

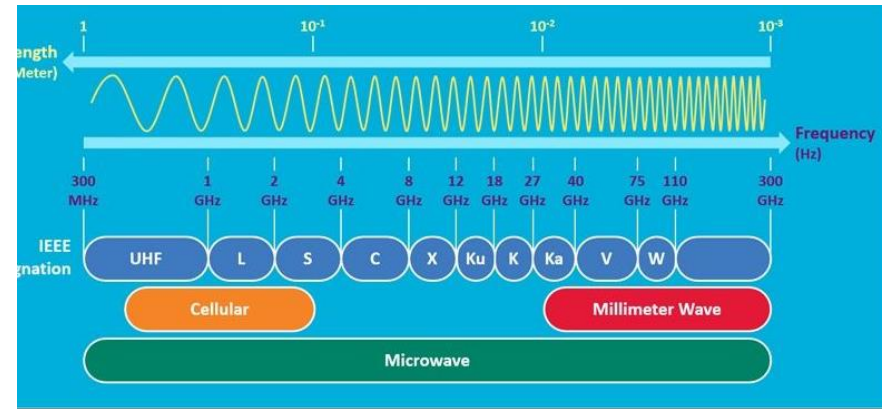


# ANSC C63® - EMC

Committee overview and wireless standards  
Update on Unlicensed and Licensed Wireless Device Standards  
ANSC C63.10-2020 and Draft C63.26

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- 02 C63.10 – Unlicensed transmitters
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# ANSC C63 – Who we are and what we do

C63 is a major United States EMC standards developer focused on many aspects of emission and immunity measurements, instrumentation and resources for test lab competency and quality control.

# ANSC C63 background

The exact time of C63's founding is unknown, but its existence can be traced back to 1936.

The C63 committee consists of the main committee (with members from corporations, organizations, government and individual consultants), eight sub-committees (SCs) and approximately 16 active working groups.

The sub-committees are:

**SC-1** – Techniques and Developments

**SC-2** – Definitions

**SC-3** – International Standardization

**SC-4** – Wireless and ISM Equipment Measurements

**SC-5** – Immunity Testing

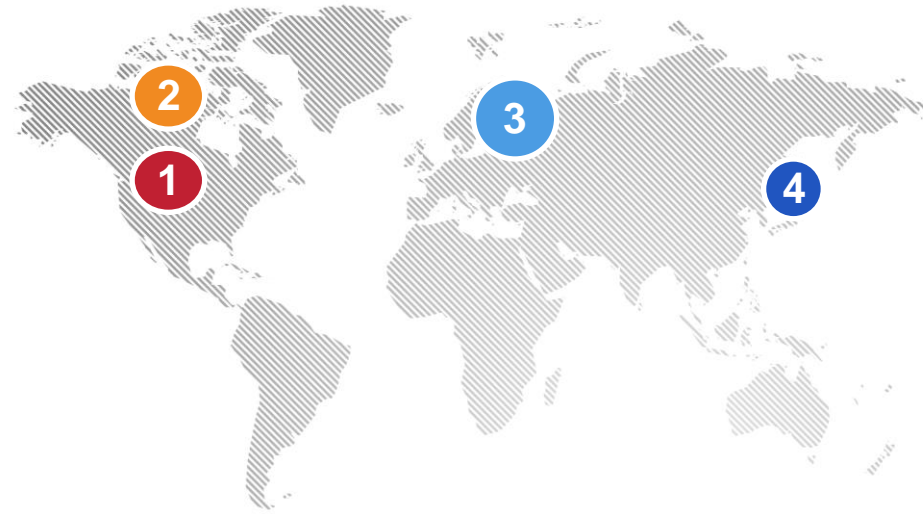
**SC-6** – Laboratory Accreditation

**SC-7** – Unlicensed Personal Communication Services

**SC-8** – Medical Equipment Testing

# ANSC C63 - Membership

- United States
- Canada
- Europe
- Japan



# ANSC C63 – Sub-committee expertise (I)

- SC-1** Addresses new or existing measurement methods, site qualification methods, calibration methods, associated instrumentation and limits development.
- SC-2** Develops electromagnetic environmental effects (E3) terminology for C63 publications; guidelines and best practices for the application of C63; other commercial and U.S. military E3 standards. Harmonizes the use of E3 terms with U.S. military and international standardization bodies.
- SC-3** Provides a forum for comparing international standards activities to ANSC C63 membership standards activities and makes recommendations to the C63 Main Committee on possible U.S. positions on international EMC matters to facilitate harmonization of national and international standards, considering U.S. regulatory as well as commercial requirements.
- SC-4** Writes and maintains existing and proposed C63 standards for wireless and ISM devices (e.g., lighting, wireless power transfer, industrial and dielectric heaters and similar equipment).

