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SAR EVALUATION CONSIDERATIONS FOR WIRELESS HANDSETS

1. INTRODUCTION

This document describes the SAR evaluation requirements for consumer wireless handsets such as cellphones, including smart phones and cordless phones that operate next to the ear. Recent generation cellphones generally have multiple transmitters that operate simultaneously. These SAR procedures are applicable to both licensed and unlicensed transmitters that are built-in within handsets to support technologies such as WWAN, WLAN, DECT and Bluetooth. In general, the SAR test reduction and exclusion provisions discussed in KDB Publication 447498 D01 should be applied to streamline both standalone and simultaneous transmission SAR measurements and similarly, the *published RF exposure KDB procedures* must be applied to test the different wireless technologies, such as 3GPP, 3GPP2, WiMax, 802.11, and Bluetooth.[1] When simultaneous transmission SAR measurement is required, the test procedures in KDB Publication 865664 D01 must be used. The SAR test considerations for recent generation smart phones supporting simultaneous transmission configurations, power reduction implementations, VoIP transmission, NFC, wireless charging and other operating modes are discussed in this guidance.

2. SAR EVALUATION CONSIDERATIONS

2.1. General

Handsets are tested for SAR compliance in head, body-worn accessory and other applicable use configurations according to the procedures described in the following subsections. Some of the other use configurations may include wireless routing/hotspot mode and UMPC mini-tablet related use conditions. For phones with other near body use configurations that cannot be restricted from use through acceptable user disclosure, the general test procedures described in 4.2.2 and 4.2.3 of KDB Publication 447498 D01 should be considered.

2.2. Head exposure conditions

Head exposure for voice mode is limited to next to the ear exposure conditions. The SAR measurement procedures in KDB Publication 865664 D01 must be applied for test results to be acceptable, unless further guidance has been provided by the FCC. Head SAR compliance should be tested according to the test positions defined in IEEE Std 1528-2013 using the SAM phantom. For handsets that do not operate with a traditional earpiece, where the ear reference point (ERP) can become undefined or inapplicable, a KDB inquiry describing the audio transmission technology and expected use conditions is required to determine the acceptable SAR test configurations. When data mode operates in next to the ear configurations, either data alone or in conjunction with voice transmissions, SAR evaluation is required for such use conditions.

[1] See KDB Publication 447498 D01 for *published RF exposure KDB procedures*.

2.3. Body-worn accessory exposure conditions

Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories.[2] The body-worn accessory procedures in KDB Publication 447498 D01 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. When the same wireless transmission configuration is used for testing body-worn accessory and hotspot mode SAR, respectively, in voice and data mode, SAR results for the most conservative *test separation distance* configuration may be used to support both SAR conditions. When the *reported* SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest *reported* SAR configuration for that wireless mode and frequency band should be repeated for the body-worn accessory with a headset attached to the handset.[3]

2.4. Hotspot mode exposure conditions

For cellphones that support wireless routing capabilities, the relevant hand and near-body exposure conditions are tested according to the hotspot mode SAR procedures in KDB Publication 941225 D06. A *test separation distance* of 10 mm is required between the phantom and all surfaces and edges with a transmitting antenna located within 25 mm from that surface or edge.[4] When the form factor of a handset is smaller than 9 cm × 5 cm, a test separation distance of 5 mm (instead of 10 mm) is required for testing hotspot mode. When the separation distance required for body-worn accessory testing is greater than or equal to that tested for hotspot mode, using the same wireless mode test configuration for voice and data, such as WCDMA, LTE and Wi-Fi, and for the same surface of the phone, the hotspot mode SAR data may be used to support body-worn accessory SAR compliance for that particular configuration (surface).

2.5. Phablet SAR test considerations

The UMPC mini-tablet SAR procedures in KDB Publication 941225 D07 are primarily intended for devices with an overall diagonal dimensions ≤ 20 cm that operate like a tablet and mainly support hand-held interactive use next to or near the body of users, with no provision for next to the ear voice mode operations. Early generation mini-tablets are typically designed and optimized for mobile web access and multimedia support; whereas earlier smart phones are primarily intended for voice communication with varying data capabilities. As the use conditions for recent generation UMPC mini-tablets and smart phones are gradually merging; some UMPC mini-tablets are also supporting next to the ear voice mode operations and smart phones are incorporating certain mini-tablet operating characteristics. This new generation of devices has been referred to by industry as "phablets."

