



**Federal Communications Commission
Office of Engineering and Technology
Laboratory Division**

**SAR Evaluation Procedures for Portable Devices with
Wireless Router Capabilities**

This document describes the SAR test requirements for certain wireless devices with the capability to enable wireless router functions for use in portable RF exposure conditions. Wireless router functions are often called hotspot mode by users and test laboratories. The wireless routing capabilities described in this document are implemented using transmitters that are built-in or physically attached to a wireless device, such as battery operated personal wireless routers, wireless handsets or devices of similar capabilities, with a form factor $> 9 \text{ cm} \times 5 \text{ cm}$ ($\sim 3.5'' \times 2''$). This allows a hotspot capable device to provide internet access for multiple compatible devices in its neighborhood by redirecting wireless traffic between a short range transmitter and an available long range transmitter. This wireless mode is distinct from the hotspot functionality provided by access points in business or commercial environments.

Devices with hotspot functions transmit simultaneously through multiple transmitters. The wireless traffic is typically routed between a Wi-Fi connection and an available 3G connection. For handsets using technologies such as UMTS or GSM with DTM, hotspot transmissions may continue when voice calls are in progress. Depending on the transmitter and antenna paths used in the different wireless modes for voice and data transmissions, up to 4 transmitters can transmit simultaneously. For example, traffic may be routed between Wi-Fi and LTE/EVDO/WiMax connections while a voice call is routed from a UMTS/1xRTT/GSM connection to a Bluetooth headset. The simultaneous transmission and operating configurations for head, body-worn accessories, and other product specific use conditions can become quite complex. In general, RF exposure for hotspot mode is not limited to body-worn accessory use conditions only. While the exposure evaluation for some handsets with hotspot capabilities may partially overlap with body-worn accessory SAR test requirements, the tests intended for either exposure categories are normally insufficient to cover both.

Voice calls from handsets and similar devices are “attended” transmissions initiated or accepted by users. Hotspot mode transmissions are “unattended” and may be transparent because users normally do not know which transmitters and wireless mode are transmitting at any particular time. Data from hotspot clients can be transmitted concurrently through a hotspot enabled device while the user is texting or web-browsing; therefore, hand-held and other near-body exposure conditions also need consideration. Since this type of device related use conditions can have substantial variations, combined considerations are necessary to streamline SAR test requirements.

The procedures in this document are required for devices with hotspot mode capabilities to qualify for TCB approval. A PBA is required when different test procedures are used. A test distance greater than 10 mm requires the equipment approval applications to be filed directly with the Commission, as required by the TCB Exclusion List (see KDB 628591). Permissive change filings to enable hotspot

mode for devices already in use, through software/firmware changes and field upgrades, must also be filed at the FCC for approval.

General SAR test requirements for hotspot mode

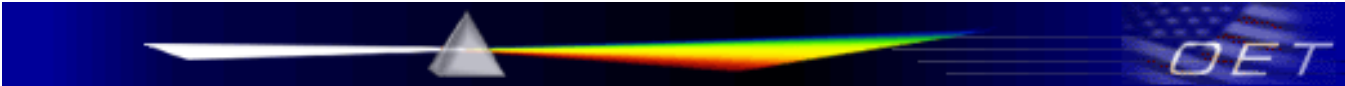
A standard composite test separation distance of 10 mm has been established for testing hotspot mode related exposure conditions. This test distance addresses the near-body exposure conditions for standalone wireless routers and handsets that allow hotspot mode to operate in other than head and body-worn accessory use conditions. Because of varying operating configurations and exposure conditions, the 10 mm test distance is not suitable for testing devices that require a host to operate; for example, peripheral transmitter cards and dongles. Since hand and near-body exposures can both be addressed by the 10 mm 1-g SAR, separate 10-g hand SAR evaluation at zero separation is not necessary. For devices with form factors smaller than 9 cm x 5 cm, a test separation distance of 5 mm or less must be used to qualify for TCB approval; otherwise, a KDB inquiry must be submitted to determine the acceptable test requirements.

The hotspot mode SAR results are used to determine simultaneous transmission SAR test exclusion and volume scan requirements. For handsets, the simultaneous transmission configurations for head, body-worn accessory, hotspot mode and other use conditions must be addressed separately to qualify for SAR test exclusion. When hotspot mode is tested according to the 5 or 10 mm requirements and simultaneous transmission SAR compliance has been addressed by SAR exclusion and/or volume scan measurements, for the applicable head, body-worn accessory and other use conditions, no additional information regarding RF exposure compliance for hotspot mode use is required in the user manuals. However, the separation distance required for body-worn accessories to comply with RF exposure requirements must be fully disclosed, conspicuously in instruction manuals, to enable users to acquire suitable body-worn accessories.

