



RF Exposure Procedures Update

TCB Workshop
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Laboratory Division
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Overview

- Existing KDB procedures update
- Evolving technology update
- SAR measurement methodology update
- Other RF exposure updates



Existing KDB Procedures Update



KDB Procedures

- Apply most recent revision or version of KDB procedures
 - obsolete procedures do not qualify for TCB approval
- Guidance from outdated KDB inquiries should not be used
 - consider reaffirming guidance
 - more than 12 months old
 - after 3 – 6 months for rapidly evolving products or technologies
- Avoid including entire SAR report or similar documents to address specific questions, be thorough on specific info and responses
- All KDB inquiries must be provided to the TCB to support review and approval, according to KDB 388624 requirements
- TCBs must address and resolve issues before submitting a PBA or issuing equipment approval



PBA List

Power Reduction Triggering

- PBA may be waived for fixed level power reduction based on single event unconditional triggering with respect to item 17) a) of KDB 388624 (PBA list)
 - require confirmation through KDB inquiry
- Subsequent modification of triggering condition is considered conditional; therefore, PBA is required
 - for example, fixed level power reduction triggered by hotspot mode and then modified by other conditions
- Purpose of KDB inquiry is to confirm issues relating to certain conditional triggering configurations that may be misinterpreted as unconditional



KDB 447498

- Standalone SAR test exclusion
 - use the equation to calculate numerical exclusion threshold
 - do not use the “example” power levels in the Appendix
- Area scan estimated 1-g SAR (Motorola fast SAR)
 - provided all conditions in KDB 447498 are satisfied, fast SAR and zoom scan based 1-g SAR results are considered equivalent
 - both need scaling to determine *reported* SAR
 - both may be applied to determine standalone and simultaneous transmission SAR test reduction and exclusion
 - zoom scan 1-g must be used when tested
 - zoom scan is required for highest *reported* SAR configuration in each wireless mode, frequency band and exposure condition
 - zoom scan 1-g SAR is always used to determine compliance



KDB 616217

Host Testing Definitions

- Representative host testing is associated with KDB 616217 modular approach testing for equivalent hosts
- Dedicated host testing is associated with the approval process of one host device with its own FCC ID

G-Sensor

- G-sensor, while not prohibited, must be able to mitigate SAR issues to be acceptable
- Demonstration of effectiveness with respect to the operating configurations and exposure conditions of the device seeking equipment approval through KDB inquiries is required



Hotspot mode SAR

- Hotspot mode SAR addresses combinations of use conditions
 - excluding head and body-worn accessory use conditions
- It is a composite test configuration intended to facilitate test reduction for multiple use conditions that may involve both 1-g and 10-g (extremity) SAR
- Unless hotspot mode operates simultaneously with normal head and/or body-worn accessory use conditions, which require separate SAR test considerations, do not incorrectly associate hotspot mode with other body use or body-worn accessory SAR conditions



Phablet Procedures

- When hotspot mode power reduction applies to phablets in KDB 648474
 - the measured hotspot mode SAR must be scaled to the maximum non-reduced output power level to apply the 1.2 W/kg test reduction allowed for phablets
- KDB 648474 will need update to reflect this



Simultaneous Transmission

- Apply the maximum aggregate output power of all simultaneous transmitting MIMO chains to determine SAR test reduction and exclusion
- Variations in maximum output power across MIMO chains, channels of individual chains or differences in antenna performance among chains must be taken into consideration
 - complex situations should be addressed through KDB inquiries before testing
- MIMO antennas placed in different host configurations may require Class II permissive change to address RF exposure
- KDB 616217 modular approach is for standalone SAR only
 - it is not intended and does not apply to MIMO or simultaneous transmission unless SAR test exclusion applies



2.1091(d)(4) Configurations

- Devices with a corded traditional handset, like a wired telephone, in Wireless Local Loop equivalent configurations should be considered under 2.1091(d)(4) of the rules
 - SAR generally applies to exposure conditions where user access to device cannot be excluded
- Vehicle diagnostic modules mounted under the front dash are also considered under 2.1091(d)(4)
 - depending on installation and operating requirements
 - low duty factor exclusion and SAR test exclusion according to worst case separation may be considered



Evolving Products and Technology Update



LTE

- Interim guidance on information to include when submitting KDB inquiries for Rel. 10 LTE SAR test guidance
 - FCC ID, device details
 - supported Rel. 10 features vs. Rel. 8 and Rel. 10 support restrictions
 - enhanced SC-FDMA support
 - uplink & downlink carrier aggregation capabilities
 - inter-band and intra-band aggregation requirements
 - SVLTE support with and without carrier aggregation
- Band 41 (2.5 – 2.6 GHz) requires more than 3 test channels; see KDB 447498
- IEC 66209 is considering LTE SAR procedures, based on Rel. 8 considerations from FCC, Korea and Japan



GSM/GPRS SAR

- The number of time slots to test for SAR should correspond to the highest source-based time-averaged maximum output power configuration
 - taking into consideration power reduction across wireless modes, modulations and time-slots
- For time slots with equivalent maximum average output power specifications, including tolerance
 - when the measured maximum output power levels are within 0.25 dB of each other, test the configuration with the most number of time slots