# ANSC C63 – Sub-committee expertise (II)

- SC-5** Develops and maintains new and existing ANSI ANSC C63 standards for immunity testing techniques and associated instrumentation.
- SC-6** Provides guidance for laboratory assessment activities.
- SC-7** Develops standards addressing spectrum etiquettes, wireless coexistence and related standards to provide new or amended measurement techniques, protocols or methods and associated instrumentation and operational constraints supporting more efficient spectrum utilization, including dynamic spectrum access.
- SC-8** Writes and maintains existing and proposed C63 standards for medical devices.

# ANSC C63 – Sub-committee responsibilities (I)

## SC-1

C63.2 - Electromagnetic Interference and Field Strength Measuring Instrumentation in the Frequency Range 9 kHz to 40 GHz

C63.4 - Emission measurements

C63.4a - Limited Amendment to modify Annex D and correct certain equations

C63.5 - Antenna Calibration

C63.7 - Guide for Construction of Test Sites for Performing Radiated Emission Measurements

C63.22 - Guide for Automated Electromagnetic Interference Measurements

C63.23 - Measurement Uncertainty

C63.25.1 - Validation Methods for Radiated Emission Test Sites, 1 GHz to 18 GHz

C63.25.2 - Validation Methods for Radiated Emission Test Sites, 30 MHz to 1 GHz



# ANSC C63 – Sub-committee responsibilities (II)

## **SC-2**

C63.14 - Definitions

C63.28 - Best Practices for Electromagnetic Compatibility

## **SC-3**

C63.12 - American National Standard Recommended Practice for Electromagnetic Compatibility Limits and Test Levels

## **SC-4**

C63.10 - Procedures for compliance testing of unlicensed wireless devices

C63.26 - Procedures for compliance testing of licensed transmitters

C63.29 - Lighting products

C63.30 - Wireless Power Transfer Products

C63.31 - ISM equipment (MP-5)

# ANSC C63 – Sub-committee responsibilities (III)

## **SC-5**

C63.9 - Laboratory immunity testing of office equipment exposed to RF sources

C63.15 - Immunity Measurement & Instrumentation

C63.16 - ESD Test Methodology

C63.24 - In-Situ RF Immunity Evaluation of Electronic Devices and Systems

## **SC-6**

C63.34 - Calibration of EMC Test Equipment – Guide

## **SC-7**

C63.17 - Unlicensed Personal Communications Service (PCS) Devices

C63.27 - Evaluation of Wireless Coexistence

# ANSC C63 – Sub-committee responsibilities (IV)

## **SC-8**

C63.18 - On-Site Medical Radiated RF Immunity Testing

C63.19 - EMC for Hearing Aids

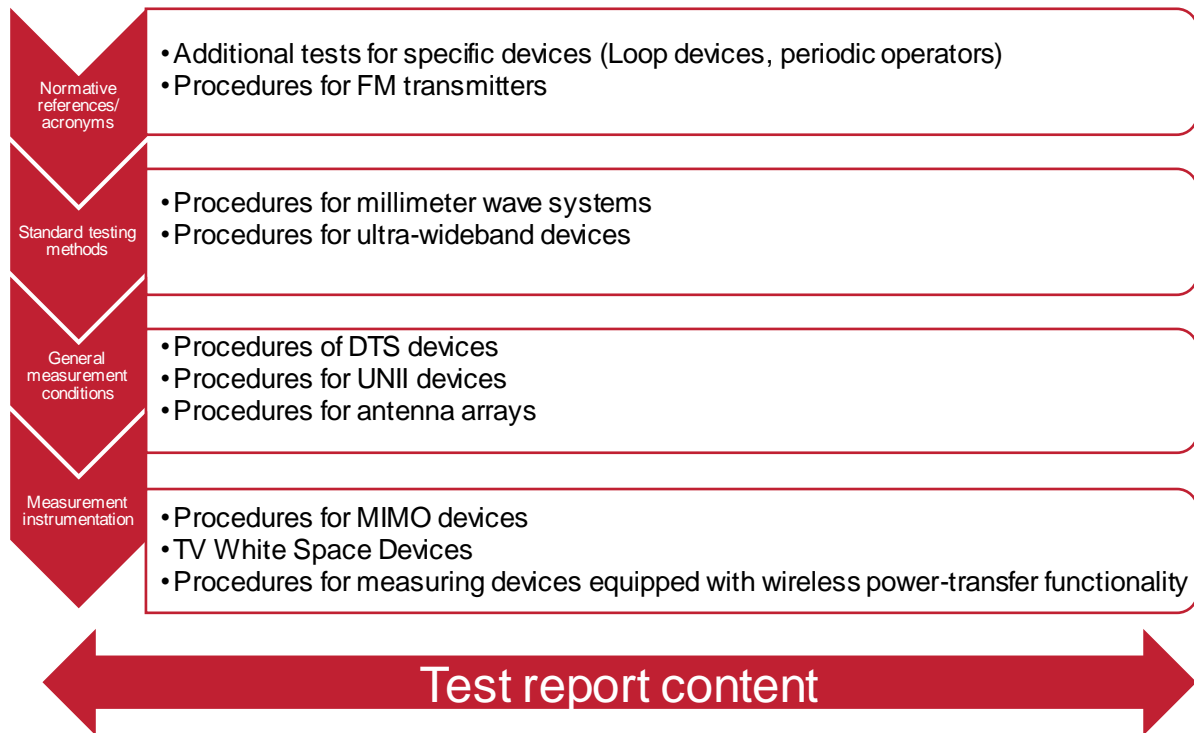
# C63.10 - Procedures for compliance testing of unlicensed wireless devices

