of Operation

The §15.255 rules permit unlicensed operation over the 57-71 GHz (60 GHz) frequency band, but the new radar certification opportunities created by the rules amendment primarily limit operation to the lower half of the frequency band (57-64 GHz).

The 57-64 GHz band is further segmented into 2.4 GHz, 4.56 GHz, and 7.0 GHz wide partitions, each with specific emission limits and technical requirements. These details will be discussed below.

C. Radar Certification Options

There are now several options for the certification of field disturbance sensors, including radars, for operation in the 60 GHz frequency band under the §15.255 rules. Listed below are the various options. A tabular representation of this information is provided in Annex A of this document.



1. Any terrestrial radar transmitting in the 57-71 GHz frequency band can be certified under §15.255(c)(2) with a conducted output power limit of -10 dBm and a peak EIRP limit of 10 dBm.
2. Any terrestrial radar transmitting within the 61.0-61.5 GHz ISM band segment, with maximum EIRP output of 40 dBm (average) and 43 dBm (peak), can be certified under the §15.255(c)(2)(v) rules.
3. Radars intended for operation onboard unmanned aircraft in the 60.0-64.0 GHz band segment can be certified under §15.255(b)(3) with a peak EIRP limit of 20 dBm and a required off-time of at least 16.5 milliseconds within any contiguous 33.0 milliseconds.
4. Terrestrial, including vehicular (in-cabin) radar devices in the 57.0-59.4 GHz band segment can be certified under §15.255(c)(2)(i), with peak EIRP limits of 20 dBm for indoor operation and 30 dBm for outdoor operation.

5. All terrestrial radar within the 57.0-61.56 GHz band segment can be certified under §15.255(c)(2)(ii), with a peak EIRP limit of 3 dBm with no off-time requirement, or 20 dBm with a corresponding off-time requirement of 16.5 milliseconds within any 33.0 millisecond interval.

6. Any terrestrial radar operating within the 57.0-64.0 GHz band segment can be certified under §15.255(c)(2)(iii)(A), with a peak EIRP limit of 14 dBm and a corresponding off-time requirement of 25.5 milliseconds within any 33.0 millisecond interval.



7. Fixed (permanent or temporary) radar intended solely for outdoor and/or vehicular uses (other than in-cabin applications) can be certified under §15.255(c)(2)(iii)(B) with a peak EIRP limit of 20 dBm and a corresponding off-time requirement of 16.5 milliseconds within any contiguous 33.0 milliseconds.

8. Pulsed radar applications with a maximum pulse duration of 6 nanoseconds and transmitting within the 57-64 GHz band segment can be certified under §15.255(c)(3), with an average EIRP limit of 13 dBm, a peak EIRP limit of 33 dBm and a transmit duty cycle limit of 10%. There is also a requirement that the average integrated EIRP within the 61.5-64.0 GHz band not exceed 5 dBm in any 0.3 microsecond time window.

Note: Any discrete off-time periods of less than 2 milliseconds are not to be considered when determining the total off-time over any 33-millisecond window.

D. Pre-Approval Guidance (PAG) Requirements

Section §2.964 of the FCC rules specifies that Pre-Approval Guidance (PAG) procedures be applied when compliance review procedures are not fully developed. Since these procedures are still developing and given the complexities associated with multiple certification options, applications for radar devices certifying under the 15.255 rules will be subject to a PAG review.

The objective of the PAG review will be to ensure that the appropriate requirements are considered based on factors such as operational frequency range, peak output power levels, and signal periodicity. These reviews can be completed quickly if the relevant information is provided. The information required for each of the certification options previously noted is provided in Annex B.

E. General Measurement Considerations

Several potential test-related matters must be considered when performing these types of measurements.

1. Test configuration considerations

Compliance measurements will likely require radiated emissions test set-ups due to the use of integrated antennae by the equipment under test (EUT). When performing emissions measurements in a radiated test set-up, the distance should be set to ensure far-field conditions relative to both the transmit and receive (test) antennae.

