EMC Standards Activity

By Ed Hare, EMC Society Vice-President for Standards Services

The 2021 Joint IEEE International Symposium on EMC+SIPI and EMC Europe was a huge success judging by the large number of peer-reviewed, high quality papers, tutorials, and workshops presented. Our Standards Committee and Working Group meetings were also well-attended – virtually. It was our second year of a virtual symposium due to the pandemic, but on the bright side, the virtual format allowed many more contributors to our technical sessions and committee meetings.

This included a special tutorial held in memory of the late Don Heirman, my predecessor as EMC Society Vice-President for Standards Services. Don was often referred to as "Mr. Standards" since he was a former Chair of CISPR and the ANSI C63® steering committee, among his many other Standards activities. Dan Hoolihan, the current C63 Chair, organized a tutorial to recognize Don's legendary contributions to the flagship ANSI C63.4: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

In addition, two other newly published standards were presented in the C63 tutorial involving wireless technologies. First, the new edition of ANSI C63.10: Procedures for Compliance Testing of Unlicensed Wireless Devices was reviewed by the Working Group Chair, Jason Nixon with Innovation, Science & Economic Development Canada, C63.10 Working Group Chair. Second, ANSI C63.30: Compliance Testing of Wireless Power Transfer Products is a NEW standard developed by the C63 committee. Travis Thul with University of Minnesota., C63.30 Working Group Chair, presented a summary of this new standard.

I'm sure Don would have been proud to see the numerous excellent contributions made by the C63 committee members during the Virtual Symposium. The article below by Dave Case, Jason Nixon, and Travis Thul sheds some light on these important wireless standards and the exciting work underway in Subcommittee 4 of C63.

Did you know ANSI C63.24 was also published in 2021? The C63 committee has been busy with THREE standards published in 2021. In addition to the two wireless C63 standards above published this year, a NEW standard was published - C63.24: Recommended Practice for In Situ RF Immunity Evaluation of Electronic Devices and Systems. Dan Hoolihan contributed the article below to provide more information.

In short, the Standards community is thriving these days. If you are interested in learning more about C63, visit www.c63.org or send me an email at w1rfi@arrl.org. I happen to know quite a bit about C63 since I am the chair of its Subcommittee 5: Immunity Testing and Measurements. And since C63.24 was developed under SC5, I just had to share the news of this recently published standard!

Wireless Standards: C63.10 3rd Revision and New C63.30 First Release – Now Published!

David A. Case,* NCE, NCT, Vice-Chair, American National Standards Committee (ANSC) C63 on EMC, Subcommittee 4

Introduction to ANSC Subcommittee 4: Wireless and Industrial, Scientific, and Medical (ISM) Equipment Measurements

To say it has been a challenging time over the past year and a half is putting it mildly. However, despite travel restrictions, no face-to-face meetings, and confinement to our own remote locations, the work of ANSC C63 continued at a brisk pace.

Such was the case related to the work of Subcommittee 4 (SC4), Wireless and ISM Equipment Measurements. Several important standards and programs continued to move forward by this committee despite the logistic issues of the past 18 months.

It was further challenging as SC4 suffered from the sudden passing of two key committee members, Dheena Moongilan with Nokia Bell Laboratories and Vladimir Bazhanov with Ericsson. These wireless experts contributed significantly to the work of SC4 for many years. They are sorely missed.

Though SC4 addresses wireless standards, not all wireless standards are addressed by the subcommittee. For example, Subcom-

mittee 8 addresses wireless issues related to Hearing Aid Electromagnetic Compatibility (C63.19). Subcommittee 7 addresses Wireless Coexistence (C63.27) and Unlicensed Personal Communications Service (PCS) Devices (C63.17). For more information on the C63 subcommittee activity, see www.c63.org.

A key standard under development by a SC4 Working Group is C63.26 (2nd Edition) Procedures for Compliance Testing of Licensed Transmitters. (This standard is basically the sister standard to C63.10 Procedures for Compliance Testing of Unlicensed Wireless Devices.) The updated version of C63.26 will include millimeter wave and vehicular radar test procedures as well as updates to other parts of the standard based on updates to the FCC KDB's related to many of the technology specific sections of the standard. Publication is expected next year (2022).

The work in C63.26 specifically addressing active antennas has evolved to a separate work item with a small technical group developing a whitepaper on issues involved when testing devices that employ active antennas. This project includes a round robin test session and a published research paper on the subject by the Working Group. The plan is for this paper to provide some guidance and share issues to consider when developing test procedures for these type of systems in future standards revisions.

