

Chamber Validation Using a Field Probe

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Overview

- Is site validation with a field probe a new idea ?
- What says the Reciprocal theorem ?
- Free Space VSWR technique
- Free Space VSWR with electric field probe
- Site VSWR Reciprocal method
- Conclusion

Is site validation with electric field probes a new idea ?

- IEC 61000-4-3: “Uniform area”
- C. Vitek: “Investigation Of Sampling Geometry For Simultaneous Emissions/Immunity Calibration Of Free Space Chambers”, IEEE Int’l Symp. on Electromagnetic Compatibility, Washington DC, 2000
- M.L. Crawford: “Evaluation of Reflectivity Level of Anechoic Chambers Using Isotropic, 3-dimensional Probing”, IEEE Int’l Symp. Antennas Propagat, Atlanta GA, 1974

What says the Reciprocal theorem ?

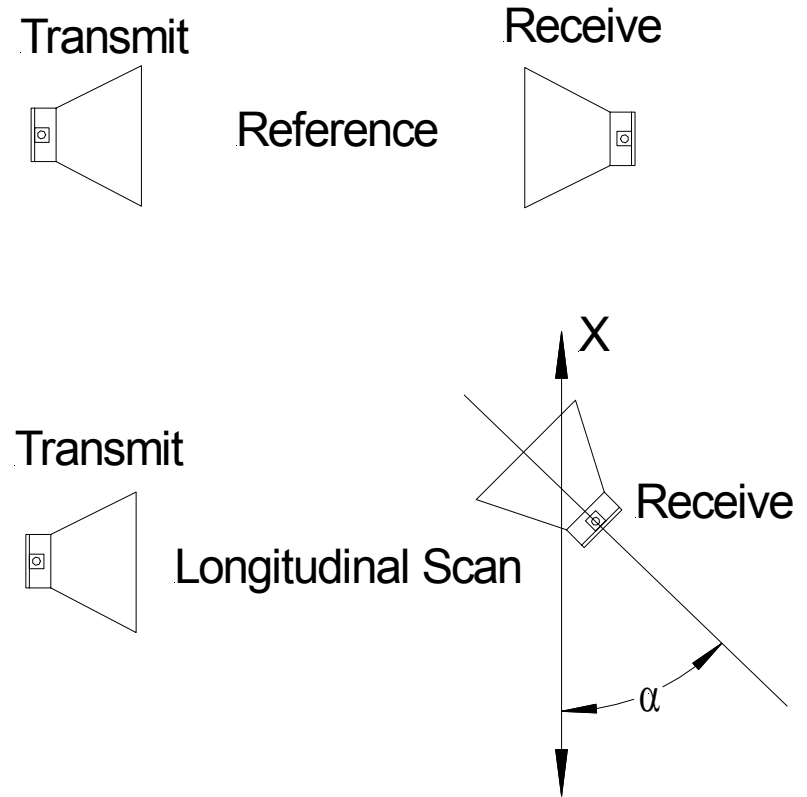
- The radiation pattern and antenna impedance is the same for transmit and receive
- The site attenuation between two antennas is the same independent which one is TX and RX
- Validity ?
 - linear
 - passive
 - isotropic

Free Space VSWR

- Origin: Antenna Test Chambers
- First Source:
 - J. S. Hollis, T. J. Lyon, L. Clayton: "Antenna Measurement Techniques", Scientific-Atlanta, inc., Atlanta, Georgia, 1970
- Determines ratio of direct ray and reflected rays
 - Not equal to absorber return loss!

