

# Test Procedures

Current Rulemaking Process in the United States

**William Graff**

**Past Chair of TCB Council,**



**TCB Council Inc.**

Sharing knowledge of regulatory compliance  
for tomorrow's wireless world

# A brief history lesson from 1936

## THE FUTURE OF RADIO AND PUBLIC INTEREST, CONVENIENCE AND NECESSITY

BY

DAVID SARNOFF

President, Radio Corporation of America

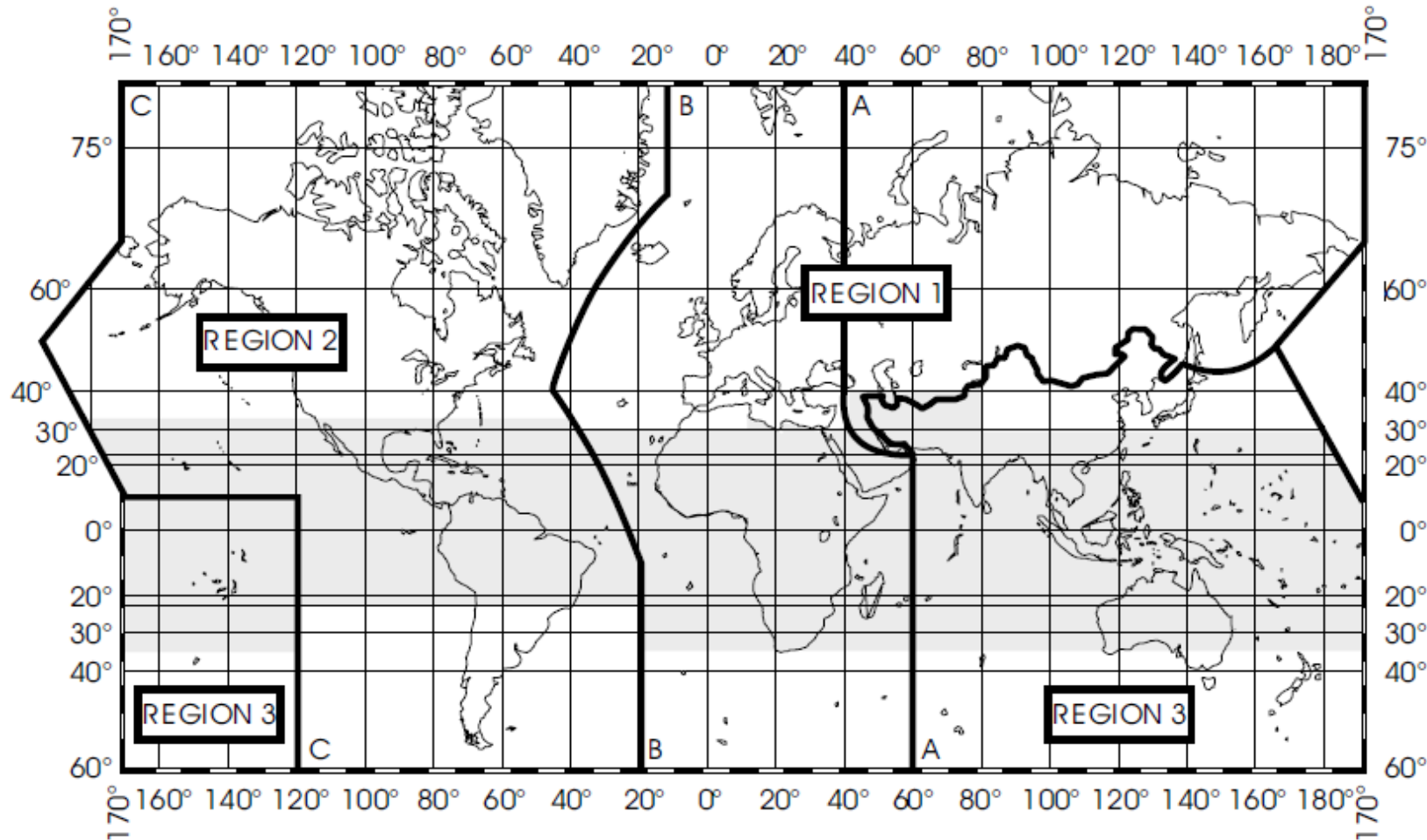
*Statement—Presented before Federal Communications Commission,  
Washington, D. C., June 15, 1936.*

THE Radio Corporation of America welcomes the opportunity to testify at this informal hearing. We are deeply aware of the importance and urgency of the tasks before the Federal Communications Commission. We are pleased to place at your disposal the information and experience of RCA, gained from its operations in radio research, communications, broadcasting, manufacture and sales. These interrelated enterprises have enabled us to study and develop radio in ever widening fields of public usefulness.