The FCC is interested in replacing their current, but never updated, MP-5 test procedures used for testing Part 18 Industrial, Scientific, and Medical Devices. As this measurement procedure covers several aspects, the decision was made to create three specific standards to cover some of the topics. The first standard, C63.31 American National Standard for Compliance Testing of Industrial, Scientific and Medical (ISM) Equipment is in the drafting stage. This standard will encompass a majority of ISM devices, except for the specific technologies addressed in other standards, specifically RF lighting and Wireless Power Transfer. C63.29, American National Standard for Compliance Testing of Lighting Products, will address RF Lighting device measurement procedures and is in the process of final review and getting ready for publication.

We are excited to announce the 3rd revision of C63.10 and the new C63.30 have been published in 2021! Following is the latest news on these two standards as prepared by the Chair of these respective Working Groups.

C63.30 Overview *by Travis Thul, Working Group Chair, University of Minnesota*

On July 15, 2021, the IEEE published "C63.30-2021 - American National Standard for Methods of Measurements of Radio-Frequency Emissions from Wireless Power Transfer Equipment." This document, focusing primarily on inductively coupled resonant wireless power transfer (WPT) systems, is the first comprehensive standard revisiting legacy testing techniques for sub-30 MHz electromagnetic fields since the publication of the FCC's MP-5 in 1986. Through the work of some 50 Working Group members, over a period of six years, with dozens of tests conducted and thousands of simulations ran, the ANSI C63.30 Working Group was able to reconcile inconsistencies in MP-5 and 47 CFR, while paving the way for adoption of wireless power devices for everything from cell phone charges to electric vehicles. Accomplishments in this standard includes increasing reactive near-field testing repeatability, development of consistent extrapolation techniques, data showing ground-plane acceptability, as well as simplifying and facilitating procedures for approving electric vehicle wireless charging systems.

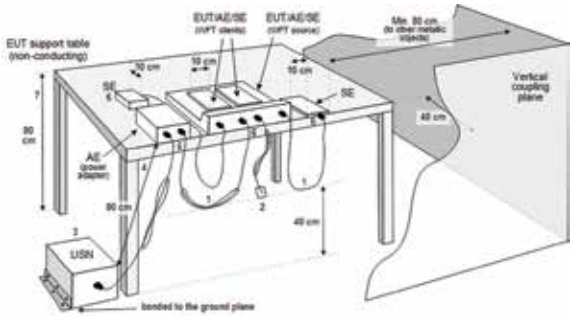
One of the primary hurdles with revising sub-30 MHz testing procedures was the dynamics associated with reactive near-field measurements. When dealing with devices operating in this frequency range, the user often runs the risk of coupling with the reactive near field – becoming part of the circuit. When this happens, the dynamics of the properties of the radiation change, often reducing test repeatability and accuracy. To account for this, the C63.30 Working Group spent months investigating the Large Loop Antenna Systems (LLAS), also known as the Van Veen system. This tool is often seen as three orthogonal loops, where the EUT is placed in the center. This reduces the risk of a dynamic test environment and cuts down on the number of tests needing to be conducted. Testing at UL, the FCC, and ISED helped to show the efficiency and accuracy of this tool for WPT systems and beyond.

Of course, setting an EUT inside the test antenna would conflict with 47 CFR Part 18 requirement to test at a distance of 300-meters. As there are no test labs that list either a 100-meter or 300-meter range for testing, the focus was on how to perform this testing with reliable and repeatable results on a 3- or 10-meter range. Further, because using a 3- or 10-meter range is also inconsistent with the extrapolation factor techniques described in Part 15 and Part 18 (i.e. making multiple measurements close to the radiator, extrapolating from those points), there was some discussion on the actual test limits. However, as C63 cannot change the limits adopted by the FCC short of filing a petition for rulemaking, another method was needed.

Because of these combined scientific and statutory nuances, the standard had to ensure the test procedure could align with the regulatory language; factors can be used to convert LLAS measurements to a 3-meter test distance. Then to accurately convert this 3-meter value to the regulatory distance, C63.30 leveraged both comprehensive magnetic field extrapolation test data collected by the FCC's Dr. Joseph McNulty, as well as data conducted thorough simulations to show accuracy. This combined research resulted in frequency depended on extrapolation factors allowing for consistent and repeatable field values to compare against regulatory limits at otherwise impractical testing distances.

Consistent with the above, the FCC's guidance has been clear

C63.30 - Example of Automotive Wireless Power Transfer.