For smart phones, with a display diagonal dimension > 15.0 cm or an overall diagonal dimension > 16.0 cm, that can provide similar mobile web access and multimedia support found in mini-tablets or UMPC mini-tablets and support voice calls next to the ear, unless it is confirmed otherwise through KDB inquiries, the following phablet procedures should be applied to evaluate SAR compliance for each applicable wireless modes and frequency band. Devices marketed as phablets, regardless of form factors and operating characteristics must be tested as a phablet to determine SAR compliance.

a) The normally required head and body-worn accessory SAR test procedures for handsets, including hotspot mode, must be applied.

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[2] The Commission has initiated a rulemaking in ET docket 13-84 and adopted a *Report & Order* in ET docket 03-137. The test and compliance procedures may be updated according to other applicable policy decisions or when ET Docket 13-84 is finalized.

[3] *Reported* SAR is the measured SAR adjusted for maximum tune-up tolerance; see KDB Publication 447498 D01 for details.

[4] A composite test distance of 10 mm is used in 1-g SAR measurements to evaluate both 10-g extremity and 1-g near body SAR compliance for typical hotspot mode use conditions. See KDB Publication 941225 D06 for details.

b) The UMPC mini-tablet procedures must also be applied 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 Publication 865664 D01 to address interactive hand use exposure conditions.[5] The 1-g SAR at 5 mm for UMPC mini-tablets is not required. 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; however, 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. The normal tablet procedures in KDB Publication 616217 are required when the overall diagonal dimension of the device is > 20.0 cm. Hotspot mode SAR is not required when normal tablet procedures are applied. Extremity 10-g SAR is also not required for the front (top) surface of larger form factor full size tablets. The more conservative normal tablet SAR results can be used to support phablet mode 10-g extremity SAR.

c) The simultaneous transmission operating configurations applicable to voice and data transmissions for both phone and mini-tablet modes must be taken into consideration separately for 1-g and 10-g SAR to determine the simultaneous transmission SAR test exclusion and measurement requirements for the relevant wireless modes and exposure conditions.[6]

3. STANDALONE AND SIMULTANEOUS TRANSMISSION SAR TEST REQUIREMENTS

Each transmitter should be evaluated independently for standalone use according to the applicable rules and policies to determine RF exposure compliance regardless of the simultaneous transmission modes of a handset. The SAR test reduction and exclusion provisions in KDB Publication 447498 D01 are applied to the transmitters in a phone to determine standalone and simultaneous transmission test requirements, according to the maximum output power, antenna-to-antenna and antenna-to-user separation distances. When the separation distance is ≤ 5 mm, a *test separation distance* of 5 mm is used to determine SAR test exclusion according to KDB Publication 447498 D01. When simultaneous transmission SAR measurements are necessary, the enlarged zoom scan measurement and volume scan post-processing procedures in KDB 865664 D01 are required. The RF exposure reporting procedures in KDB Publication 865664 D02 should be applied to document compliance.

The simultaneous voice and data transmission configurations in all applicable combinations of wireless operating modes, frequency bands and exposure conditions must be fully described in the SAR report to identify the required test configurations. Simultaneous transmission SAR test requirements for head and body-worn accessory exposure conditions are considered separately. Antenna diversity configurations, applicable handset sliding cover positions, specific test positions (touch or tilt, etc.), modulations, channel bandwidths and resource allocations, such as data rate, zone type, symbol ratio/duty factor and data block size, etc., when appropriate, may be considered collectively according to worst case results to determine simultaneous transmission SAR test exclusion according to discussions in KDB Publication 447498 D01. For example, the highest SAR measured with the sliding 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

[5] When 10-g extremity SAR is required, the highest of the *reported* standalone and simultaneous transmission SAR should be reported as a single SAR number on the grant of equipment certification according to item 2) c) of KDB Publication 690783.