In such a fast moving art as radio, government regulation must have wide powers of discretion. A strait-jacket of rigid rules would cripple its energies. In the Radio Act of 1927 and in the Communications Act of 1934, Congress recognized this fact and wisely refrained from prescribing hard-and-fast formulas. Instead it set up a high standard for flexible regulation, the standard of “public interest, convenience and necessity.” That standard gives your Commission the power, and therefore the responsibility, of judging issues on the basis of past accomplishments, of present activities, and particularly on the capacity for future progress.

- FCC Rules continue to follow the concept of ‘public interest, convenience and necessity’
- FCC Rules are based upon the idea of minimizing interference through frequency and emissions separation
- FCC Rules are blind to technology.

# Frequency Regulation



- ITU Regions



# Regulatory Players

- **Frequency Allocation**

- Radio spectrum allocation and regulatory responsibility for the spectrum is divided between the FCC and the NTIA.
- Currently only frequency bands between 9 kHz and 275 GHz are allocated
  - OET maintains the FCC's Table of Frequency Allocations, which is a compilation of allocations.
- The FCC's Table of Frequency Allocations consists of the International Table of Frequency Allocations and the United States Table of Frequency Allocations.
  - The FCC's Table of Frequency Allocations is codified in Section 2.106 of the Commission's Rules.



# USA Frequency Allocation

Most recent version **07/01/2022**

- **47CFR §2.106 Table of Frequency Allocations**  
<https://transition.fcc.gov/oet/spectrum/table/fcctable.pdf>



**FEDERAL COMMUNICATIONS COMMISSION  
OFFICE OF ENGINEERING AND TECHNOLOGY  
POLICY AND RULES DIVISION**

## **FCC ONLINE TABLE OF FREQUENCY ALLOCATIONS**

**47 C.F.R. § 2.106**

**Revised on April 19, 2017**

**Disclaimer:** The Table of Frequency Allocations as published by the Federal Register and codified in the Code of Federal Regulations remains the legal source material. This Online Table of Frequency Allocations may display amendments that have been adopted by the FCC but that have not yet taken effect.

NOTE: If a Rule Part is listed in the last column of the Allocation Table, click here to find those [Rules](#).

Contact Tom Mooring at 202-418-2450 if you have any questions or comments.<sup>1</sup>



# Test Procedures

- Historically, FCC **would author** measurement procedures

MP-1	FCC Methods of Measurements for Determining Compliance of Radio Control and Security Alarm Devices and Associated Receivers, February 1983	NTIS Accession Number PB 84-243641 <a href="#">OET On-line</a>
MP-2	Measurement of UHF Noise Figures of Television Receivers, October 1986	NTIS Accession Number PB 84-243609 <a href="#">OET On-line</a>
MP-3	Methods of Measurements of Output Signal Level, Output Terminal Conducted Spurious Emissions, Transfer Switch Characteristics, and Radio Noise Emission from TV Interface Devices, January 1985	NTIS Accession Number PB 89-117030 <a href="#">OET On-line</a>
MP-4	FCC Methods of Measurement of Radio Noise Emission from Computing Devices, July 1987	Replaced by National Standard C63.4-1991 <a href="#">OET On-line</a>
<b>MP-5</b>	<b>FCC Methods of Measurements of Radio Noise Emissions from ISM Equipment, February 1986</b>	NTIS Accession Number PB 89-117048 <a href="#">OET On-line</a>
MP-8	Measurement Procedures for Radiotelegraph Auto Alarm, December 1984	NTIS Accession Number PB 89-117055 <a href="#">OET On-line</a>
MP-9	FCC Procedure for Measuring Cable Television Switch Isolation, September 1987	<a href="#">OET On-line</a>