Free Space VSWR – Test Setup

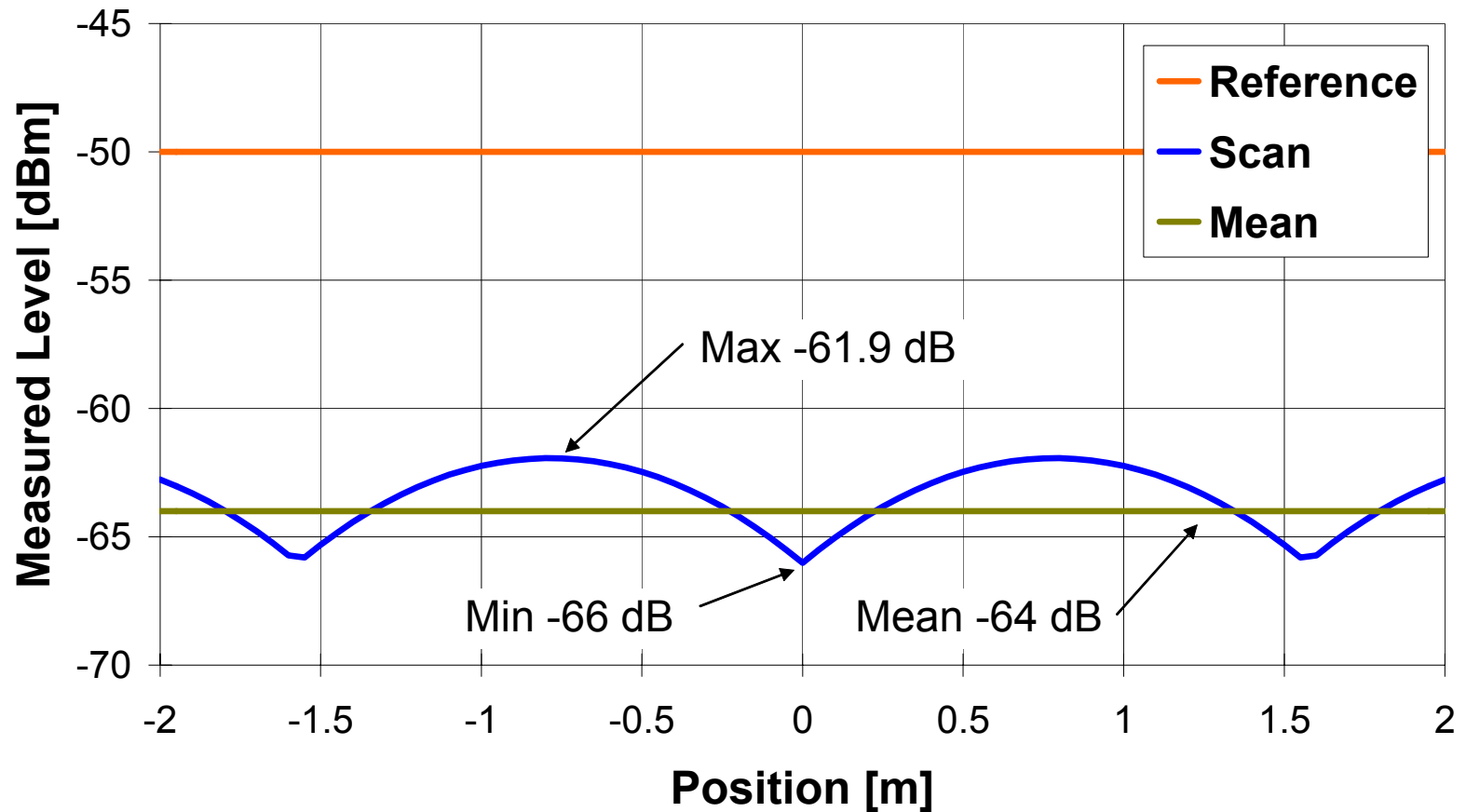
- Boresight reference
- Longitudinal Scan in Quiet Zone
 - Stepsize $< \lambda/10$
- Antenna turned by α
- Several scan axis and α 's possible