[6] Simultaneous transmission SAR for 10-g extremity SAR requires consideration only when standalone 10-g SAR is required.

the sum of 1-g SAR.[7] 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 to determine SAR test exclusion according to the sum of 1-g SAR or SAR to peak location separation ratio to minimize the number of required simultaneous transmission SAR measurements.[8]

4. SIMULTANEOUS VOICE AND DATA TRANSMISSION TEST CONSIDERATIONS

Most cellphones 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 one or more antennas for standalone and simultaneous transmission operations. Some technologies (for example, 1xRTT and EvDo) may require voice and high speed data to be transmitted separately. Other technologies (for example WCDMA and HSPA) may allow voice and data to be transmitted within the same physical (RF) channel. Smart phones with 3G and 4G/LTE may support voice and data transmission on separate transmitters concurrently. The 3G transmitter(s) is used for 1xRTT, EvDo, WCDMA/HSPA, GSM/GPRS/EDGE, each capable of transmitting in only one of these modes at a time; and an independent LTE transmitter is used for the 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 and EVDO transmission. These two modes of implementation are typically referred to in industry as SVLTE and SVDO. EvDo Rev. B supports carrier aggregation where recent implementations have allowed up to 3 carriers to transmit simultaneously within the same frequency band, which requires each carrier to be controlled separately in a coordinated manner by a basestation simulator to perform the SAR tests.[9] When EvDo Rev. B transmits simultaneously with voice, combinations of simultaneous voice and multiple carrier data transmissions must be considered for SAR testing. The term SVD is also used to identify various forms of simultaneous voice and data transmission implementations. As wireless networks continue to migrate from 3G to 4G, some of these configurations can become obsolete and new operating modes may be introduced as networks are upgraded. The SAR test requirements must be determined according to the transmission paths used by the different combinations of transmitters and antennas in a phone. Sufficient details of the transmitter and antenna implementations are required to support the SAR test setup, which is typically illustrated in diagrams along with supporting descriptions in the SAR report. When it is unclear, a KDB inquiry should be submitted to determine the SAR test requirements.

5. DYNAMIC ANTENNA TUNING

Some recent generation smart phones may incorporate specific hardware that allows selected antennas to be tuned dynamically during transmission according to actual use conditions to optimize antenna matching. Control mechanisms based open loop, closed loop or combinations of these may be used in conjunction with sensing of certain use condition to determine antenna tuning. Manufacturers may use different hardware, sensing mechanisms or RF operating parameters and algorithms for selected frequency bands and wireless transmission modes of individual phone models. The individual frequency

[7] Only sliding or flip cover positions that are relevant for the exposure condition should be considered. For example, covers that slide sideways to support texting are generally not relevant for next to the ear or body-worn accessory use.

[8] See KDB Publication 447498 D01 for further discussion on SAR test exclusion considerations.

[9] Due to the complexity of device configurations for simultaneous transmission SAR measurements in carrier aggregation modes, test code can only be considered on a case-by-case basis after it has been verified through KDB inquiries that the transmission characteristics and device operating conditions are the same as those controlled using coordinated basestation simulators.

bands may be sub-divided into multiple sub-bands to optimize tuning. The frequency band and sub-bands can be tuned with respect to built-in capacitive and switching components that can support a substantially large number of antenna tuning states. In order to reduce the number of SAR tests required to demonstrate compliance for the numerous tuning states, when applicable, certain SAR screening procedures may be considered to identify the higher SAR conditions that need the full set of normally required SAR measurements and allow SAR test reduction for the lower SAR conditions.

As this type of technology continues to evolve and adapt to various phone designs, the SAR screening procedures are expected to vary with design and implementation, When the tuning hardware is separate from the antenna and does not influence antenna performance, depending on the available tuning states, sensing and control mechanisms etc., fast SAR measurement methods such as those used in sensor array systems, the area scan estimated 1-g SAR procedures in KDB publication 447498 D01 or, in some cases, single point SAR measurements may be considered to determine the test configurations that require full SAR measurement to demonstrate compliance. A KDB inquiry with sufficient details is required to determine the acceptable SAR screening and full SAR measurement requirements to support dynamic antenna tuner SAR test reduction.

