

Federal Communications Commission  
Office of Engineering and Technology

Title: Mobile and Portable Device - RF Exposure Procedures and Equipment Authorization Policies

Short Title: Mobile Portable RF Exposure

Reason: This document contains two attachments under Draft Review for publication 447498 to replace the current published attachments 447498 D01 Mobile Portable RF Exposure v03r03 and 447498 D02 SAR Procedures for Dongle Xmtr v01.

Publication:

Draft For Review: 447498

Rule Parts:

Keyword:

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First Category: Radio Frequency (RF) Exposure

Second Category: General RF Safety Questions

Third Category:  
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Question:

What are the RF exposure requirements and procedures for mobile and portable devices?  
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Answer:

Mobile and portable device RF exposure and equipment authorization requirements are in FCC rule Sections 1.1307, 2.1091, 2.1093.

Attachment below - 447498 D01 Mobile Portable RF Exposure v03r03 - provides clarification pertaining to RF exposure requirements for mobile and portable device equipment authorizations.

Attachment below - 447498 D02 SAR Procedures for Dongle Xmtr v01 - provides guidance for SAR testing of USB dongle transmitters.

In addition, refer to the most recent Telecommunications Certification Body (TCB) Exclusion List for equipment that cannot be certified by a Telecommunications Certification Body for Specific Absorption Rate (SAR) RF exposure evaluations. The current TCB Exclusion List is Publication Number 628591. . A Mobile Multi-transmitter MPE Estimation [XLS] MPE spreadsheet is available at: <http://www.fcc.gov/oet/ea/presentations/files/oct05/MPE-mobile.xls> for estimating MPE limits for multiple antennas.

Attachment List:

[447498 D01 Mobile Portable RF Exposure v04, Date](#)

[447498 D02 SAR Procedures for Dongle Xmtr v02 ,Date](#)



**Attachment 1 (447498 D01 Mobile Portable RF Exposure v04)**

**Mobile and Portable Device**

**RF Exposure Procedures and Equipment Authorization Policies**

This document identifies certain RF exposure evaluation procedures and requirements and equipment authorization policies for mobile and portable devices.<sup>1</sup> It replaces preceding versions of this KDB and should be used in conjunction with other FCC policy and procedure documents.<sup>2</sup> Unless otherwise specified, the power thresholds in this document are applied with respect to the source-based time-averaged output power defined in §§ 2.1091(d)(2) and 2.1093(d)(5) of the rules. While certain simultaneous transmission issues have been addressed in *specific FCC test procedures*, RF exposure evaluation considerations for other product configurations are still necessary.<sup>3</sup> As products and technologies continue to evolve, the FCC Laboratory should be contacted using the OET-Lab Knowledge Database ([www.fcc.gov/labhelp](http://www.fcc.gov/labhelp)) about additional procedures and specific test requirements.

**1) General test requirements and specific FCC test procedures**

- a) When required, portable devices must be evaluated using the *specific FCC test procedures*, and the SAR measurement techniques of OET Bulletin 65 Supplement C 01-01 and IEEE Std 1528-2003.
- b) When routine evaluation is required for SAR and the output power is  $\leq 60/f_{(\text{GHz})}$  mW, the test reduction and test exclusion procedures given herein, or in KDB 616217 and its supplement or KDB 648474, are applicable.<sup>4</sup>
- c) Unless excluded by *specific FCC test procedures*, portable devices with output power  $> 60/f_{(\text{GHz})}$  mW shall include SAR data for equipment approval. The FCC Laboratory may be contacted if SAR is expected to be very low, especially for devices operating below 300 MHz, to determine if SAR evaluation is necessary.<sup>5</sup>
- d) When applicable, 802.11 a/b/g devices should be tested according to the antenna diversity procedures in KDB 248227.<sup>6</sup> Contact the FCC Laboratory for antenna diversity test requirements, such as MIMO and beam-forming, in other product configurations.

<sup>1</sup> RF exposure evaluation includes measurement or computational modeling of field strength, power density, or SAR for devices subject to MPE or SAR limits. For mobile devices that are categorically excluded from routine evaluation, simple calculations may be used to estimate the field strength or power density to determine minimal antenna-to-user separation distances.

<sup>2</sup> Other equipment authorization policies and procedures include items in the TCB Exclusion List (KDB 628591), OET Bulletin 65 and Supplement C 01-01, procedures at FCC OET Measurement Techniques ([www.fcc.gov/oet/ea/eameasurements.html](http://www.fcc.gov/oet/ea/eameasurements.html)), and in other KDB Publications ([www.fcc.gov/labhelp](http://www.fcc.gov/labhelp)).