Dynamic Antenna Tuning

- SAR test considerations are expected to vary with different antenna tuning implementations
- A KDB inquiry with clear explanations on design and implementation is required to address SAR testing issues
 - antenna tuning optimized for far-field conditions may introduce near-field RF current distribution and SAR changes
 - depending on implementation, available tuning states may influence near-field current distributions differently
 - information or results to demonstrate the SAR for best and worst tuning states are both compliant
 - implying intermediate tuning states are also acceptable
 - or include results for intermediate states



Source-Based Time Averaging

- Various time averaging considerations have been proposed to lower the average power dynamically during transmission
- These mechanisms are expected to vary with individual wireless technology and product implementation
- In general, only source-based time averaging implementations can be accepted; i.e., TDMA like
- For 3G/4G technologies, applying ad hoc TDMA-like restrictions to modify data transmission
 - the control channels and associated messages are expected to continue transmitting; most likely at a lower power level
 - these must be taken into consideration in the SAR measurement
 - there could be SAR measurement issues that need to be addressed
- Other wireless technologies could have similar concerns



Test Equipment Considerations

- Multiple basestation simulators or similar equipment are required to perform power measurements
 - to determine SAR test exclusion
 - due to channel or carrier aggregation and similar conditions
- When the necessary equipment is unavailable at a test lab at the early stage of an evolving technology
 - SAR test exclusion may be determined according to power measurements performed by the grantee (manufacturer)
- The proper equipment must be available at the test lab to support SAR measurement



60 GHz 802.11ad

- Antennas arrays and beam-forming are typically used
 - may require RF exposure evaluation for coherent signals
- Calibrated miniature waveguide probes may be considered for field measurements
 - the calibration must be verified
 - waveguide probes must be surrounded by RF absorbers during measurement to avoid field scattering and perturbation
 - other reflecting objects and scatters also need RF absorbers
 - fields should be measured at closest far-field distance and extrapolate to the required exposure distance by accounting for free-space attenuation to determine compliance
 - all typical 60 GHz field measurement concerns must be taken into consideration for results to be valid



SAR Measurement Methodology Update



SAR System Validation

- SAR targets for system validation/verification dipoles
 - when measured (calibrated) & compensated SAR targets are shown on calibration certificates
 - system verification results may be compared to either targets provided the measured SAR is within 10% of both targets
- Current loops are available for 30 – 300 MHz SAR system validation
 - these supersede the interim procedures in KDB 865664
 - a KDB inquiry with expected delivery date of current loops is required to continue applying the interim procedures
 - expect KDB 865664 to be updated soon



Tissue Dielectric Parameter

- SAR error compensation for up to 10% tissue dielectric parameter tolerance may be limited to 3 GHz due to certain SAR system requirements
 - as reflected in most recent KDB 865664
- SPEAG is in the process of verifying SAR measurement uncertainty for DASY systems to apply this SAR error compensation with 10% tissue dielectric parameter tolerance above 3 GHz
 - DASY system does not block this compensation above 3 GHz
 - system manual does indicate 5% tissue dielectric parameter tolerance to satisfy measurement uncertainty requirements above 3 GHz



Coherent Signal Considerations

- Diode based scalar probes are not suitable for coherent signals
- Worst case exposure is a function of N^2 ; N = number of signals
 - factor of 4, 9, and 16 for 2, 3 and 4 signals
- IEC TR 62630 has two options to estimate compliance with scalar fields
 - assuming all signals are spatially and temporally in-phase to sum field magnitudes of the sources at each measurement point
 - $SAR_{true} \leq [\sum_i \sqrt{SAR_i(\mathbf{r})}]^2$
 - assuming all signals are only temporally in-phase to sum field component magnitudes of the sources at each measurement point
 - $SAR_{true} \leq [\sigma(\mathbf{r})/2\rho(\mathbf{r})] \cdot \sum_{x,y,z} [\sum_i |E_i(\mathbf{r})|]^2$
 - these require manual processing of measured field results to determine SAR distribution and 1-g SAR
- Technical issues relating to coherence in tissue or exposure location vs. far-field need to be addressed to apply IEC TR 62630 for individual product and SAR system implementations



Other RF Exposure Updates



ET Docket 03-137

- Extremity SAR limit applies to pinna
- Supplement C discontinued
- Relevant information and procedures in Supplement C have been gradually integrated into various KDB publications over the years
 - further guidance has been planned on the replacement of Supplement C



Supplement C vs. KDB

Supplement C	Topic	KDB
Section 1	Exposure Rules	47 CFR, KDB 447498
Section 2	Evaluation Options, Basic Techniques	KDB 865664, 447498, 648474, 941225
Section 3	§15.247	KDB 248227
Appendix A	Exposure Limits	47 CFR
Appendix B	Documenting Compliance	KDB 865664 (Reporting)
Appendix C	Tissue Dielectric Parameters	KDB 865664
Appendix D	IEEE 1528-2003	KDB 865664, 447498
N/A	Latest Policies	KDB 628591, 388624, 178919, 690783
N/A	Product & Technology Related Guidance	KDB 941225, 447498, 615223, 616217, 643646, 648474, 680106 etc.