



RF Exposure Procedures General Update

TCB Workshop
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Laboratory Division
Office of Engineering and Technology
Federal Communications Commission



Overview

- KDB procedures
- Device and technology
- SAR measurement methodology and test systems
- SAR measurement standards



KDB 447498 - Updates

- Updated a few footnotes
 - included reference to KDB 865664 about previous Supplement C text
 - Commission also applies measurement uncertainty when testing samples for compliance and comparing measured results to applicable limits
 - hotspot mode and UMPC procedures
 - when antenna is ≤ 2.5 cm from a surface or edge
 - *test separation distance* is determined by antenna or device enclosure, as appropriate, to the phantom; not by antenna to device surface or edge distance
 - estimated SAR is not required to determine simultaneous SAR test exclusion



KDB 447498 – Fast SAR

- Issues at 5 GHz confirmed for area scan estimated 1-g SAR (Motorola fast SAR)
- KDB revised to limit procedures to below 3 GHz
 - users should contact SAR system manufacturer to submit a KDB inquiry to determine if such implementations may be applied above 3 GHz
 - also apply to SAR systems with similar or equivalent implementations, but not using the exact algorithms



KDB 648474 - Phablets

● KDB 648474 changes

- When hotspot mode applies, 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g *reported* SAR > 1.2 W/kg. When power reduction applies to hotspot mode, the measured SAR must be scaled to the maximum output power, including tolerance, allowed for phablet modes to compare with the 1.2 W/kg SAR test reduction threshold.

● (unpublished) clarification for potential confusion

- The UMPC mini-tablet procedures ~~must also be applied~~ **are adapted** to test the SAR of all surfaces and edges with an antenna located at ≤ 25 mm from that surface or edge, in direct contact with a flat phantom, for 10-g extremity SAR according to the body-equivalent tissue dielectric parameters in KDB 865664 to address interactive hand use exposure conditions. The UMPC mini-tablet 1-g SAR at 5 mm is not ~~required~~ **used**.



KDB 865664 – Supp. C

- Added previous Supplement C SAR measurement uncertainty text
 - The SAR equipment manufacturer may have evaluated some of these uncertainty components according to specific measurement conditions, however, additional analyses may be required for the uncertainty components that are dependent on the operating conditions and test configurations of an individual test device. The expanded SAR measurement uncertainty must be $\leq 30\%$, for a confidence interval of $k = 2$. For this reason, applicants are encouraged to avoid using any equipment or test procedures with large measurement uncertainties to evaluate SAR compliance. ^{fn}
 - added footnote ^{fn}: The Commission also applies appropriate measurement uncertainty procedures when testing samples for compliance and comparing measured results to applicable limits.



KDB 865664 – 150 MHz

- Revised below 300 MHz SAR system validation requirements
- 150 MHz shielded current loop defined in on-going IEC 62209-2 draft revisions available from selected SAR system manufacturer(s) should be used for SAR system validation and verification in 100 MHz - 300 MHz. Until detailed and SAR target are fully documented in 62209, confirm SAR target and required measurement setup configurations through KDB inquiry when use for first time by each test lab.
 - procedures do not apply to testing below 100 MHz; dielectric parameters & other details unavailable
- a KDB inquiry is required to determine if other alternatives may be acceptable
- round robin is planned by IEC 62209 for May – October 2014



KDB 941225 - Rel. 8 LTE

- Updated Rel. 8 LTE SAR procedures on TTI concerns
 - measured SAR with maximum **number of TTI** (~~transmit~~ **transmission** time interval) supported by device (**unpublished further clarification**)
 - default basestation setup vs. each TTI can be configured independently
 - questions about device implementation and network scheduler restrictions
 - questions about control channel transmission continues during inactive TTIs
- Drafting of Rel. 8 LTE procedures continues in IEC 66209 committee
 - using power measurement and standard deviation to establish threshold for predicting highest SAR configurations for testing



KDB 941225 – Rel. 10 LTE

- Rel. 10 LTE SAR testing interim guidance
 - when Rel. 8 SAR procedures apply, KDB inquiry is not required
 - identified Rel. 10 items that can introduce SAR measurement issues & concerns
 - UL carrier aggregation, enhanced SC-FDMA, MIMO support etc.
 - included interim guidance for DL carrier aggregation SAR test exclusion
 - plan to establish procedures for allowing DL CA without PBA
- Questions relating to need for separate VoLTE SAR procedures



Source-Based Time-Averaging

- 2.1093(d)(2) - Exposure may be averaged over a period not to exceed 30 minutes to determine compliance with general population/uncontrolled SAR limit
- 2.1093(d)(5) - “source-based” time-averaging based on an inherent property or duty-cycle of a device is allowed ... TDMA
- (d)(2) limits averaging window required by (d)(5) to no more than 30 minutes
- applies to SAR test exclusion and measurement



Low Duty Factor Exclusion

- KDB 447498 low transmission duty factor procedures
 - require case-by-case consideration where source-based time-averaging does not apply
 - typically operational based and limited by a worst case transmission duty factor
 - KDB inquiry and PBA are required; generally applies to SAR test exclusion only
- KDB 447498 SAR test exclusion provision applies to both source-based and low duty factor procedures
 - do not mix source-based and low duty factor
 - one or the other; cannot apply both



Dynamic Antenna Tuning

- SAR test considerations are expected to vary with different antenna tuning implementations and device configurations
 - tuning optimization for FDD generally covers transmit & receive bands
 - different types of control and feedback mechanisms used
 - number of tuning states depends on hardware & firmware requirements
- A KDB inquiry with clear explanations on design and implementation is required to address SAR testing issues
 - relationship between tuning conditions, exposure conditions and SAR
 - test plan to support SAR test reduction for tuning state conditions
 - preliminary screening with respect to tuning parameters, control mechanisms, antenna configurations, exposure conditions etc.
 - non-standard SAR methods may be considered on a case-by-case basis for screening purposes to identify normal SAR testing configurations



SAR Probe Calibration

- General requirements are described in KDB 865664
 - according to IEEE 1528-2003 procedures
- IEEE 1528-2013 introduced concepts for signal specific calibration
 - detailed procedures are not described in 1528-2013
- KDB 865664 includes SAR system validation procedures
 - for 1528-2003 calibrations and high peak-to-average power ratio signals
 - to verify signal specific probe calibration to support PBA consideration
- Recent development on “intelligent probe calibration”
 - probes models are simulated numerically and validated to generate calibration parameters
 - calibration parameters are applied dynamically by the SAR system according to actual signal received over the air with special hardware from the test device
 - additional details are mostly unavailable at this point
 - use of this method requires case-by-case consideration



Sensor Array SAR Systems

- These are next generation fast SAR measurement systems based on
 - sensor arrays embedded in the SAM or flat phantom
 - SAR is “estimated” according to fields calculated by near-field transformation according to specific implementations and assumptions
 - each measurement typically requires only a few seconds or less
- System implementation and specific details are necessary to begin considering applicable KDB procedures to
 - determine the applicability of individual systems for device testing
 - establish SAR system validation and verification procedures
 - verify the validity and accuracy of results for individual device testing
- Until specific system details are available
 - such systems can only be considered on a case-by-case basis for SAR screening purposes for supporting complex SAR testing requirements
- IEC 62209-3 was established in January 2014 for such systems
 - can take several years to develop procedures and measurement standard