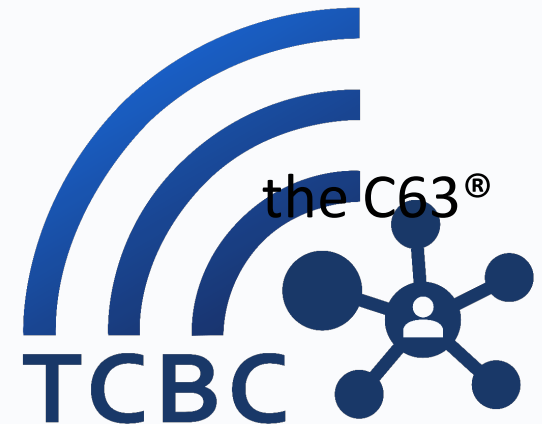
# Test Procedures

- **The FCC no longer creates standards in a vacuum.** FCC instead works with the **American National Standards Committee C63-EMC** community in developing ‘consensus standards’.
- The C63 Committee develops electromagnetic compatibility standards documents which publishes, archives and sells these standards to the general public.
- The Committee petitions the FCC to adopt its and incorporate it into the FCC Rules.



# Who is C63<sup>®</sup>?

- C63<sup>®</sup> is a standards developer focused on many aspects of emission and immunity measurements, instrumentation and resources for test lab competency and quality control.
- The uniqueness of the committee is the close link of its EMC standards with the needs of manufacturers and testing organizations, but most importantly the acceptance of its standards by US regulatory organizations.
- The broad diversity of active members provides extensive representation of the stakeholders served by the efforts of committee and the standards it creates.





# C63<sup>®</sup> Mission Statement

**“Development of definitions and methods of measurement of electromagnetic noise and signal strengths (radiated and conducted), determination of levels of signal strength, levels of unwanted sources, limiting ratio of noise (and/or unwanted sources) to signals and development of methods of control of, and guidelines for influence, coupling and immunity. Where subjects dealt with overlap with those of other national committees, appropriate liaison will be established.”**



# C63<sup>®</sup> Subcommittee Organization

- **SC 1** - Techniques and Development
- **SC 2** - E3 Terminology Definitions and Best Practices
- **SC 3** - International Standardization
- **SC 4** - Wireless and ISM equipment measurements
- **SC 5** - Immunity Testing and Measurements
- **SC 6** - Accreditation/Conformity Assessment
- **SC 7** - Spectrum Etiquette
- **SC 8** - Medical Device EMC Test Method



# C63<sup>®</sup> Standards

- **The C63 Committee has approximately 20 active standards in the EMC area**
  - Each Subcommittee has several working groups reporting to it
  - Each working group has responsibility for one Standard.
  - The standards that are developed are considered to be American National Standards.
  - They imply a consensus of those parties concerned with its scope and provisions.
  - An American National Standard is intended as a guide to aid the manufacturer, the consumer, and the general public.
  - **The procedures of ANSI require that action be taken to reaffirm, revise, or withdraw standards no later than five years from their date of publication.**
  - One of our Main Committee's Goals is also to develop new standards as appropriate.



# C63<sup>®</sup> Standards Incorporated by Reference in FCC Rules

- ANSI C63.17–2013, Unlicensed Personal Communications Services (UPCS) Devices
- ANSI C63.4–2014: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz,
- ANSI C63.10–2020: Procedures for Compliance Testing of Unlicensed Wireless Devices
- ANSI C63.26–2015: Procedures for Compliance Testing of Licensed Transmitters
- ANSI C63.30–2021: Wireless Power Transfer Products
  
- ***Working hard for future acceptance***
- ANSI C63.26 – DRAFT: 2015 version under revision
- ANSI C63.31 – DRAFT: ISM Equipment (replacement for MP5, 1986)



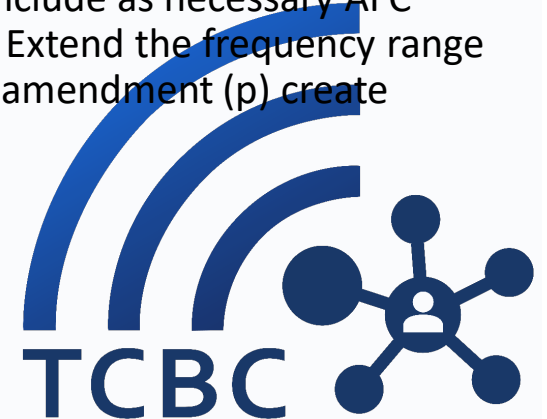
## C63 standard under revision (Licensed)