6. TRANSMITTER AND ANTENNA OPERATING CONFIGURATIONS

In a typical cellphone, the 3G transmitter may operate with one or two antennas to cover the frequency bands for both domestic and international use. The 4G transmitter would generally have one transmit antenna and possibly additional antennas for receive diversity. As phones continue to support more LTE bands; for example, in the 700 MHz, 1700 MHz and 2600 MHz bands, different antenna configurations may be required. In addition to the 3G/4G transmitters and antennas, most phones also support WLAN and Bluetooth operations with additional antenna(s). Some phones may limit the WLAN or 802.11 operations to the 2.4 GHz band only, while others may support both 2.4 GHz and multiple 5 GHz bands. Depending on the implementation, most phones use a single antenna to cover all WLAN operations. Phones may also use a single transmitter module that incorporates both WLAN and Bluetooth, with varying antenna and simultaneous transmission requirements. When hotspot mode applies, a phone may restrict its wireless routing operations to certain 3G/4G transmitter and transmission mode combinations and the WLAN modes could be limited to 2.4 GHz or include only some 5 GHz bands. Among the possible transmitter, antenna and operating mode combinations, some phones may apply additional firmware restrictions to limit certain combinations of simultaneous transmission configurations to satisfy internal interference, SAR or other infrastructure requirements. For phones with Wi-Fi Direct capabilities, when the optional “cross-connection” feature is available and enabled, the device may provide infrastructure access (AP) to other devices under its control as the group leader. This type of unattended operation is transparent to users, which may require additional simultaneous transmission SAR test or exclusion considerations for exposure conditions that would not require Wi-Fi transmissions if the unattended Wi-Fi Direct features were unavailable. It is essential that all these are clearly identified before performing SAR testing, with respect to the head and body exposure conditions required to support the operating modes of a phone. These must also be explained clearly in the SAR report for the test setup and results to be acceptable for supporting compliance. Without clear explanations, the test results alone are insufficient and unacceptable for demonstrating compliance.

7. SIMULTANEOUS TRANSMISSION POWER REDUCTION CONSIDERATIONS

When multiple transmitters operate simultaneously at relatively high maximum output power and at close proximity to users, as the device form factor becomes small the antenna and radiating structures are brought close to each other, the potential for internal interference and higher SAR increases. Smart phone manufacturers have implemented different power reduction techniques to maintain compliance. The maximum output power of transmitters operating in data mode is often reduced or can be pulse-modulated with a periodic duty factor to reduce the time-averaged power during simultaneous transmission to maintain voice call quality and SAR compliance. There are also situations where the

output power for data mode is reduced to mitigate interference concerns for other transmitters and receivers within the phone. In some cases, a fixed level of reduction for maximum output power is applied to specific frequency bands, wireless modes and simultaneous transmission configurations. For other situations that require more flexibility, the power reduction mechanisms can become quite complex and dynamic. The amount of power reduction and combinations of circumstances that require power reduction are often controlled by specific transmit or receive parameters, selected groups of channels within a frequency band or the types of components or accessories that are actively in use during the transmission, etc. These types of power and SAR reduction implementations for simultaneous transmission operations have continued to evolve with no clearly established industry standards. Each implementation generally requires case-by-case consideration, in conjunction with the large combinations of transmitter, antenna, operating mode and simultaneous transmission variations, to determine the test configurations needed to support compliance. Unless the power reduction is for a fixed level according to source-based time averaging requirements and triggered by a specific frequency band or dedicated operation when a simultaneous transmission configuration is enabled for operation, such as hotspot mode or certain SVLTE/SVDO operations, the acceptable test requirements for other power reduction implementations and subsequent variations should generally be determined through KDB inquiries before testing.

8. OPTIONAL BATTERIES, NFC, WIRELESS CHARGING AND SIMILAR ACCESSORIES

Some cellphones may include other functions and capabilities that can influence the SAR characteristics of transmitters in the handset; for example, optional batteries, NFC and wireless charging operations. The hardware required for this type of additional capabilities can be built-in as an integral part of the phone or available as optional accessories from the original phone manufacturer. When the after-market accessories are provided by third-party suppliers, the test and equipment approval considerations in KDB Publication 447498 D01 must be applied, as appropriate, to ensure host devices remain compliant when operating with such accessories.