Procedures have been:

1. Incorporated into FCC rules under 47 CFR §§ 2.910, 15.38
2. Incorporated into ISED Canada RSS-GEN
3. Contains both equipment specifications and test procedures for many unlicensed wireless devices.
4. To date, there have been 3 editions of this standard
  - First edition was to cover “low hanging fruit.”
  - Second edition adds some new test methods
  - Third edition adds even more methods but also updates older ones to be more current.



# C63.10 - Procedures for compliance testing of unlicensed wireless devices



# C63.10 - Procedures for compliance testing of unlicensed wireless devices (2020 Edition)

## What's new: Clauses 1-3

Topic / Section	2013 Version	2020 Version
Measurement equipment	CISPR 16-1-1:2010	CISPR 16-1-1:2015-09
Site Attenuation	ANSI C63.4 only	ANSI C63.4:2014 plus ANSI C63.4a. Also modified section 5.2 for radiated emissions test sites to allow alternative test sites below 30 MHz that shows correlation to an OFS.
Measurement uncertainty	ETSI TR 100 028-2001	ANSI C63.23 and ETSI TR 100 028-2001
Calibration of Electromagnetic Field Sensors and Probes, excluding Antennas	IEEE Std 1309-2005	IEEE Std 1309-2013
Measurement equipment	CISPR 16-1-4:2010	CISPR 16-1-4:2010 AMD1:2012, AMD2:2017,
Definition of spectral plot	Latest draft adds a definition of spectral plot. Spectral plots are to be included in test reports for many test cases. This means the actual trace and not a plot showing discrete points	
Dimensional tolerances	Latest draft adds dimensional tolerances with a new section 1.4 and Table 1	

# C63.10 - Procedures for compliance testing of unlicensed wireless devices (2020 Edition)

## What's new: Clause 4

Topic / Section	2013 Version	2020 Version
Use of FFT-based receivers	Not specified	New section 4.1.4 to add FFT-based instrumentation
Reduced Video Bandwidth measurement method	Allowed but lacked clarity	Requires the EUT shall be operated with a maximum duty cycle representative of normal worst-case operating conditions.
Precautions for using external amplifiers	Lacked guidance	New section added "Using an external preamplifier with a spectrum analyzer or EMI receiver " to address this
Average value of pulsed emissions	Only addressed calculation of average value from peak value	Added option for direct measurement of average value using average time of 100ms or pulse train period, whichever is shorter period
LISN definition	Only addressed magnitude of impedance	Added tabular data for magnitude and phase response. Added graphical data for phase response
Antennas	Updated to include antennas for preliminary / exploratory measurements, precautions for using active antennas, additional requirements when using hybrid antennas. For measurements >1GHz adds LPDA, hybrids – provides requirements on calibration	

# C63.10 - Procedures for compliance testing of unlicensed wireless devices (2020 Edition)

## What's new: Clause 4

Topic / Section	2013 Version	2020 Version
Calibration	Addressed Test and Measurement equipment	Clarifies scope of calibration and verification to extends beyond the measurement equipment to the ancillary equipment (cables, attenuators etc.)
Antenna Calibration	Loop antennas not specifically addressed	Adds requirement that loop antennas be calibrated in accordance with Annex N of ANSI C63.5-2017
LISN Calibration	Allowed for losses less than 0.5dB to be omitted	Requires ALL insertion loss be accounted for in the measurement.
Cable losses	Only addressed cable loss effects of temperature	Expands the scope from just cable loss measurements to include insertion loss or gain of all passive (e.g. cables, attenuators) and active devices (e.g. preamplifiers) used in the measurement chain



# C63.10 - Procedures for compliance testing of unlicensed wireless devices (2020 Edition)

## What's new: Clause 5

Topic / Section	2013 Version	2020 Version
Radiated Test Site	30-1000 MHz NSA as prescribed in C63.4:2014 1-18GHz sVSWR per CISPR 16-1-4	30-1000MHz - adds ANSI C63.4a as a requirement for NSA measurements. It also adds a note that Site validation measurements need to encompass the range of EUT heights when volumetric NSA is required. 1-18GHz no change
Test Modes and channels	Addresses ways to reduce testing for Channel BW and how to determine worst case modes for Band Edge, Spurious Emissions and in-band PSD	Adds the caveat that reductions in reporting requirements do not indicate that some testing is not required. It also clarifies that it is the manufacturers' responsibility to ensure that the device under test complies with the regulatory requirements under all modes of operation. Adds the need to check different resource assignments for OFDM-A and similar technologies. Adds requirement to check additional channels beyond low and high when those channels operate at a lower power than adjacent channels.