- **C63.26-202X: American National Standard of procedures for compliance testing of transmitters used in Licensed radio services**
- Scope: This standard covers the procedures for testing a wide variety of licensed transmitters; including but not limited to transmitters operating under Parts 22, 24, 25, 27, 90, 95 and 101 of the FCC Rules, transmitters subject to the general procedures in Part 2 of the FCC Rules and procedures for transmitters not covered in the FCC Rules. The standard also addresses specific topics; e.g., ERP/EIRP, average power measurements and instrumentation requirements.
- Status: Draft is being written.
- Purchase: This Draft is not yet complete and not available for purchase



# C63 standards under revision (Unlicensed)

- **C63.10: C63.10-202X American National Standard for Testing Unlicensed Wireless Devices**
- Scope: This PINS is intended to address the following topics to be incorporated into Edition 4: (a) editorial corrections, including clarification of terms and removal of subclauses no longer deemed necessary, updating the FCC cross reference matrix and review any standards references; (b) review and clarify as necessary the administrative procedures in Clause 5 of C63.10; (c) Test reduction methods based on emerging technologies (d) Add bandwidth correction methods for when a RBW less than reference BW is used (See C63.26 4.2.3) (e) review and change as necessary Clause 5.6.3 for testing band edge requirements as power levels change (f) review and change as necessary Clause 11 (DTS) for applicability; (g) review and change as necessary procedures for UNII due to changes in FCC Rules, including TPC and antenna elevation mask testing; (h) Measurement guidance for 802.11 technologies using resource units (i) review and include as necessary DFS test procedures; (j) review and change as necessary MIMO procedures: and, (k) review and include as necessary AFC validation procedures (l) Incorporate or revise Test methods based on relevant FCC KDBs (m) Extend the frequency range (n) Radar test methods for 57-71 GHz (o) incorporate changes made in the corrigendum and amendment (p) create antenna gain measurement procedure (q) review and correct any items as necessary
- Status: New project. Draft is being written
- Purchase: This standard is not yet complete and not available for purchase.



# What if there is no standard?

- The FCC continues to regulate radio frequency devices that are capable of emitting RF energy in the radio frequency range of 9 kHz to 3000 GHz.
- FCC will step in when a recognized 'Standard' is not available.
  - Usually this occurs when technology moves faster than the standards. Remember, C63 committees depend upon industry 'consensus'.
- Use FCC (and many times Canada) will address shortcomings in the 'Knowledge Database'.
- When all else fails see if a similar product has already appeared in the Equipment Authorization Database.



# What standard test method should you follow?

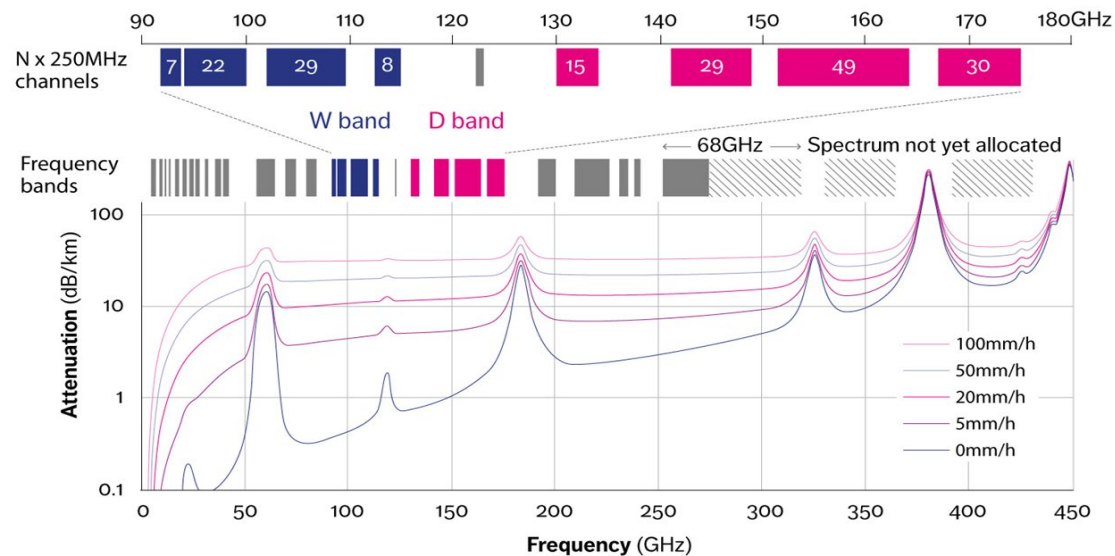
- FCC Knowledge Database Publications **may** bridge the 'gap' that occurs when new technology becomes available and consensus standards have not yet been developed.
- The FCC's Knowledge Database (KDB) is a collection of publications that provide guidance on equipment authorization procedures and measurement standards for radio frequency devices.
- The KDB is intended to assist the public in following Commission requirements and does not constitute rules.
- However, the FCC has established a process for developing and adopting technical standards for new technologies. This process involves collaboration with industry, manufacturers, service providers, and consumer groups, to develop standards that are in the public interest
- <https://apps.fcc.gov/oetcf/kdb/reports/GuidedPublicationList.cfm>