Phones with built-in NFC, wireless charging or similar functions that do not require separate SAR testing for these specific capabilities can generally be tested according to the SAR measurement procedures normally required for the phone. Influences of the hardware introduced by these built-in accessories and functions are inherently considered through testing of the other transmitters that require SAR evaluation. When these capabilities are provided as aftermarket accessories by the grantee; for example, providing optional batteries or incorporating additional hardware on a battery cover or carrying case (sleeve), influences of the added hardware and impact to the SAR characteristics of the phone must be determined separately for aftermarket accessories. The SAR tests normally required for the phone must be repeated with the accessory to ensure the phone remains compliant. A Class II permissive change may need to be applied.[10]

A handset must be tested according to all required SAR test procedures, without the after-market accessory (additional batteries, battery cover and sleeve, etc.), to demonstrate compliance. For handsets with additional batteries, NFC and wireless charging battery covers or similar accessory (sleeve carrier, etc.), the highest *reported* SAR for each wireless technology (1xRTT, EVDO, WCDMA, GSM, Wi-Fi, etc.), frequency band, operating mode (different modes/configurations within each wireless technology) and applicable exposure condition (head, body-worn accessory, hotspot mode, etc.) without the accessory must be repeated with the specific accessory attached. In addition, for test cases where the measured SAR for a handset without the accessory is greater than 1.2 W/kg, these tests should be repeated with the additional batteries, NFC and wireless charging battery covers or similar accessory.

[10] See KDB Publication 648474 D02 for additional information on evaluation and approval considerations for handsets with wireless charging battery covers.

When there are noticeable changes in SAR distributions for tests with and without the accessory; for example, shifting of the peak SAR location, a KDB inquiry should be submitted to determine if additional SAR tests may be required.

For third-party accessories, such as sleeves, it is necessary to verify the maximum output power and SAR distribution of the handset test sample without the accessory attached, for each wireless mode and exposure condition in each frequency band, to ensure the test sample is acceptable before testing with the accessory. For phones that require proprietary test mode, software or other setup requirements to perform the necessary tests, at the discretion of the phone manufacturer, specific licensing and support agreement is typically necessary for third-party accessory manufacturers to have access to such options to perform the tests. For Wi-Fi SAR measurements, when applicable, publically available apps (application software) that support sustained file transfer with a transmission duty factor > 80% and remain stable for the duration of the SAR measurement may be used with prior FCC confirmation. All SAR results tested without the accessory attached, when adjusted to 100% duty factor at maximum tune-up tolerance, must be within 15% of those reported in the original equipment certification of the phone and remain compliant before testing with the accessory. The test setup and all relevant information must be clearly explained in the SAR report for the results to be acceptable.

When test reduction is applied to evaluate additional batteries and accessories, the standalone SAR results could be insufficient for all configurations to determine simultaneous transmission SAR test exclusion. The highest *reported* SAR for the same test configuration among those measured with and without the accessory should be used to determine simultaneous transmission SAR test exclusion. When power reduction applies, the test configurations required for additional accessories can become quite complex and must be confirmed through KDB inquiries and clearly explained in the SAR report.

9. VOIP SUPPORT

As wireless infrastructures continue to migrate from 3G to 4G, VOIP is expected to become a standard built-in feature for most smart phones. When a phone supports VoIP through carrier networks, SAR evaluation for head and body-worn accessory exposure conditions is required. The required SAR test procedures and wireless operating configurations required by the *published RF exposure KDB procedures* for the specific wireless technology to support VoIP operations should be applied for SAR testing. When it is unclear, a KDB inquiry should be submitted to determine the test configurations.