# C63.10 - Procedures for compliance testing of unlicensed wireless devices (2020 Edition)

## What's new: Clauses 6

Topic / Section	2013 Version	2020 Version
Operational Configuration	Required tested under the maximum duty cycle supported	Clarifies that maximum supported duty cycle is under normal operating conditions.
FMCW Emissions	Only referred to informative Annex C for information	<p>Provides specific guidance related to the need to correct peak emission on FMCW desensitization factor as well as guidance on the Chirp Bandwidth having different desensitization factors for the fundamental and the harmonic</p> <p><i>Chirp BW = Fundamental Chirp BW * 0.25</i></p> <p>Annex L created to describe the FMCW desensitization factor and sweep time considerations for these signal</p>

# C63.10 - Procedures for compliance testing of unlicensed wireless devices (2020 Edition)

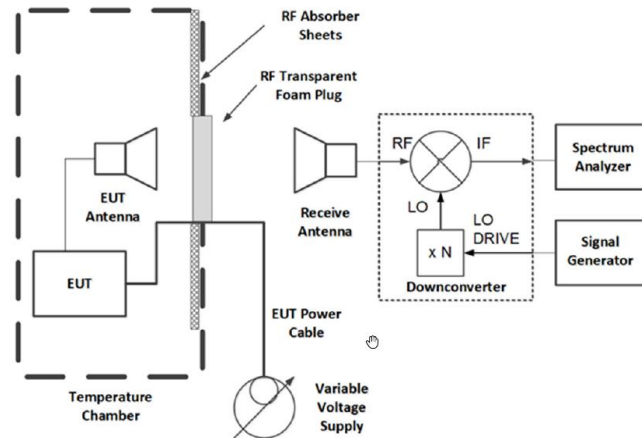
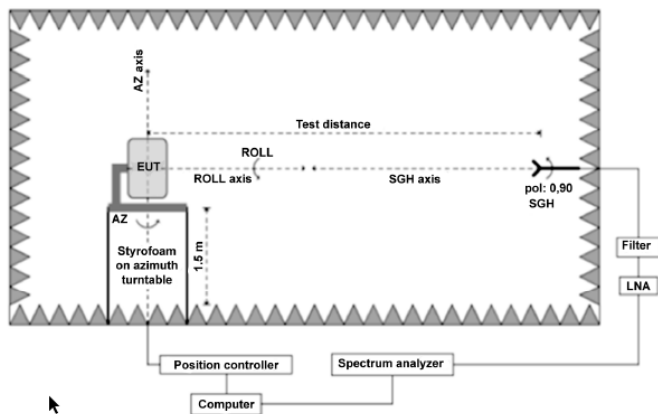
## What's new: Clause 9

Topic / Section	2013 Version	2020 Version
Measurement distance	Preferred that testing take place in the far field but allowed $2D^2/\lambda$	All measurements shall be made in the far field of the measurement antenna.
Precautions for downconverters	Not addressed, only external mixers addressed	Expands information and precautions needed for the use of downconverters and external mixers: <ul style="list-style-type: none"><li>• Risks of overloading the analyzer</li><li>• Presence of image frequencies</li><li>• Need for filters to reject fundamental emission (although typically antenna and waveguide provide sufficient high pass filtering)</li></ul>
Instrumentation	Previously section 9.2.	Requires non-conductive antenna and EUT positioners.
Test Site		Completely new. Fully anechoic chamber, 1.5m antenna and EUT height. Acknowledges no site validation method currently exists.

# C63.10 - Procedures for compliance testing of unlicensed wireless devices (2020 Edition)

## What's new: Clause 9

Topic / Section	2013 Version	2020 Version
Emission bandwidth	99% OBW procedure not included.	Expanded details on measurement procedure. Adds new section to cover occupied bandwidth (99% bandwidth) measurements
Frequency Stability		New section – requires installation of RF absorber sheets on the inside of the environmental chamber walls—especially where walls may be illuminated by the EUT antenna beam



# C63.10 - Procedures for compliance testing of unlicensed wireless devices (2020 Edition)

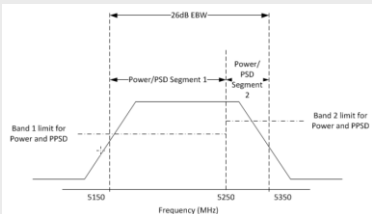
## What's new: Clause 11

Topic / Section	2013 Version	2020 Version
Protocol Limited Duty Cycle Devices	Not covered	Updates section 11.3 and 11.12.2.5 to address devices with protocol-limited duty cycles. Allows direct average measurement of field strength provided device is operating at or above the maximum duty factor (also 11.21.2.5)
Peak Power	Allowed use of Integrated band power measurement technique	Removes Integrated Band Power measurement technique for Peak Power
Average power with a Spectrum Analyzer	Did not give guidance on use of triggering methods when device operates below 98% duty cycle	Allows the use of triggering methods (Gated Triggering) for devices that operate below 98% duty cycle.