# But sometimes there are neither Standards or KDBs!

- For instance...
  - The 'Table of Frequency Allocation' only lists to 275GHz
  - 275-3000GHz is simply listed as 'Not Allocated'
  - Lots of empty spectrum above 100GHz
  - Lots of interest in potential uses



# Frequency bands above 100 GHz

- **Space-Related Services:** These bands are lightly used for Earth Exploration-Satellite Services (EESS). EESS collects data related to changes in the Earth's atmosphere and weather conditions.
- **Research and Innovation:** As technology progresses beyond the 100 GHz mark, we encounter both technical challenges and regulatory considerations
- **6G Networks:** Spectrum above 100 GHz holds immense potential for future applications which are expected to use carrier frequencies in this range to achieve higher data rates and broader bandwidth for digital applications



## §15.258 Operation in the bands 116–123 GHz, 174.8–182 GHz, 185–190 GHz and 244–246 GHz.

- Unlicensed Rule became effective 06/04/2019
  - Occupied BW - stay within the band
  - Peak and Average EIRP power measurements required using wideband sensor
  - Spurious emissions below 40GHz to 15.209 'Class B' limits. Spurious emissions above 40GHz expressed as power density @3M
  - Measurement procedures that have been found to be acceptable to the Commission in accordance with § 2.947 of this chapter may be used to demonstrate compliance.
    - ***No product Certifications as of today!***



# C63.10, Clause 9 – mmWave Testing (1)

- A radiated method of measurements to demonstrate compliance with regulatory requirements has been chosen.
- EIRP measurements required. Usually, mmWave EUTs utilize integrated antenna array elements; therefore, they do not have a coaxial or waveguide antenna port.
  - A conducted method of measurement *may* be employed for certain tests if EUT and mixer waveguides both are accessible and of the same type.
- Pending the development of suitable validation criteria and procedures for the measurement frequency range, the test site should be a fully anechoic chamber



# C63.10, Clause 9 – mmWave Testing (2)

- All measurements shall be made in the far field of the measurement antenna. The far-field boundary for mm-wave antennas defined as  $2D^2/\lambda$ .
  - For fundamental or out-of-band emissions the far-field boundary distance of the EUT antenna or measurement antenna, whichever is largest, shall be used.
  - For spurious and harmonic emissions, the far-field boundary distance shall be based on the measurement antenna
- Consult regulators for guidance when far-field measurements are not practical
  - Note: A near field measurement method **may** be used provided the regulatory authority has accepted its use.