<sup>3</sup> The *specific FCC test procedures*, identified by KDB Publication numbers, are available using links at the website ([www.fcc.gov/oet/ea/eameasurements.html](http://www.fcc.gov/oet/ea/eameasurements.html)). SAR measurement procedures presently available from this website are those for 3GPP/3GPP2 devices (KDB 941225), 802.11 a/b/g devices (KDB 248227), laptop computers (KDB 616217), notebook/netbook (Supplement to KDB 616217) and cell phones (KDB 648474) with multiple transmitters, 3 - 6 GHz devices (KDB 865664) and system accuracy verification (KDB 450824).

<sup>4</sup> See footnote 3, *supra*.

<sup>5</sup> This provision applies to portable devices that are designed with large antenna-to-user separation distances such that the SAR is expected to be  $< 0.2$  W/kg at the specified operating frequency and power level.

<sup>6</sup> See footnote 3, *supra*.

- e) When the SAR procedures require multiple channels to be tested and the 1-g SAR for the highest output channel is less than<sup>7</sup>
  - i) 0.8 W/kg, where the transmission band corresponding to all channels is  $\leq 100$  MHz, testing for the other channels is not required; or
  - ii) 0.4 W/kg, where the transmission band corresponding to all channels is  $\leq 200$  MHz, testing for the other channels is not required.
- f) Test reports should only include data for the test configurations that are required to demonstrate compliance to the FCC rules. Test results that are not required, but included with prior FCC confirmation, must be identified and documented in test reports as inapplicable data that has not been considered for FCC equipment certification.
- g) Installation and operating instructions as required by §§ 2.1033(b)(3) and 2.1033(c)(3) are necessary for installers, integrators and end users to comply with mobile and portable transmitter exposure requirements.

## 2) **Transmitters and modules for use in portable exposure conditions that do not require SAR evaluation for simultaneous transmission**

- a) Unlicensed intentional radiators and licensed devices can be approved as either a transmitter or a module for use in stand-alone portable exposure conditions that do not allow simultaneous transmission.<sup>8,9</sup> Based on the SAR or output power level, the following three conditions may be applied; otherwise, the provisions of item 2) c) should be considered. When SAR is evaluated using the procedures in item 2) b), additional stand-alone SAR evaluation is not required to incorporate the transmitter into final products based on procedures contained herein, or in KDB 616217 and its supplement or KDB 648474, when simultaneous transmission SAR evaluation is not required for the transmitter.<sup>10</sup>
  - i) A device may be used in portable exposure conditions with no restrictions on host platforms when either the source-based time-averaged output power is  $\leq 60/f_{(GHz)}$  mW or all measured 1-g SAR are  $< 0.4$  W/kg.<sup>11</sup> When SAR evaluation is required, the most conservative exposure conditions for all expected operating configurations must be tested.
  - ii) A device may be approved for use in multiple host platforms, each with similar family attributes, for example, PDA, notebook/netbook/laptop and tablet computers, when each host platform is tested in the most conservative exposure conditions and the 1-g SAR is  $< 0.8$  W/kg for all configurations.

<sup>7</sup> This enables the number of frequency channels required for testing in section 6 (c) to be reduced without the need for a KDB inquiry or PBA.

<sup>8</sup> Other equipment authorization requirements, such as limited modular approval (§ 15.212(b)) and composite system (§ 15.31(k)) may also apply.

<sup>9</sup> Stand-alone portable exposure conditions apply to single or multiple transmitters that do not transmit simultaneously.

<sup>10</sup> See footnote 3, *supra*.

<sup>11</sup> A device can be a transmitter, a module or a final product by itself.

