Attachment 648474 D04 SAR Handsets Multi Xmiter and Ant v01

SAR Evaluation Considerations for Handsets with Multiple Transmitters and Antennas

I. Introduction

This document describes the SAR evaluation requirements for consumer cellphones operating with multiple transmitters and simultaneous transmitting antennas. The procedures are applicable to phones with built-in licensed and unlicensed transmitters, such as WWAN, WLAN and Bluetooth transmitters. The SAR test reduction and exclusion provisions in KDB 447498 can be applied to streamline both standalone and simultaneous transmission SAR measurements. The *published KDB procedures* must be used to test different wireless technologies, such as 3GPP, 3GPP2, WiMax, 802.11 and Bluetooth.[1] When simultaneous transmission SAR measurement is required, the procedures in KDB 865664 must be considered. SAR test considerations for simultaneous transmission configurations, power reduction implementations, VoIP test requirements, NFC, wireless charging and similar accessories are also discussed for recent generation smart phones.

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Comment [1]: Can you define this further? Is this definition limited to devices held to ear? As you know, there are devices that are evolving, that may resemble tablets and may be "phones" as well.

II. SAR Evaluation Considerations

Cellphones are tested for SAR compliance in both head and body-worn accessory use configurations. Head exposure is limited to next to the ear voice mode operations. Body-worn accessory exposure is typically related to voice mode operations when phones are carried in body-worn accessories. For phones that support hotspot mode operations, with wireless router capabilities and various web browsing functions, the relevant exposure conditions for hand and body are tested according to the hotspot SAR procedures in KDB 941225.

A. Standalone and simultaneous transmission SAR test requirements

Regardless of the simultaneous transmission requirements of a phone, each transmitter must be evaluated independently according to the applicable rules and policies to determine RF exposure compliance.

1. The SAR test reduction and exclusion provisions in KDB 447498 should be applied to determine the tests required for standalone and simultaneous transmission for all transmitters in the phone. For the purpose of determining SAR test exclusion, a separation distance numerical value of 5 mm is used to determine the thresholds according to the tables in KDB 447498. The test exclusions are based on the maximum output power, antenna-to-antenna and antenna-to-user separation distances.

2. The SAR measurement procedures in KDB 865664 are required to be applied for test results to be acceptable for TCB approval.

3. Head SAR compliance is tested according to the test positions defined in IEEE Std 1528-2003 using the SAM phantom.

4. The body-worn accessory procedures in KDB 447498 are applied to test for body-worn accessory SAR compliance.

[1] See KDB 447498 for *published KDB procedures*.

5. For handsets that support hotspot mode, the procedures in KDB 941225 are applied.

6. A physical SAR test separation distance of 10 mm is required for all surfaces and edges with a transmitting antenna located within 25 mm from that surface or edge to evaluate the wireless router mode exposure condition.

7. A physical SAR test separation distance of 5 mm is required for phones with a form factor smaller than 9 cm x 5 cm to evaluate the wireless router mode exposure condition.

8. When the separation distance required for body-worn accessory testing is greater than or equal to that required for the same surface of a phone and in the same wireless mode for hotspot use, the hotspot SAR data may be used to support body-worn accessory SAR compliance for that particular configuration.

9. The simultaneous voice and data transmission configurations and combinations for all applicable wireless operating modes, frequency bands and exposure conditions must be identified in the SAR report.

10. Simultaneous transmission SAR tests are considered separately for head (touch and tilt positions) and body-worn accessory exposure conditions, antenna diversity configurations, handset flip or slide cover positions, modulations, channel bandwidths and resource allocations, such as data rate, zone type, symbol ratio/duty factor, data block size etc.

11. For example, the highest SAR measured with the slide cover of a handset in the extended and retracted positions for the touch and tilt positions on the left and right side of the head for each transmitter/antenna may be considered collectively to determine simultaneous transmission SAR test exclusion, according to the sum of 1-g SAR or SAR to peak location separation ratio.

12. However, these must not be mixed with body-worn accessory SAR test configurations to determine SAR test exclusion. When applying the highest SAR in this manner does not allow SAR test exclusion, the individual device operating configuration and exposure condition should be considered separately for SAR test exclusion and reduction, to minimize the number of required simultaneous transmission SAR measurements.

13. When simultaneous transmission SAR measurements are necessary, the enlarged zoom scan measurement and volume scan post-processing procedures in KDB 865664 are required.