Note: Changes in this section were to align with FCC KDB 558074 in addition to improving measurement methods

# C63.10 - Procedures for compliance testing of unlicensed wireless devices (2020 Edition)

## What's new: Clauses 12

Topic / Section	2013 Version	2020 Version
Straddle Channels	Not covered and had to refer to FCC KDB 789033	New section addresses cases where the emission crosses bands. 
Peak Excursion	Included procedures	Removed as this is no longer a necessary procedure for NII devices
Emission Bandwidth	Did not address 5.8GHz band 6dB Bandwidth and required 1% of EBW setting for RBW	Added 6dB bandwidth procedure and now allows for other relative BWs (e.g. -26dB) 1-5% of EBW setting for RBW
Elevation Mask/Elevation Gain	No procedures existed	New procedures added to address outdoor devices where regulators require measurements of the elevation pattern of the transmit antenna

# C63.10 - Procedures for compliance testing of unlicensed wireless devices (2020 Edition)

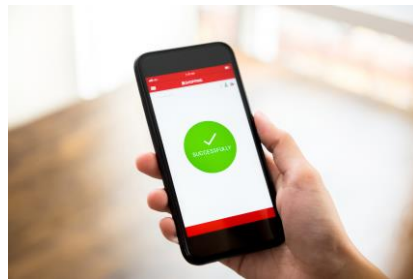
## What's new: Clauses 15 and 16 Annex K

Topic / Section	2013 Version	2020 Version
TV Whitespace Devices	Not covered	New, this section details test procedures that are specific to White Space Devices
Wireless Power Transfer Devices	Not covered	If the WPT device has communications on the fundamental (excluding load modulation) new section provides configuration requirements to be used when testing
Annex K – DFS testing	Not covered	Informative Annex gives an overview for the need and some requirements for DFS testing but does not give measurement procedures as that is covered by specific FCC KDBs ( <a href="#">KDB 905462</a> )

# C63.26 - Procedures for compliance testing of licensed wireless devices

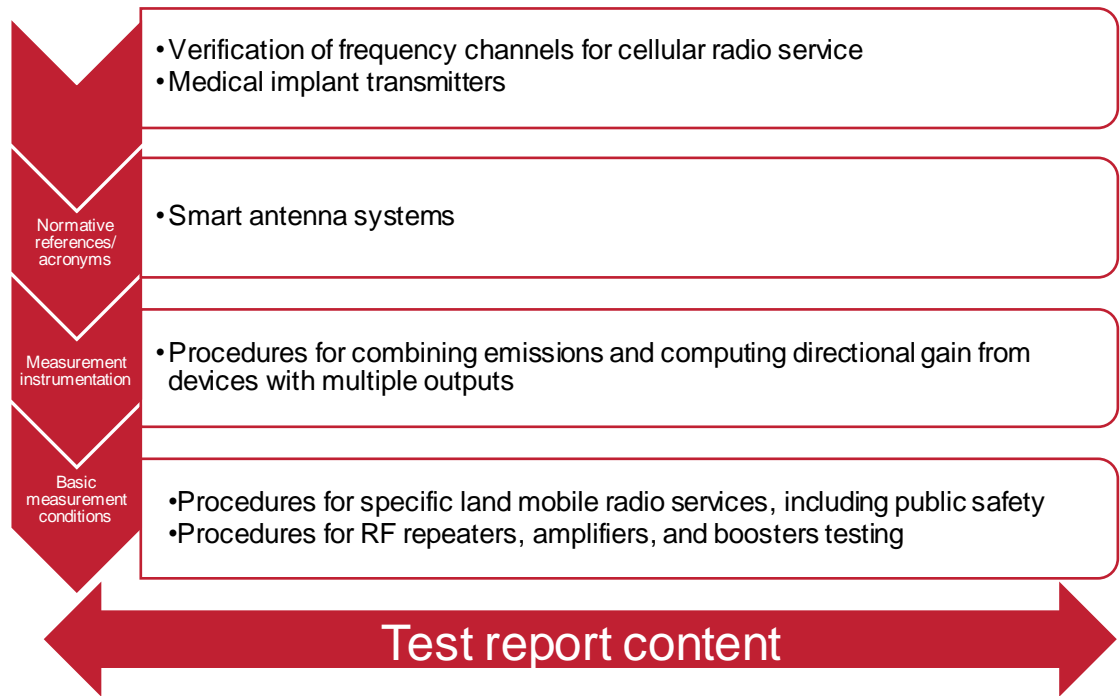
Procedures have been:

1. Incorporated into FCC rules under 47 CFR §§ 2.910
2. Incorporated into ISED Canada RSS-GEN
3. Contains both equipment specifications and test procedures for many licensed wireless devices.
4. Addresses common licensed wireless devices, including:
  - a) Commercial Mobile Radio Services (CMRS)
  - b) Public Mobile Services
  - c) Cellular Radiotelephone Service
  - d) Personal Communication Services (PCS)
  - e) Miscellaneous Wireless Communication Services
  - f) Private Land Mobile Radio Services (PLMRS)
  - g) Personal Radio Services (PRS)
  - h) Public Safety Radio Pool (formerly Public Safety Radio Service)