- iii) A device may be approved for use in a single platform when all hosts within the same platform have the same operating configurations and exposure conditions, with only minor configuration and construction differences. The most conservative exposure conditions among all host configurations within the platform must be fully tested using the procedures in item 2) b) according to the required platform test configurations, such as those in item 4); the remaining less restrictive exposure conditions and host configurations may apply (see the procedures in item 1) e). The 1-g SAR must be  $< 1.2$  W/kg for all configurations.
- b) The conditions of item 2) a) are established using the following SAR procedures:
  - i) The antenna(s) and radiating structures must be tested for each host platform and device configuration according to the minimum separation distance expected for all applicable operations.
    - (1) Devices that can be connected to a host through a cable must be tested with the device positioned in all applicable orientations against the flat phantom.<sup>12</sup>
    - (2) Devices without built-in mechanisms, such as a permanent housing, to provide a fixed minimum separation distance from users, must be tested with the antenna(s) and radiating structures in direct contact against the flat phantom.
    - (3) Devices connected to built-in, non-extendable interfaces, such as CardBus or SDIO, must be tested according to the minimum separation distance required for the host and device configurations.<sup>13</sup> Contact the FCC Laboratory for other interface and host device test requirements.
  - ii) The test configuration with the highest 1-g SAR for each host platform and device configuration, evaluated in items 2) a) and 2) b), must be used to determine if additional SAR evaluation is required due to enhanced energy coupling at increased separation distances.
    - (1) The probe tip is positioned at the peak SAR location determined in item 2) b) ii), at a distance of one half the probe tip diameter from the phantom surface. With the probe fixed at this location, the device is moved away from the phantom in 5 mm increments from the initial touching or minimum separation position. A single point SAR is measured for each of these device positions until the SAR is less than 50% of that measured at the initial position.
    - (2) When the device position in item 2) b) ii) (1) with the highest point SAR is  $> 25\%$  of that measured at the initial position, a complete 1-g SAR evaluation is required for this configuration.
  - iii) Installation and operating requirements, including restrictions, for the condition(s) of item 2) a) and host platform(s) approved in the equipment authorization must be

<sup>12</sup> A separation distance  $\leq 0.5$  cm is required for USB-dongle transmitters. Contact the FCC Laboratory concerning requirements for other device form factors and interfaces.

<sup>13</sup> A separation distance  $\leq 1.0$  cm is required for this type of interface module used in laptop computers; a separation distance  $\leq 0.5$  cm is required for PDA and similar platforms. The distance is measured from the module to the surface of a flat phantom.

provided to OEM integrators and end users to comply with RF exposure requirements.

- c) When the maximum 1-g SAR is  $\geq 1.2$  W/kg, a PBA is required for TCB approval. In addition, the transmitter or module may need to be tested and approved for the operating configurations and exposure conditions of a dedicated host device. Devices that can be connected to multiple hosts by the user may need to adjust the design to meet SAR requirements.<sup>14</sup> An inquiry should be submitted to the FCC Laboratory to determine if certain options are applicable and acceptable.

### 3) Transmitters and modules for use in portable exposure conditions that allow simultaneous transmission

- a) Except during network hand-offs where the maximum hand-off duration is less than 30 seconds, simultaneous transmission applies when there is overlapping transmission. SAR is evaluated for simultaneous transmission using volume scan measurements.<sup>15</sup>
- b) SAR is not required for the following simultaneous transmission conditions<sup>16</sup>
- i) When excluded by the procedures in KDB 616217 and its supplement or KDB 648474.<sup>17</sup>
- ii) When specific requirements for simultaneous transmission SAR evaluation have not been established for the host platform or device configuration:
- (1) for the antennas that are located  $< 5$  cm from persons, where
- (a) The closest antenna separation distance is  $\geq 5$  cm for all simultaneous transmitting antennas within the host or device; and
- (b) The sum of the 1-g SAR is  $< 1.6$  W/kg for all simultaneous transmitting antennas that require stand-alone SAR evaluation or the SAR to peak location separation ratios are  $< 0.3$  for all simultaneous transmitting antenna pairs;<sup>18</sup> and
- (c) The output power is  $\leq 60/f_{(\text{GHz})}$  mW for any simultaneous transmitting antenna(s) for which stand-alone SAR evaluation is not required.
- (2) for the antennas that are located  $\geq 5$  cm from persons, contact the FCC Laboratory to determine if the simultaneous transmission SAR exclusion procedures for notebook/netbook/laptop computers in KDB 616217 and its supplement may be applied.<sup>19</sup>

<sup>14</sup> This provision applies to devices with high SAR and users can freely operate such devices in different hosts where SAR may change due to design and operating variations.

<sup>15</sup> Volume scan SAR measurement requirements are described in KDB 616217 and KDB 648474.

<sup>16</sup> See TCB Exclusion List (KDB 628591) regarding certification requirements when simultaneous transmission SAR evaluation is required.

<sup>17</sup> See footnote 3, *supra*.

<sup>18</sup> SAR to peak location separation ratio is defined in KDB 648474.

<sup>19</sup> See footnote 3, *supra*.



- c) The operating and installation requirements, including restrictions, must be provided for OEM integrators and end users to comply with simultaneous transmission SAR requirements.