14. The RF exposure reporting procedures in KDB 865664 are applied to document compliance.

B. Simultaneous voice and data transmission

Recent generation phones transmit both voice and data. Most smart phones with 3G and 4G capabilities can transmit voice and data simultaneously. Depending on the combinations of wireless technologies available in a phone, different transmitters may be used to transmit voice and data through multiple antennas for standalone and simultaneous transmission operations. Some technologies may require voice and high speed data to be transmitted separately, for example, 1xRTT and EvDo. Other technologies may allow voice and data to occur within the same physical channel, such as WCDMA and HSPA. Smart phones with 3G and 4G/LTE can support voice and data transmission on separate transmitters concurrently. The 3G transmitter(s) is used for 1xRTT, EvDo, WCDMA/HSPA, GSM/GPRS/EDGE and capable of transmitting in only one of these modes at a time, and an independent 4G LTE transmitter is used for 4G transmissions. Among the possible combinations of transmitter and antenna paths, certain implementations may allow EvDo to operate from the LTE transmitter to support simultaneous 1xRTT

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standardized. These additional features are not supplied as an integral part of the phone by the original equipment manufacturer or the wireless carrier; it may not be feasible to test these types of ad hoc user operating modes. The phone manufacturer may either choose to block such apps or test the wireless modes that have the potential to support VoIP apps for head, next to the ear, and body-worn accessory exposure conditions using the applicable wireless data mode configurations. When these types of operations cannot be blocked, disclosures to users through clear and conspicuous instructions are required. Users must be advised that while these operations cannot be blocked, they are not recommended and have not been tested for RF exposure compliance; therefore must be avoided. When it is unclear which data operating mode or test setup to use for VoIP SAR testing, a KDB inquiry should be submitted to determine the test configurations.

G. SAM phantom limitations

Recent generation phones operating with multiple transmitters and antennas have begun to incorporate antennas near the sides and bottom edges of the phone. Occasionally, a phone with antennas located near the bottom or lower side edges of the phone may have peak SAR locations near the mouth and jaw regions or along the steep curved surfaces of the SAM phantom. While it has been known for some time that there are SAR measurement difficulties in these regions of the SAM phantom, there has been no easy solution. SAR probes are calibrated in tissue-equivalent medium with sufficient separation between the probe sensors and nearby physical boundaries to ensure scattering does not affect probe calibration. When the probe tip is moved into tight regions, such as the mouth and jaw of the SAM phantom, with multiple boundaries surrounding the probe sensors, the probe calibration and measurement accuracy can become questionable. In addition, if the measurement location requires a probe to be tilted at steep angles, it may no longer comply with calibration requirements and measurement protocols for maintaining the required measurement uncertainty. In some situations it is just not feasible to tilt the probe or rotate the phantom without acquiring additional SAM phantoms that are constructed specifically to enable rotation. Under these circumstances, the measured SAR distribution is typically clipped, showing only part of the problematic SAR distribution.

To ensure there is sufficient conservativeness for demonstrating compliance until practical solutions are available, other than acquiring multiple phantoms, additional measurement considerations are necessary to address these measurement difficulties. When measurements are required in tight areas of the SAM phantom or the peak SAR is on a curved surface where SAR probe access is not feasible for a horizontally bisected SAM phantom, or the SAR distribution is truncated, the SAR measurement should be repeated using a flat phantom. The phone should be positioned with a separation distance of 4 mm between the ear reference point (ERP) and the outer surface of the phantom shell; if this is not feasible, the top edge of the phone should be touching the phantom. While maintaining this distance at the ERP, the low (bottom) edge of the phone is lowered to establish the same separation distance at the peak SAR location identified by the truncated partial SAR distribution measured with the SAM phantom. When the peak SAR location cannot be identified by the truncated SAR distribution, a KDB inquiry with all relevant information and results should be submitted to determine test requirements. The phone must not be tilted to the left or right while placed in this inclined position to the flat phantom. The same considerations may be extended to the enlarged zoom scan measurements required by the volume scan post-processing procedures provided that the peak SAR locations of individual antennas are identified in area scans and the position corresponding to the peak location with the smallest distance between the phone and the phantom is used for all enlarged zoom scan measurements with the flat phantom.

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Comment [2]: How should this distance be measured? It is a very difficult procedure to make repeatable for a test lab and also very difficult for a TCB to determine if the distance was measured correctly, which would drastically change the SAR result.

Could a standardized distance or standardized points between the phantom and the phone for measurement be used for consistency?