# C63.26 - Procedures for compliance testing of unlicensed wireless devices



# C63.26 - Procedures for compliance testing of unlicensed wireless devices

## EMI Receivers

- Quasi-Peak Measurements - 6dB IF BW
- All other Measurements - 3dB IF BW

## Spectrum Analyzers

- 3dB IF BW
- General corrections when using narrower bandwidths
  - adding  $10 \log [(reference\ bandwidth)/(resolution\ or\ measurement\ bandwidth)]$
  - Can be applied to both peak and average.
  - No scaling when measuring with wider bandwidths.



## Power meters

- Peak responding
- VBW of the meter and sensor > OBW
- Average responding
- Measurements corrected for duty cycles less than 98% ( $10 \log 1/DC$ )

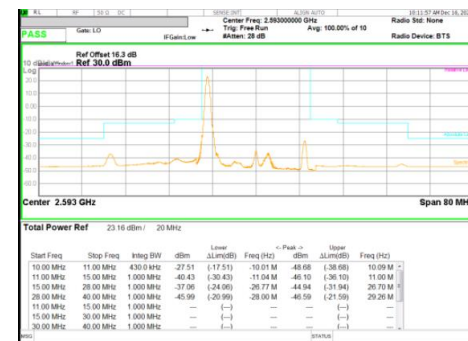
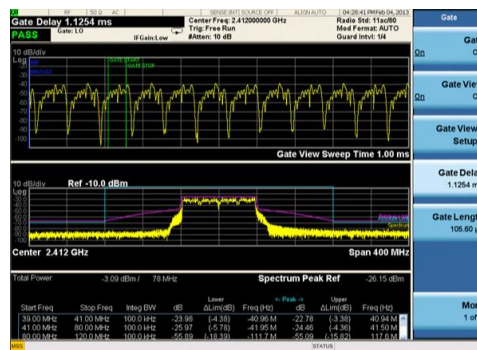
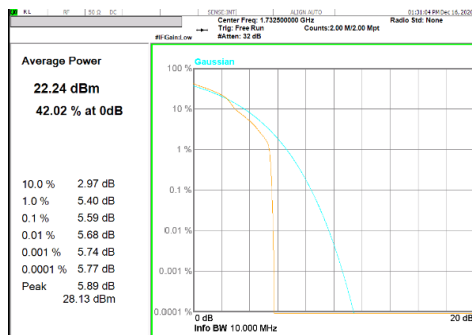
## Call Box (Communications test set)

- May be used if it contains the correct detectors and if specifications are available.

# C63.26 – Procedures for compliance testing of unlicensed wireless devices

“Nice-to-have” on test instrumentation:

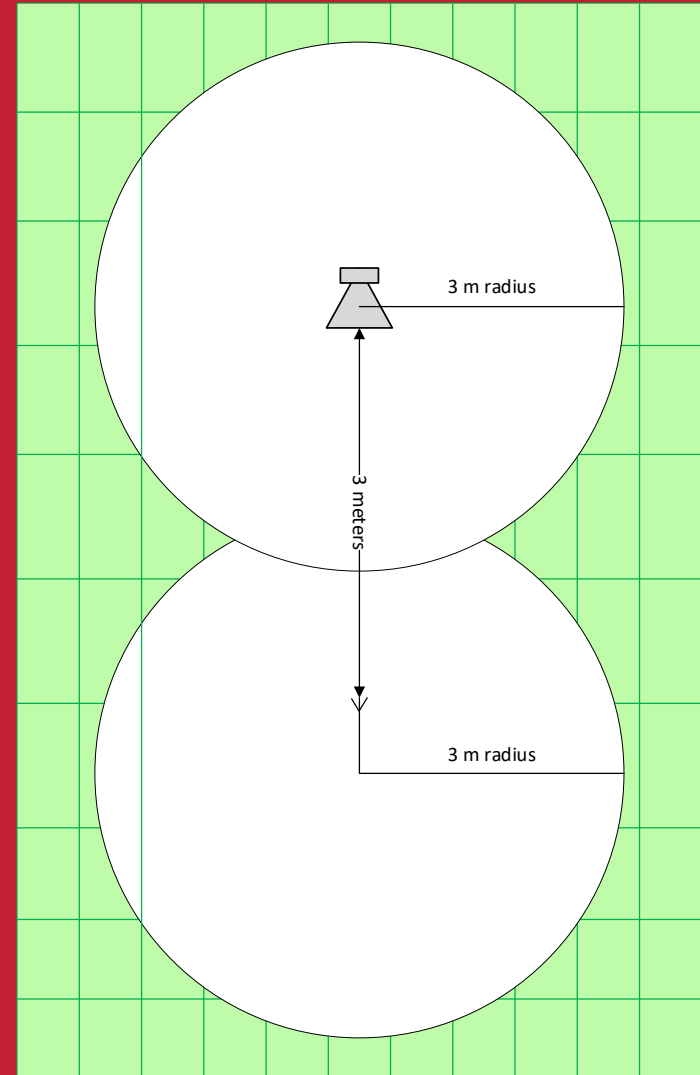
- Channel Power Integration
- CCDF function
- RMS detection
- RF gating