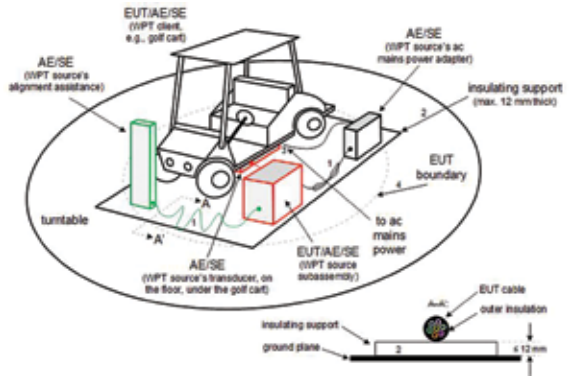


C63.30 - Example Test Arrangement for Conducted Emissions Measurements.

that such devices shall be tested on an open field test site, unless using a ground plane can be shown to correlate to those made in an open field test site. Through testing of various EUTs and additional simulations, C63.30 was able to show correlation which will reduce the complexities of testing these primarily magnetic field devices. This will further help facilitate testing and approval, positively impacting OEMs, labs, and the regulatory agencies.

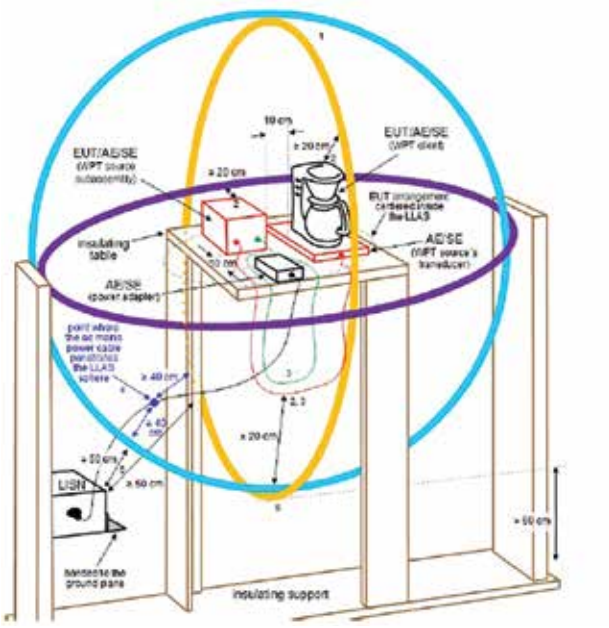
The above research and testing helped to lay the groundwork to also prescribe test procedures for WPT for electric vehicles. These systems, too large for an LLAS and likely to be used on multiple models of vehicles, required years of assessment and analysis. Through close collaboration with members of SAE J2954 (the automotive industry's WPT team), ANSI C63.30 developed critical techniques which will expedite the accreditation of such technologies. These procedures include specifying a dummy plate for "type" style platform accreditation, a specially tailored light vehicle testing procedures exclusive to standard automobiles as defined in the Code of Federal Regulations, as well as a general vehicle procedure applicable to vehicles ranging from golf carts to larger trucks (with factors provided to allow regulatory discretion between methods).

The testing of Wireless Power Transfer devices is not only confined to Part 18 ISM devices but also includes Part 15 Wireless Power Transfer devices. Some of the initial work was also in development of methodologies to evaluate these Part 15 WPT devices. Though some of the work was complete on this part, the Working Group decided to approach SC4 and more specifically C63.10 to discuss transferring the test information for the Part 15 WPT devices to that standard which is focused on Part 15 devices, thus making C63.30 more focused on ISM type devices under FCC Part 18 testing.



C63.30 - Example Test Arrangement for Radiated Emissions Measurements.

Beyond the research, analysis, and technique development in ANSI C63.30, the Working Group (and its supervisory American Standards Committee - ASC) have also worked to advocate for adoption and incorporation by the FCC. This advocacy has been augmented by formal petitions to the FCC from the SAE. C63.30 has also presented regular updates on this standard to the Telecommunications Certification Body's annual conference, at multiple Minnesota EMC Events, and at a multitude of IEEE venues (including the joint IEEE/SAE Chicago Chapter and the IEEE EMC+SIPI Symposium). Combined, C63.30 portends to be the largest revision to sub-30 MHz test procedures in a generation, facilitate expedited testing of reactive near-field based devices, and increase the ease of adoption of electric vehicles. Further, some of work is now incorporated into the recently published 3rd revision of ANSI C63.10. The C63.30 Working Group is extremely proud of this new standard and all the fantastic technologists who helped make it a reality. For



C63.30 - The the Large Loop Antenna Systems (LLAS), also known as the Van Veen system.

more information on ANSI C63.30, please contact Travis Thul at travis.m.thul@ieee.org.

C63.10 3rd Revision Overview *by Jason Nixon, Working Group Chair, Innovation, Science & Economic Development (ISED) Canada*

The 3rd revision of C63.10, the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices, was published in early 2021. As with the previous two versions, the focus is on compliance test procedures for licensed exempt transmitters. The standard does not address issues such as Dynamic Frequency Detection requirements or Specific Absorption Rate test procedures. The standard does not address testing of licensed exempt PCS devices.