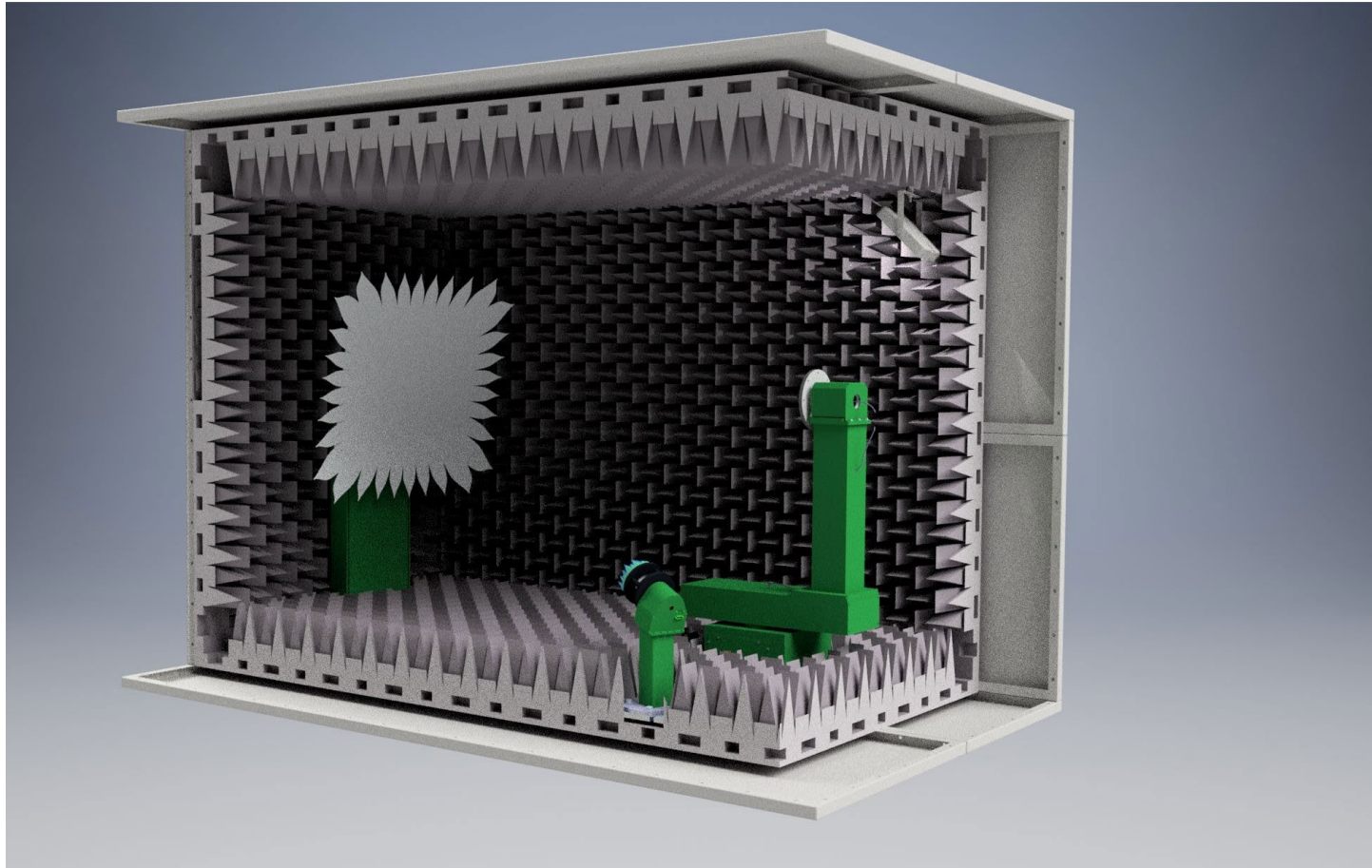


# Terahertz Testing (above 95GHz)

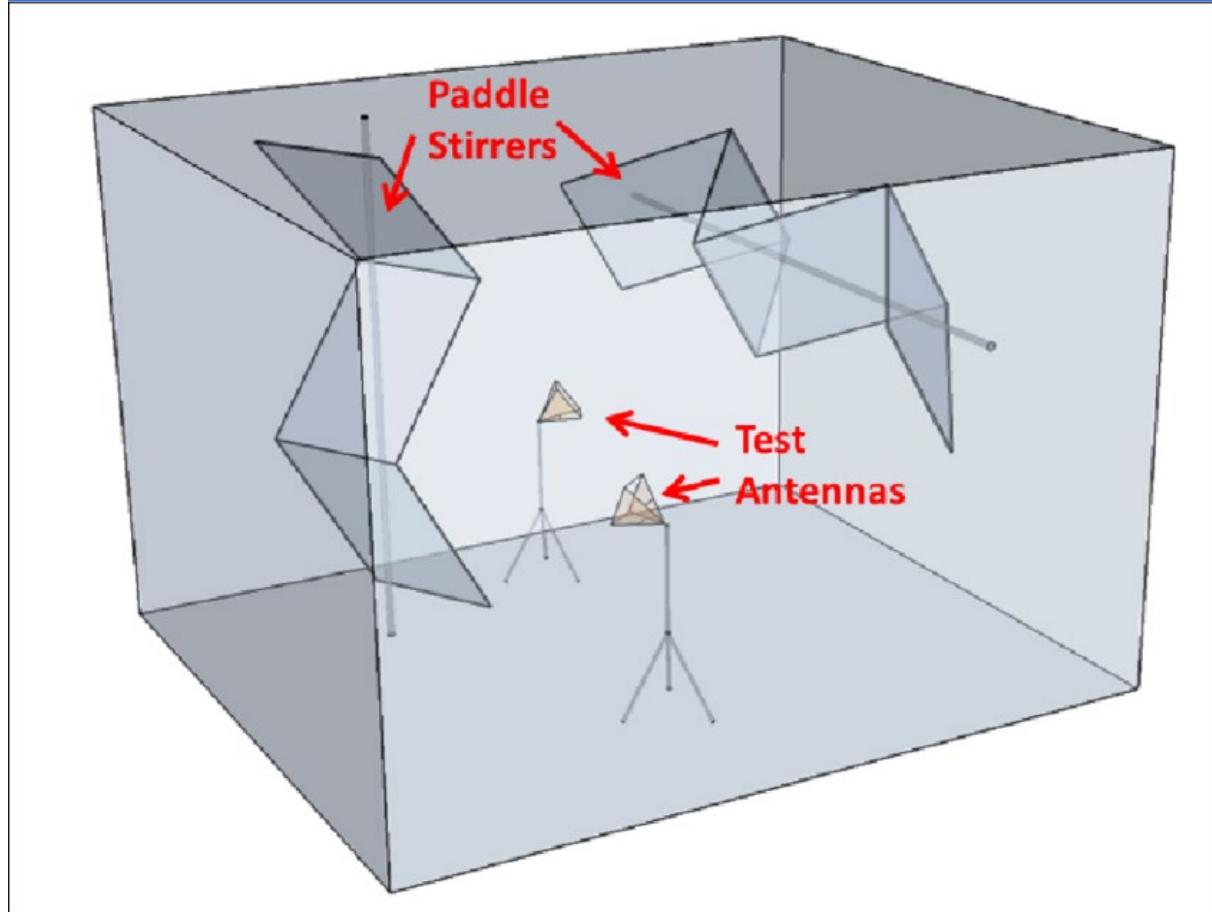
- Alternate test sites are being evaluated by C63 committees
- FCC has not specified any test methods other than what is shown in C63.10
- Measurements are complicated by high atmospheric attenuation
  - [over 70dB typical @3M](#)
- FCC does have a compact antenna test range for evaluation.
  - [Canada will allow it's use \(Notice 2020-DRS0014\)](#)
- No CATR evaluations yet available from the Commission
- Grants will be issued but TCBs but only in close consultation with FCC



# CATR



# Mode Stirred Chamber





# FCC KDB Guidance

- The following may be useful when considering terahertz or any mmWave testing:
  - KDB 842590 Upper Microwave Flexible Use Service:
    - <https://apps.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?id=240776&switch=P>
  - KDB 653005 76-81 GHz Radars:
    - <https://apps.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?id=230830&switch=P>
  - TR 14-1001 MMW Measurements with Harmonic mixers:
    - <https://apps.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?id=20677&switch=P>



# C63 upcoming and additional guidance

(Thanks to Nicholas Abbondante)

- **C63.26:** A new draft has a mmWave section based on the KDB 842590. An inquiry to the regulator is needed to approve testing in the near field. 95GHz fundamentals would be running up against the far field distance requirements, and it becomes a tradeoff between being in the far field and the noise floor of the measurement system.
- **C63.25.3:** Will address validations for CATR and reverb chambers to 8-40 GHz, and is aiming to provide guidance that is applicable above 40 GHz
- **C63.10 ed4.0:** Will try to tackle the topic of extending testing to 750 GHz as required by the FCC 19-19 spectrum frontiers R&O. The current amendment Ed3.0 A1 extends the frequency range to 750 GHz but tells laboratories to consult the regulator



# Conclusions

- Standardized and test methods recognized by the Commission exist for nearly all telecommunication products below 95GHz
- IEEE ANSC C63 is tasked with developing testing methodologies for both Licensed and Unlicensed transmitters
- C63 is working to address new technology. Standards are published through ANSI
- If no standards exist, FCC will publish using KDBs
- If no KDB exists, then FCC will review alternative test method submitted directly to the Commission



# Questions?

- Please feel free to write and ask any questions to my email address

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