# C63.26 - Procedures for compliance testing of unlicensed wireless devices

## Test Sites:

- Substitution method
- Measurement distance: 3m, 10m, 30m
- No specific site qualifications
  - 10m and 30m - Distance between antennas and RF reflecting options >90m
- RF anechoic chamber
- Chamber must be large enough to allow far-field separation.
  - All surfaces must be covered.
  - At lowest measurement frequency



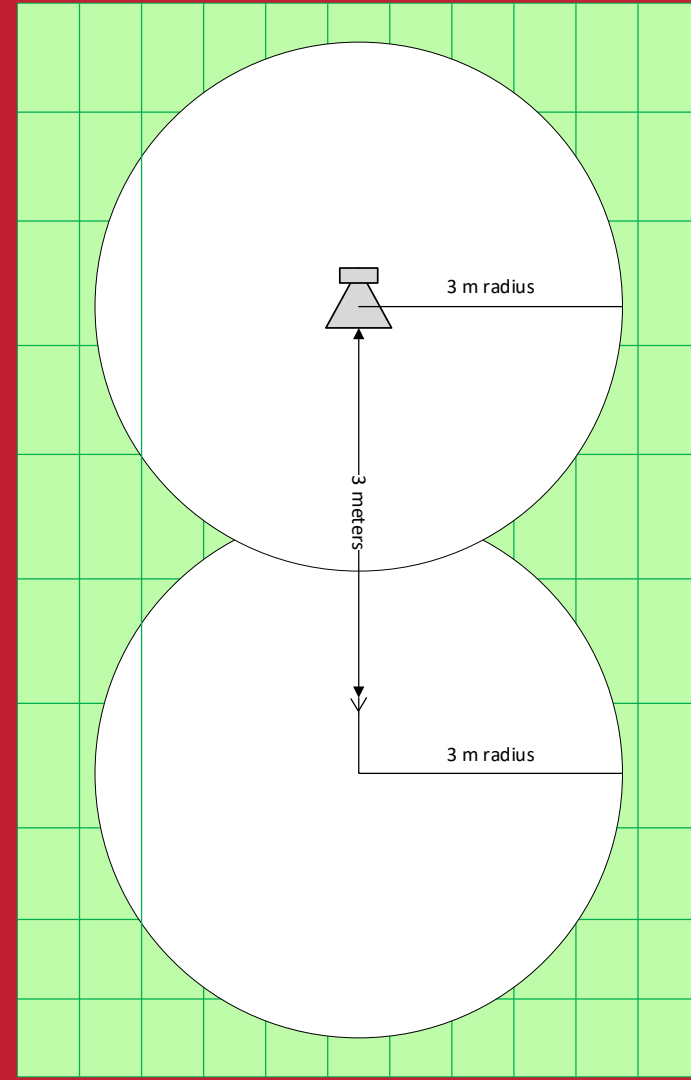
# C63.26 - Procedures for compliance testing of unlicensed wireless devices

## Test Sites:

- Direct Radiation method
- Measurement distance: 3m
- Below 30MHz
  - No specific site qualifications
  - OFS - Free from metal objects, buried pipes and any objects that may affect radiated measurements.

