Expected Changes and Additions to the Antenna Measurement Standard IEEE Std 149™

Vince Rodriguez
NSI-MI Technologies
Suwanee, GA, USA
vrodriguez@nsi-mi.com

Lars Foged
Microwave Vision Italy
Pomezia, Rome,Italy
Lars.Foged@microwavevision.com

Jeff Fordham
NSI-MI Technologies
Suwanee, GA, USA
jfordham@nsi-mi.com

Abstract: **The IEEE Standard 149 has not been revised since 1979. Over the years the Standard was reaffirmed without any changes. Recently the IEEE Standards association stopped the practice of reaffirming standards. This change in policy by the IEEE has been the "medicine" that this standard needed. A working group was organized and a project authorization request (PAR) was approved by IEEE for the document to be updated. In this paper, the expected changes to the document are described. The main change is to convert the standard to a recommended practice document. Additionally, some new techniques to measure antennas such as the use of reverberation chambers and compact ranges is discussed in more detail. Most importantly, a discussion on uncertainty is included. The result will be a very useful document for those designing and evaluating antenna test facilities, and those performing the antenna measurements.**

Keywords—IEEE Standards, Antenna Measurements

I. Introduction

The IEEE Std 149 [1] document, in its current form, is a marginally useful document. While it is full of very interesting and pertinent information, the document has not undergone a significant update since 1979. The basics of antenna measurement have not change and the underlying theory has not changed as the physics behind it have not changed. The document is mainly centered on outdoor ranges for the measurement of antennas. There are long discussions on elevated and ground reflection ranges [1]. However, there are very limited discussions on anechoic chambers and on popular techniques such as compact antenna test ranges (CATR) or near to far field measurements using mathematical transforms.

Over the years the document survived in its current form by being re-affirmed periodically. Recently the IEEE Standards Association abolished the practice of re-affirming the standard. This change in the policies of the IEEE was a blessing as it forced the antenna measurement community to look back at the document and update it and include important things such as new techniques and discussion on uncertainties.

II. Purpose of IEEE Std 149

A working group was formed, and a project approval request (PAR) was submitted to IEEE. The PAR document was approved and the purpose of the standard are therein described.

The PAR was submitted on the 15th of October of 2015 and approved on the 5th of December of the same year. The PAR states the purpose of the document. The first statement on the scope section of the PAR document reads "This document comprises recommended practices for the measurement of antenna transmitting and receiving properties. It is a comprehensive revision and extension of ANSI/IEEE Std 149-1979." That statement conveys the purpose of the document. The purpose is to provide the user of the document with a set of recommended practices for the measurement of antennas. The statement from the PAR also mentions the document being a "comprehensive revision and extension". In the next section the new additions and changes to the document are discussed

III. Changes to the Standard

The main change to the standard is in the title itself. While the original document was entitled "IEEE Standard Test Procedures for Antennas", the new document has changed the title of the standard to "Recommended Practice for Antenna Measurements". That change from standard to recommended practice is one of the big changes to the document. An IEEE Standard indicates some mandated procedure or approach. A Standard will contain statements with the grammatical statement "Shall" whereas the recommended practice is a more relaxed "Should". This change is brought by the reality of the antenna measurement business itself. Antennas come in many forms and types. A standard cannot mandate the type of test that shall be performed on all antennas. Some applications do not require very strict measurements of the antenna. If the standard was to be written as a mandatory document, it will have to be extremely relaxed and would be of little use in some applications. Since the standard is developed as a recommended practice, it does not mandate, but recommends the best industry practices of how to conduct a specific measurement.

There are other several areas that the revision has extended to the original document. One of them is guidance on the design of indoor ranges. The original document mentioned anechoic indoor ranges, but it mainly provided guidance on outdoor elevated ranges and ground reflection ranges. It went over very specific rules for the design of outdoor facilities. The new version of the document includes guidance on the design of indoor ranges. Additionally, a new section is available on evaluation of antennas test ranges. This section provides some guidance on the limitations of some industry accepted methods for the evaluation of anechoic ranges that in many cases were used in applications for which they were not ideal.

Among the indoor ranges described is the CATR, the 1979 document mentioned compact ranges briefly in one paragraph. The new document provides more detail about the room design

for the CATR, and guidelines for the evaluation of the quiet zone (QZ) of a CATR. More importantly, guidance on the evaluation of uncertainties for the measurements in a CATR are provided.

Uncertainties are essential in any measurement. The new revision has added discussion on the main uncertainty terms for the different methodologies described in the document. The uncertainties follow the guide to the expression of uncertainty in measurement [2].

The uncertainty discussion pertains to identifying the uncertainty terms for each methodology and then provides guidance on how to evaluate the overall uncertainty using the terms and their expected probability distributions. The uncertainty discussion is one of the critical and most important additions to the standard.

The other addition is the use of reverberation chambers for measuring the efficiency of antennas. The addition of reverberation provides an additional methodology to the well known Wheeler cap approach already described in the original document [1].

IV. Conclusion

The changes to the new version of the IEEE Std 149 will make the document an essential reference in any laboratory that conducts antenna measurements. Its discussion on quiet zone evaluation set some boundaries to some of the industry accepted methods. Most importantly, the discussion on uncertainty makes the document extremely useful for the laboratories as it provides the laboratory with a guide on how to evaluate the uncertainty of a given method.

References

[1] 149-1979 - IEEE Standard Test Procedures for Antennas

[2] ISO/IEC Guide 98-3:2008 (JCGM/WG1/100) Uncertainty of measurement -- Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)