The 3rd revision of the standard has a number of technical changes in comparison with the earlier versions, in part driven by updated FCC KDB Guidance documents, others driven by technology changes or changes to referenced C63 standards such as C63.4. In addition, new content includes sections that were not fully complete at the time of balloting for the 2nd revision.

Changes to this 3rd revision include the addition of dimensional tolerances, changes to LISN calibration methodology, updated antenna measurement requirements, and additional references to C63.25.1 for site validation from 1 to 18 GHz. The standard also removed the reference to use rod antennas below 30 MHz.

In Section 5, a change was made to include guidance on test reduction considerations for Wi-Fi OFDMA technology addressing issues on band edge and power line conducted emissions. The sections addressing frequency hopping devices, DTS, and U-NII device evaluation were updated to be in line with recent FCC KDB updates.

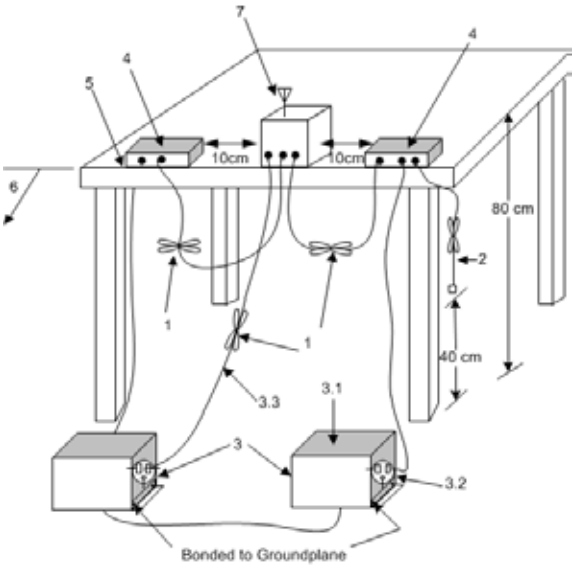
Revisions to the millimeter wave test methodology include using a fully anechoic test chamber that is not fully calibrated for the upper frequency range. In addition, equation #23 has been corrected.

A new Section 16 was created which addresses test methodology for Wireless Power Transfer technology that operates under Part 15 rules. The test includes how to evaluate not only the source device but client and overall system as well.

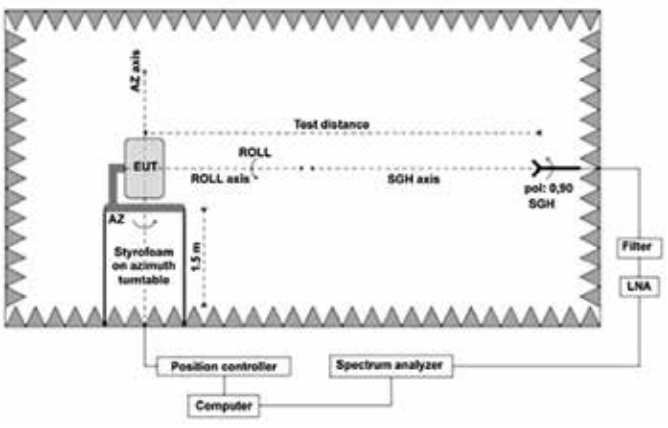
Shortly after the standard went to balloting and after publication, the FCC released several KDB's addressing the opening of 5850-5895 MHz and 5925-7125 MHz for Part 15 U-NII device operation. The 3rd revision of C63.10 for the most part can be used for evaluating the basic requirements for these new devices, though one needs to address differences between this version and some of the additional requirements spelled out in the new FCC KDB's.

At this time C63 is petitioning the FCC to consider adoption of this version; we hope that ISED will follow suit. The work however on C63.10 has not been completed as there is an open work item to address a correction of a mathematical formula in the UWB section and in the pulse desensitization section. The Working Group for this effort is now forming. If you are interested in joining the Working Group to support C63.10, please contact Jason Nixon at jason.nixon@ised-isde.gc.ca.

David A. Case NCE, NCT, is the Principal Consultant for David A. Case EMC Consulting LLC specializing in Wireless and EMC Regulatory Compliance Consulting. He is the Vice-Chair of C63 Subcommittee 4 and served as Vice-Chair of the C63.10 Working Group. He may be reached at dave.case@ieee.org.* **EMC



C63.10 - Figure 5 - LISN setup for transmitter with peripherals R1.



C63.10 - mmWave Example of a typical shielded anechoic chamber and positioner setup.