

Federal Communications Commission  
Office of Engineering and Technology

Title: Dipole Requirements for SAR System Validation and Verification

Short Title: Dipole SAR Validation Verification

Reason: This document is under Draft Review to add attachment 450824 D02 Dipole SAR Validation Verification V01 to publication 450824.

Publication:

Draft For Review: 450824

Rule Parts:

Keyword: SAR Measurement, Probe Calibration, System Verification

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First Category: Administrative Requirements

Second Category:

Third Category:  
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Question: What are the SAR probe and dipole calibration, validation and verification considerations for measurements from 150 MHz to 3 GHz?

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Answer:

See the attached documents 450824 D01 SAR Prob Cal and Ver Meas v01r01 and 450824 D02 Dipole SAR Validation Verification V01 below.

Attachment List:

450824 D01 SAR Prob Cal and Ver Meas v01r01 ,Published on: Jan 10 2007 4:27PM (existing)  
450824 D02 Dipole SAR Validation Verification V01 below. Published Date (to be added)

**Attachment (450824 D02 Dipole SAR Validation Verification V01)****Dipole Requirements for SAR System Validation and Verification****General Requirements**

Dipoles are specified in SAR measurement standards for validating SAR system performance and verifying routine measurement accuracy. These dipoles are optimized for measurement repeatability and lab-to-lab reproducibility in configurations required by measurement standards. The detail dipole design parameters are specified at selected frequencies in these standards to ensure acceptable electrical and mechanical tolerances can be specified. Specific test configurations are also defined to enable SAR to be measured within 10% of the defined SAR target values. These targets have been derived using both numerical simulations and experimental validation in measurement configurations defined in the measurement standards.

**Dipole Requirements**

The dipole SAR targets must be validated according to the numerical simulation and experimental validation protocols used in developing the published target values in SAR measurement standards; for example, IEEE 1528-2003. After the initial numerical and experimental validations, regular calibrations are necessary to reconfirm the electrical specifications and SAR targets of the dipoles. If a dipole is constructed according to the exact specifications in the standards, including electrical and mechanical tolerance, the SAR targets specified in the standards may be used without separate numerical simulation. However, it is still necessary to conduct the initial experimental validation and regular calibration to reconfirm the SAR target. In situations when it can be demonstrated that an extended calibration intervals is justified, longer calibration intervals for extending the annual calibration recommended by the SAR standards may be considered.

Dipoles are often optimized individually to provide the best impedance matching ( $50\Omega$ ) and return loss ( $\leq -20$  dB) according to the tissue and phantom shell property requirements. This may introduce small differences between the specified and calibrated SAR targets for the individual dipole. Therefore, a dipole must be calibrated according to the specific phantom configuration and tissue properties required for routine measurements, especially at higher frequencies. Dipoles must also be calibrated using a fully validated SAR system according to the tissue dielectric parameters and SAR probe calibration range required for device testing. The Probe Calibration and System Verification application note in KDB 450824 continues to apply, in conjunction with this attachment, and must be considered in order to use a dipole at acceptable offset frequencies.

**Calibration Requirements**

The SAR system must be validated before it can be used for the initial dipole validation or subsequent calibrations. According to measurement protocol, dipoles must be calibrated with a SAR system that has been fully validated at the measurement frequency. The measurement accuracy of the SAR system must also be verified with a calibrated dipole or equivalent source before performing any dipole calibration measurements. Since a calibrated dipole is required to

validate the SAR system, it is unacceptable to calibrate a dipole with the same SAR system that requires it to validate that SAR system. Documentation of dipole calibration and measurement integrity is required to support the calibration results; for example, information and data on the SAR probe and tissue dielectric parameters used in the dipole calibration and SAR system validation/verification status. The following are the recommended FCC procedures for SAR dipole calibration.

- 1) The phantom configuration, tissue dielectric parameters, dipole positioning requirements, dielectric spacer and other electrical and mechanical details should be clearly specified in the dipole calibration report. Dipoles must be recalibrated at least once every three years; however, immediate re-calibration is required for the following conditions. The test laboratory must ensure that the required supporting information and documentation have been included in the SAR report to qualify for the extended 3-year calibration interval; otherwise, the IEEE 1528-2003 recommended annual calibration is expected.
  - a) After a dipole is damaged and properly repaired to meet required specifications
  - b) When the measured SAR deviates from the calibrated SAR value by more than 10% due to changes in physical, mechanical, electrical or other relevant dipole conditions; i.e. the error is not introduced by incorrect measurement procedures or other issues relating to the SAR measurement system
  - c) When the most recent return-loss, measured at least annually, deviates by more than 3 dB from the previous measurement or not meeting the required -20 dB return-loss specification
  - d) When the most recent measurement of the real or imaginary parts of the impedance, measured at least annually, deviates by more than  $2.5 \Omega$  from the previous measurement

### **Head and Body Tissue Media Considerations for SAR System Verification**

When both head and body tissue-equivalent liquids are required for testing a device, SAR system verification should be conducted using the tissue type required for testing the primary operating and exposure conditions of the device; for example, head for cellphones and body for data cards. This option requires the SAR probe to be calibrated for both head and body measurements, and the same probe must be used for both the dipole and device measurements. When a dominant exposure configuration cannot be identified, either head or body system verification may be used; however, the selection must be clearly explained in the SAR report. In addition, the dipole measurements must be within 8% of the calibrated SAR value using the required tissue dielectric parameters. Otherwise, independent head and body system verifications are necessary.