Additional guidance concerning test set-up considerations can be found in the C63.10-2020 standard incorporated by reference in §15.38(e)(4) of the FCC rules.

2. Test instrumentation considerations

Low noise amplifiers may be necessary to improve the effective dynamic range of the measurement instrument as an aid in performing accurate radiated measurements.



Adequate headroom in the measurement instrumentation must be considered when performing average power measurements to preclude amplifier overload or compression due to peak excursions.

When the emission frequency to be measured is greater than the maximum frequency range of the measurement instrument, including an RF downconverter or external harmonic mixer in the test circuit will become necessary. In these cases, the downconverter bandwidth must be at least as wide as the fundamental emission bandwidth and harmonic mixers may introduce undesired image frequencies. See FCC technical report TR 14-1001 for additional information regarding these test-associated considerations.

When using a spectrum analyzer to perform peak power measurements of pulsed radar emissions, a phenomenon known as pulse desensitization can occur, leading to inaccurate measurement results. In such cases, a pulse desensitization factor must be used to adjust the measured amplitude level. More information regarding pulse desensitization can be found in Clause 4.1.5.2.7 and Annex C of the C63.10-2020 standard, as well as in industry literature.

Similarly, when using a spectrum analyzer to perform peak power measurements of frequency-modulated continuous wave (FMCW) radar emissions, decreased sensitivity and resolution may require the application of a correction factor to the measured value. Additional information regarding FMCW desensitization can be found in Clause 4.1.5.2.8 and Annex L of the C63.10-2020 standard.

3. EUT considerations

The operation of the EUT during compliance testing shall be representative of normal use of the equipment.

Compliance testing shall include the mode of operation of the equipment that results in the highest transmitter activity (on time), consistent with the requirement to measure and report the highest transmitted power in any mode of operation.

For transmitters that utilize multiple modulation schemes, it may be necessary to test each independent scheme to demonstrate compliance with the applicable requirements.

For radar transmitters that employ FMCW or other frequency-agile techniques, the requisite RF parameters shall be measured with the frequency sweep, hop, or step function active (i.e., §15.31(c) does not apply).

F. Fundamental Emission Bandwidth Measurement

For pulsed transmitters, the fundamental emission bandwidth is defined at the -10 dB points as specified in §15.255(C)(3).

For other than pulsed radar transmitters, the fundamental emission bandwidth is presumed to be “...the width of a frequency band such that, below the lower and above the upper frequency limits, the mean

powers emitted are each equal to a specified percentage $\beta/2$ of the total mean power of a given emission. Unless otherwise specified in an ITU-R Recommendation for the appropriate class of emission, the value of $\beta/2$ should be taken as 0.5%," as defined in §2.1(c) of the FCC rules. This is also known as the 99% occupied bandwidth (OBW).

Clauses 9.3 and 9.4 of C63.10-2020 provide standardized procedures recognized by the FCC for measuring both the relative (-10 dB) bandwidth and the 99% OBW.

G. Fundamental Emission Measurement



Most of the §15.255 output power limits are specified in terms of peak EIRP. When using a spectrum or signal analyzer to perform radiated power measurements for determining the peak EIRP, several factors must be considered.

Spectrum and/or signal analyzers do not typically have an available resolution bandwidth capable of fully capturing fundamental emissions with bandwidths on the order of several GHz. Therefore, an RBW of 1-MHz shall be used in conjunction with the peak hold function while sweeping in free run mode until the maximum amplitude has been realized.

There are at least two possible approaches for determining the peak EIRP using data acquired with a spectrum or signal analyzer. The first is to directly measure the peak amplitude of the radiated power for use in determining the peak EIRP. The other option is to measure the average (RMS) radiated power and the transmission duty cycle and then use this information to calculate the peak power. Each of these approaches has its own unique considerations.

Clause 9.1 of C63.10-2020 provides guidance regarding measurement instrumentation and test site requirements applicable to measurements in the millimeter-wave region of the frequency spectrum.

Clause 9.2 provides equations that can be used to determine the EIRP from the measured radiated power.