OR

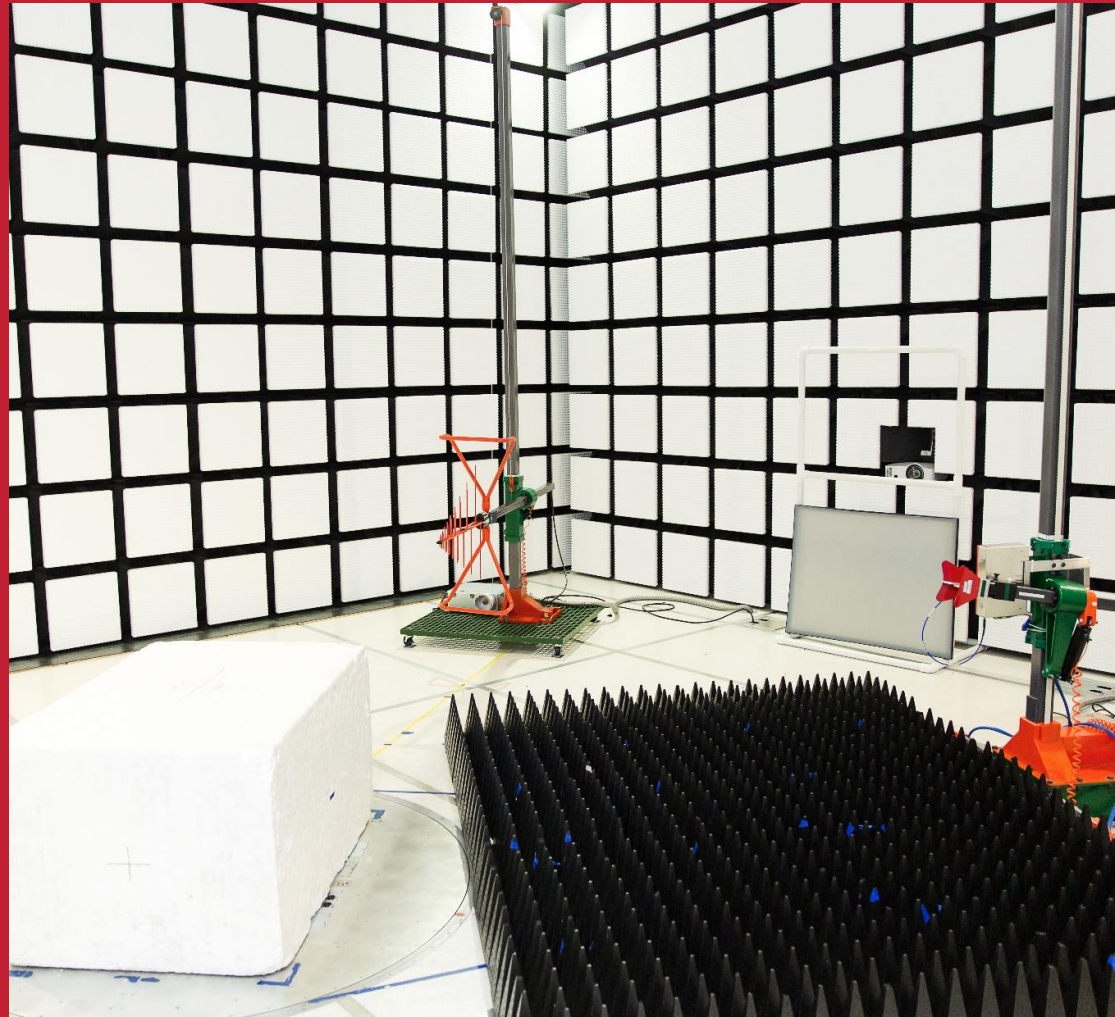
- Site that complies with C63.4
  - This site must demonstrate equivalence OFS



# C63.26 - Procedures for compliance testing of unlicensed wireless devices

## Test Sites

- Direct Radiation method
- Measurement distance: 3m
- Above 30MHz
  - 30 -1000 MHz
    - Site must meet requirements with C63.4 (i.e., normalized site attenuation (NSA))
- 1 - 40 GHz
  - Site must meet requirements with C63.4 (i.e., SVSWR of 1-18GHz)
- >40GHz
  - Reflection contributions reduced as much as practical



# C63.26 - Procedures for compliance testing of unlicensed wireless devices (202X Edition)

## Upcoming:

Topic / Section	2015 Version	202X Version
mmWave Total Radiated Power	Not addressed	<ul style="list-style-type: none"><li>• New section to address<ul style="list-style-type: none"><li>• Interim test procedures released by FCC come from the mmWave Working Group which forms this new section.</li></ul></li><li>• Allows option for EIRP measurement as a conservative estimate for TRP.<ul style="list-style-type: none"><li>• If device passes no need to measure TRP</li></ul></li><li>• Detailed description on performing TRP</li><li>• Guidance on evaluation of different beam directions<ul style="list-style-type: none"><li>• Highest EIRP beam for fundamental may not be the worst case for spurious.</li></ul></li></ul>
Vehicular Radar	Not addressed	<ul style="list-style-type: none"><li>• Guidance to ensure correct measurement of Pulsed Radar and FMCW Radar</li><li>• Concerns with ensuring peak and average measurements address:<ul style="list-style-type: none"><li>• Desensitization issues related to pulsed or intermittent signals</li><li>• Must be applied to peak emissions</li><li>• Averaging times appropriate for the chirp rate</li></ul></li></ul>

# C63.26 - Procedures for compliance testing of unlicensed wireless devices (202X Edition)

## Upcoming:

Topic / Section	2015 Version	202X Version
Signal Boosters	Single enclosure boosters considered	Procedures expanded to cover multiple enclosure boosters

Topic / Section	2015 Version	202X 3 <sup>rd</sup> Edition (future looking)
Massive MIMO	Not addressed	<p>There is a working group studying large antenna arrays and measurement distances.</p> <p>Note – this work will continue beyond the next edition (proposed edition 2) and may be included in the 3<sup>rd</sup> Edition.</p>



“After you've done a thing the same way for two years, look it over carefully. After five years, look at it with suspicion. And after ten years, throw it away and start all over.”

— Alfred Edward Perlman



# Questions

Bob DeLisi  
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Thank You.

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