Hotspot mode SAR test requirements for hand-held and other near-body use conditions

Standalone personal wireless routers and handsets with hotspot mode capabilities must address hand-held and other near-body exposure conditions to show SAR compliance. The following procedures are applicable when the overall device length and width are ≥ 9 cm x 5 cm respectively. A test separation of 10 mm is required. SAR must be measured for all sides and surfaces with a transmitting antenna located within 25 mm from that surface or edge, for the data modes, wireless technologies and frequency bands supporting hotspot mode. The standalone SAR results in each device test orientation must be analyzed for the applicable hotspot mode simultaneous transmission configurations to determine SAR test exclusion and volume scan requirements. The simultaneous transmission configurations must be clearly described in the SAR report to support the analyses or test results. When the device form factor is smaller than 9 cm x 5 cm, unless a test separation distance of 5 mm or less is used a KDB inquiry is required to determine the acceptable test distance.

For battery operated standalone wireless routers that allows external or peripheral transmitter(s), such as an approved USB dongle or ExpressCard, to provide hotspot mode support, a 1-g SAR of 1.6 W/kg must be assumed for such transmitters to qualify for simultaneous transmission SAR test exclusion. For USB dongles, the analysis must assume the peak SAR location is at 1 cm or less from the USB connector.



For transmitter cards, the analysis must assume the peak SAR location is at the edge of the router centered along the plug-in card slot. When the maximum average conducted power of the built-in transmitter; for example, a Wi-Fi, is less than $60/f_{(\text{GHz})}$ mW and SAR measurement is not required, zero W/kg should be assumed for that built-in transmitter to apply the sum of 1-g SAR exclusion; otherwise, SAR to peak location ratio must be used to determine simultaneous transmission SAR exclusion.

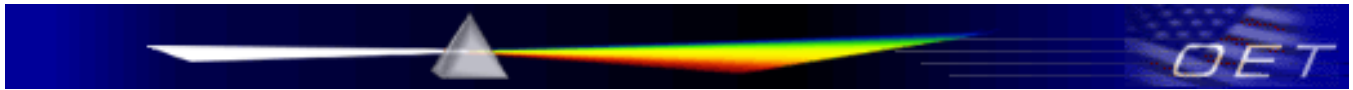
Head and body-worn accessory SAR test requirements for handsets with hotspot mode

When hotspot mode use is not restricted during voice calls, SAR compliance must be addressed for the simultaneous voice and hotspot data configurations in head and body-worn accessory use conditions.¹ Depending on the transmitter and antenna paths used by the wireless modes and technologies in a handset, different simultaneous voice and data combinations may apply. For example, when voice and data modes in 1xRTT and EVDO or GSM and GPRS are operating from the same transmitter, simultaneous voice and data transmissions are typically not supported; therefore, hotspot mode operations are not feasible with EVDO or GPRS when 1xRTT or GSM voice calls are in progress. When separate transmitters are used for voice and hotspot mode, simultaneous transmission of voice and hotspot data can occur. For example, hotspot data may be transmitted concurrently through a EVDO, LTE or WiMAX transmitter when voice calls are routed through a separate UMTS or 1xRTT transmitter. Simultaneous voice and hotspot data is also feasible for GSM/GPRS handsets with DTM by using additional time slots. These technology and implementation dependent voice and hotspot data configurations for head and body-worn accessory use conditions must be addressed for SAR compliance. The standalone head and body-worn accessory SAR data for the applicable voice and data configurations in each wireless mode and frequency band should be analyzed separately to determine simultaneous transmission SAR test exclusion according to the procedures in KDB 648474.

When the same wireless modes and device transmission configurations are required for testing body-worn accessories and hotspot mode, it is not necessary to test body-worn accessory SAR for the same device orientation (typically the back of the handset) if the test separation distance for hotspot mode is more conservative than that used for body-worn accessories. When body-worn SAR is not required and unavailable for the particular device test orientation(s), the more conservative hotspot mode SAR must be used to determine compliance for body-worn accessory and also hotspot mode simultaneous transmission SAR test exclusion in body-worn accessory use conditions. On the other hand, if the body-worn accessory test conditions are more conservative than that required for hotspot mode, the body-worn SAR may be used to determine compliance for hotspot mode; therefore, hotspot mode SAR is not necessary for that particular device test orientation.

The body-worn accessory use conditions for today's smart phones are primarily intended for voice mode operations when the phone is carried in a qualified body-worn accessory and users are given full disclosure to acquire body-worn accessories that satisfy the separation distance required for SAR compliance. When hotspot mode is available in body-worn accessory use configurations, both voice and data transmissions must be taken into consideration to determine simultaneous transmission SAR test exclusion or volume scan requirements. The range of test separation distances documented in Supplement C 01-01 for testing body-worn accessories is 0 – 25 mm. In general, the body-worn

¹ Some devices have used hardware or firmware control to restrict hotspot mode use in selected wireless modes, frequency bands, operating configurations or exposure conditions.



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accessory test distance required to support compliance must be based on the types of accessories supplied with the phone or those available off-the-shelf, according to the form factor and operating characteristics of the individual phone model. The grantee is responsible for determining the body-worn accessory test distance required for the types of accessories available, according to the form factor and use conditions of a phone model to demonstrate compliance.