In addition to built-in VoIP support through wireless carriers, users of smart phones can typically download apps (application software) to enable other VoIP functionalities. When third-party apps are provided or endorsed by the handset manufacturer or wireless carriers to support VoIP operations, the exposure conditions for these features should also be considered for SAR testing. The operating characteristics of other user acquired third-party VoIP apps are not standardized. When the additional features are not supplied as an integral part of the phone or supported by the original equipment manufacturer or the wireless carrier; it is generally difficult to test this type of user acquired ad hoc features consistently. For some phones, the manufacturer may choose to block certain incompatible 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 most appropriate wireless data mode configurations. When SAR results are unavailable to demonstrate compliance for user acquired third-party ad hoc VoIP apps, user disclosure through clear and conspicuous instructions are required. Users must be advised that these features cannot be blocked or disabled without impacting the normal functionalities of the phone and have not been tested for RF exposure compliance; therefore, they are not recommended and must be avoided.

10. SAM PHANTOM LIMITATIONS

The antennas of recent generation phones are typically incorporated near the sides and along edges of the phone. Occasionally, a phone with antennas located near the bottom or lower side edges may have peak SAR locations near the mouth and jaw regions or along the steep curved surfaces of the SAM phantom

where SAR probe access is not feasible with a horizontally configured SAM phantom. It has been known for some time that there are also other SAR measurement difficulties in the tight regions of the SAM phantom with no easy solution. SAR probes are calibrated in tissue-equivalent medium with sufficient separation between the probe sensors and nearby physical boundaries to ensure field scattering does not affect the probe calibration. When the probe tip is positioned in tight areas, such as in the mouth and jaw regions of the SAM phantom, with multiple boundaries surrounding the probe sensors, the probe calibration and measurement accuracy can become questionable. In addition, measurements near these locations with steep curvatures may require a probe to be tilted at steep angles that may no longer comply with the required calibration requirements and measurement protocols for maintaining measurement accuracy and uncertainty. For some situations, it is just not feasible to tilt the probe without using a rotated SAM phantom that are specifically constructed to enable probe access below the cheek and near the jaw area.[11] When a rotated SAM phantom is not used, the measured SAR distribution is often clipped and showing only part of the SAR distribution under consideration.

To ensure there is sufficient conservativeness for demonstrating compliance and until practical solutions are available, other than acquiring multiple phantoms, additional measurements are necessary to address these difficulties. When measurements are required in regions with probe access difficulties or along steep curved surfaces of the SAM phantom, the measured SAR distribution is often truncated. Measurements with truncated SAR distributions may be repeated using a properly rotated SAM phantom; however, the rotated SAM configuration is generally unacceptable when measurements are required inside the mouth or jaw where there are probe calibration concerns. Under these circumstances, when rotated SAM phantoms are unavailable or there could be SAR probe calibration concerns, 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 flat phantom shell. While maintaining this distance at the ERP location of the phone, the low (bottom) edge of the phone is lowered from the phantom to establish the same separation distance at the peak SAR location identified by the truncated partial SAR distribution measured with the SAM phantom. The distance from the peak SAR location to the phone should be determined by the straight line passing perpendicularly through the phantom surface. The coordinates of the peak SAR location can be determined with respect to the ERP location by adapting the SAR peak location separation ratio procedures used for simultaneous transmission SAR test exclusion and other graphical tools available in the SAR measurement system. If it is not feasible to maintain 4 mm separation at the ERP while establishing the required separation at the peak SAR location, the top edge of the phone should be allowed to touch the phantom and, as necessary, with a separation < 4 mm at the ERP. If the peak SAR location is not identifiable in 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 using area scans and the position corresponding to the peak location with the smallest distance between the phone and the phantom is applied to all enlarged zoom scan measurements using the flat phantom.

[11] The tissue-equivalent liquid depth requirement for rotated SAM phantom is described in 2.5 of KDB Publication 865664 D01.

Change Notice

5/28/2013: 648474 D04 Handset SAR v01r01 replaces 648474 D04 SAR Handsets Multi Xmiter and Ant v01: Relevant comments for 04/05/2013 draft have been taken into consideration.

12/04/2013: 648474 D04 Handset SAR v01r02 replaces 648474 D04 Handset SAR v01r01: Revised phablet procedures to account for power reduction in hotspot mode to apply SAR test reduction.

10/23/2015: 648474 D04 Handset SAR v01r03 replaces 648474 D04 Handset SAR v01r02: Updated references to latest IEEE Std 1528-2013 with IEEE Std 1528-2013, included SAR screening considerations for dynamic antenna tuners and other minor updates.