The procedures defined in Clauses 9.6 through 9.8 can be used to measure the peak power of the fundamental emission with the following precautions.

1. When performing peak power measurements with a spectrum/signal analyzer, amplitude desensitization must be considered and addressed. Clause 4.1.5.2.7 and Appendix L of C63.10-2020 address measurement desensitization and sweep time considerations when measuring the peak power of an FMCW radar transmitter. Note that the original standard contains an error in equation L-1 that has been corrected in a subsequent Corrigendum¹
2. Be aware of the potential for instrument desensitization and correction methods when performing peak power measurements of pulsed or FMCW radar transmitters. See Clause 4.1.5.2.8 and Annex C of C63.10-2020 for more information.
3. When performing average (RMS) power measurements, it is essential to perform them over an adequate number of complete cycles or periods of the EUT. Data in Annex L of C63.10-2020 show that measurement error can be significantly reduced by averaging an FMCW signal over multiple periods. Based on this work, average power measurements performed on

¹ ANSI/USEMCSC C63.10-2020/Cor 1-2023 (Corrigendum to ANSI C63.10-2020) see [IEEE SA - Standards Store | IEEE/ANSI C63.10-2020/Cor1-2023 \(techstreet.com\)](https://www.ieee.org/standards/store/ieee/ansi/C63.10-2020/Cor1-2023/techstreet.com)

frequency-agile radar transmissions, such as FMCW with a spectrum or signal analyzer, shall be performed over at least 100 consecutive cycles.



4. Note that footnote 73 of Clause 9.9 no longer applies to radar devices operating under the amended 15.255 rules (i.e., use of an RF detector is no longer required).

H. Unwanted emissions

Unwanted emission amplitudes shall be measured according to the procedures provided in Clauses 9.10 and 9.11 of ANSI C63.10-2020.

I. Frequency stability

§15.215(c) of the FCC rules specifies that the bandwidth of the fundamental emission must be contained within the authorized frequency band over a temperature range of -20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage.

Frequency stability is to be measured at the highest and lowest frequency of operation and with the modulation that produces the widest emission bandwidth, according to §2.1055.

The frequency stability measurement procedures described in Clause 9.5 of C63,10-2020 shall be used to demonstrate compliance to the §15.215(c) requirement.

Annex A

15.255 Applicable Technical Parameters

Table A-1 – Industry Consensus Agreement



Mode	Frequency Range	Use Cases	Power Limit (Peak EIRP)	Off Time Requirement: off times (≥ 2 ms) must sum to at least X ms per 33 ms interval
Field disturbance sensors excluding outdoor drones /UA (<i>i.e.</i> , unmanned aircraft – see below)	57.0 - 59.4 GHz	All	20 dBm for indoor 30 for outdoor, including all vehicular, applications	None
	57.0 - 61.56 GHz	All	3 dBm	None
	57.0 - 61.56 GHz	All	20 dBm	16.5 ms off time per 33 ms
	57.0-64.0 GHz	All	14 dBm	25.5 ms off time per 33 ms
	57.0-64.0 GHz	Fixed outdoor or vehicular uses (except in-cabin) ⁴	20 dBm	16.5 ms off time per 33 ms
Outdoor drones/UA	60-64 GHz	Drones/UA	20 dBm	16.5 ms off time per 33 ms

NOTES:

- Switching between requirements in frequency ranges is allowed in successive 33 ms frames (for example, operation in the 57-61.56 GHz band under applicable parameters in the first 33 ms frame followed by operation in the 57-64 GHz band under applicable parameters in the second 33 ms frame, *etc.*).
- No separate duty cycle requirements are imposed on active 60 GHz transmitters beyond what is stated in the right-most column.

- Fixed operation includes temporarily or permanently fixed operations. Vehicular uses include operations where the device is installed within or on the exterior of a vehicle intended for outdoor use (such that any indoor use is incidental – for example, an automobile in a parking garage) but excludes all in-cabin applications or operations.