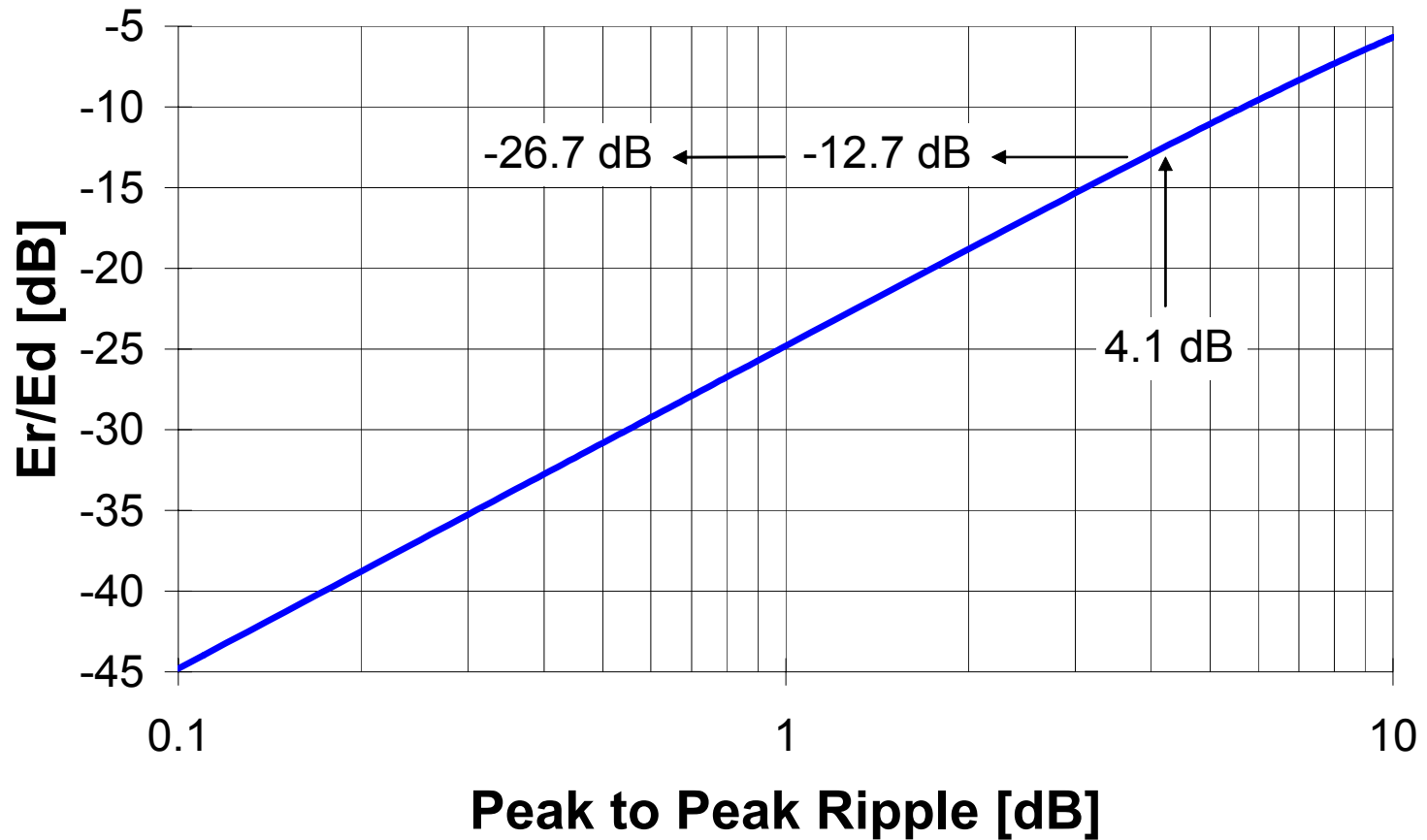
Free Space VSWR – Evaluation - Steps

- Perform measurements
- Plot Sweep diagram
 - Reference, Max, Min, Mean, Peak to Peak (Max-Min)
- Look to evaluation diagram
 - Determine VSWR from Peak to Peak
- Correct the value
 - Add difference between Mean and Reference

Free Space VSWR – Example - 1



Free Space VSWR – Example - 2



Free Space VSWR – Pros & Cons

- Pros
 - No antenna factors
 - Very sensitive method (up to 50 dB)
- Cons
 - Precise antenna positioner
 - Measurement software
 - No automated evaluation
 - Discrete frequencies
 - Very time consuming

Free Space VSWR: Replacement of probe antenna to electric field probe

- Pros
 - Less time consuming
 - Simple probe positioner needed
- Cons
 - Lower sensitivity to site anomalies
 - Expensive TWT amplifier necessary
 - No spatial resolution

Free Space VSWR with electric field probe vs. Site VSWR reciprocal method

- 6 non-equidistance discrete points instead of continuous movement
- Wideband instead of single frequency
 - Result valid for octave not for each frequency!
- Different geometry
 - Front, right, left, h2 instead of longitudinal and transverse

Conclusion

- Reciprocal validation methods well suited to characterize anechoic chambers
- Site VSWR is a “Wideband Free Space VSWR version”
- Isotropicity of the electric field probe is an important part of the measurement uncertainty
- Compared to antenna
 - Good isotropic behavior
 - Slow response time