Table A-2 – Pulse Radar Joint Agreement

Technical Parameter	Permissible Pulse Radar Operations
Operating frequency (high)	64 GHz
Operating frequency (low)	57 GHz
Duty cycle	10%, evaluated in any 0.3 μ s time window
Average EIRP 	13 dBm, evaluated in any 0.3 μ s time window, and the average integrated EIRP within 61.5 to 64.0 GHz shall not exceed 5 dBm in any 0.3 μ s time window
Pulse duration	< 6 ns
Peak EIRP 	Peak RF emissions must not exceed 20 dB greater than the maximum permitted average emission limit applicable to the equipment under test

Annex B
PAG Checklist

The following list specifies the information to be provided by the applicant in a PAG inquiry to expedite the FCC review.

1. Applicants for certification under §15.255(c)(2), in addition to a show of compliance to the specified limits, shall explain how conducted output power was determined and demonstrate compliance to the limits.
2. Applicants for certification to operate in the 60.0-61.5 GHz ISM band under §15.255(c)(2)(v), in addition to showing compliance to the stated technical requirements, shall also demonstrate that the fundamental emission bandwidth is entirely contained within the band.
3. For radar devices intended for operation in the 60-64 GHz band segment and for use onboard unmanned aircraft per §15.255(b)(3), in addition to a show of compliance to the output power limit, data showing that the fundamental emission bandwidth is contained within the designated band segment and time domain data demonstrating compliance to the off-time requirement shall be provided. Additionally, an explanation must be provided as to how the altitude restriction will be realized. It's noted that there is also a similar altitude restriction in the FAA rules at §107.51 within Title 14 of the Code of Federal Regulations (CFR).
4. Applications for radar operation in the 57.0-59.4 GHz band segment under the §15.255(c)(2)(i) rule provision, in addition to showing compliance to the stated limits, shall also provide data demonstrating that the fundamental emission bandwidth is entirely contained within the designated band segment, and a statement as to whether usage will be limited to indoor or outdoor operations and how such limitations will be ensured.
5. For radar devices intended to operate in the 57.0-61.56 GHz band segment under the provisions of §15.255(c)(2)(ii), in addition to a show of compliance to the applicable limits, provide data showing that the fundamental emission bandwidth is fully contained within the authorized band segment. Where applicable ($3 \text{ dBm} < \text{EIRP} \leq 20 \text{ dBm}$), time domain data showing compliance to the off-time requirement shall be provided.
6. Radar devices intended for operation over the 57.0-64.0 GHz band segment under the requirements of §15.255(c)(2)(iii), in addition to showing compliance with the applicable limits, shall also provide data demonstrating that the fundamental emission bandwidth is fully contained within the designated band segment and time domain data demonstrating that the stated off-time requirement is satisfied under all operational conditions.
7. If the radar is to be certified for operation over the 57.0-64.0 GHz band segment under the auspices of §15.255(c)(2)(iii)(A), provide data showing that the fundamental emission bandwidth is completely contained within the authorized band segment and time domain data demonstrating compliance to the associated off-time requirement, in addition of a show of compliance to the relevant limits.
8. If the radar is to be certified for operation over the 57.0-64.0 GHz band segment under the §15.255(c)(2)(iii)(B) requirements, in addition to showing compliance to the stated limits, provide data showing that the fundamental emission bandwidth is completely contained within the authorized band

segment and time domain data demonstrating compliance to the associated off-time requirement. Where applicable, provide a comprehensive explanation as to how the “fixed” requirement will be satisfied and maintained or how the device will be limited to exterior vehicular applications.

9. If certifying a pulsed radar for operation over the 57.0-64.0 GHz band under the §15.255(C)(3) rules requirements, in addition to a show of compliance to the specified limits, show that the fundamental emission bandwidth is constrained to the designated band segment and provide time domain data showing the maximum pulse duration and the maximum duty cycle within any three μ s time window.

10. If the radar device is to be certified under multiple rule parts, then data shall be provided that demonstrates compliance with the corresponding rule requirements. In addition, information shall be provided on how switching between modes is limited to 33 ms time increments.