#### 4) SAR test positions and requirements for specific host platforms and exposure conditions

- a) Antennas installed in the keyboard or base sections of laptop or convertible tablet computers are evaluated in *Laptop Mode* with the bottom of the computer in direct contact against a flat phantom and the display open to the perpendicular (90°) position.<sup>20</sup> The simultaneous transmission test requirements in item 3) b) ii) (1) may be applied to the keyboard section of laptop computers.
- b) The following procedures are applicable to tablet computers with antennas installed along the tablet edges while operating in *Tablet Mode*.<sup>21</sup> When the output power of an antenna is  $> 60/f_{(\text{GHz})}$  mW, SAR is required for both bottom face and edge exposure conditions.
  - i) Each antenna is evaluated for bottom face exposure with the base of the tablet in direct contact with a flat phantom. Convertible tablets must be tested in normal use conditions with the display folded on top of the keyboard section. The simultaneous transmission test requirements in item 3) b) ii) (1) may be applied to tablet computers in this operating mode.
  - ii) Antennas installed along the edges of a tablet are each evaluated with the corresponding edge in direct contact with a flat phantom. The applicable edge configurations include: (A) one fixed display orientation in either portrait or landscape configuration; (B) two fixed display orientations with one in portrait and one in landscape configurations; and (C) multiple display orientations supporting both portrait and landscape configurations.
    - (1) For edge configuration (A): SAR is required for each antenna located within 5 cm of the tablet edge closest to the user for the applicable display orientation. For antenna(s) located  $\geq 5$  cm from this edge, the test reduction and exclusion procedures for laptop computers in KDB 616217 are applied.<sup>22</sup>
    - (2) For edge configurations (B) and (C): The procedures for edge configuration (a) are applied to each antenna, for the applicable display orientations where the corresponding edge is closest to the user. For each antenna, SAR is required only for the edge with the most conservative exposure condition.

<sup>20</sup> Tablet computers are constructed either with the keyboard and display in a single section (“slate” type), or in two hinged sections (“convertible” type) where the display can be folded onto the keyboard section or unfolded like a laptop computer. For testing purposes, *Laptop Mode* is defined as the operating configuration where the display is open perpendicular to and facing towards the keyboard.

<sup>21</sup> For testing purposes, *Tablet Mode* for a convertible tablet computer is defined as the operating configuration where the display is folded over onto the keyboard section and facing outwards. The display orientation may be switched between portrait or landscape configurations for both slate and convertible tablets, allowing one or more of the tablet edges to become closest to the user during normal use.

<sup>22</sup> See footnote 3, *supra*.

- iii) For each edge positioned closest to the user, simultaneous transmission SAR evaluation is not required when the simultaneous transmitting antennas along that edge are:
  - (1) located  $< 5$  cm from the edge and the sum of the stand-alone 1-g SAR is  $<$  the SAR limit for these antennas or the SAR to peak location separation ratios are  $< 0.3$  for all antenna pairs.<sup>23</sup>
  - (2) located  $\geq 5$  cm from the edge and the simultaneous transmission SAR exclusion procedures for laptop computers in KDB 616217 and its supplement are applicable.<sup>24</sup>
- c) Extremity and body SAR evaluation considerations
  - i) PDA, UMPC (Ultra-Mobile PC), and devices with similar form factor and configurations that allow next to the ear transmissions are tested according to the handset procedures in IEEE Std 1528-2003, OET Bulletin 65 Supplement C 01-01 and the *specific FCC test procedures*.
  - ii) Devices that allow transmissions while worn next to the body using an accessory are tested with the device and associated accessories in all applicable orientations, at the minimum separation distance, using a flat phantom.
  - iii) Contact the FCC Laboratory to determine whether:
    - (1) Hand SAR is required for hand-held and hand-operated devices with output power  $> 1000 \cdot [f_{(\text{GHz})}]^{-0.5}$  mW that are designed with the hand operating closer than 5 cm from the antenna during normal use.<sup>25</sup>
    - (2) Extremity SAR is required for wrist, feet or ankle worn devices.
    - (3) Body SAR is required for hand-held and hand-operated or wrist, feet and ankle worn devices that operate closer than 5 cm to the body and the output power is  $> 300 \cdot [f_{(\text{GHz})}]^{-0.5}$  mW.
  - d) The simultaneous transmission SAR evaluation procedures for cell phones in KDB 648474 may be applied to antennas that are built-in within a PDA or UMPC.<sup>26</sup> Contact the FCC Laboratory for other devices having similar packaging and form factors.

## 5) Push-to-talk (PTT) devices<sup>27</sup>

- a) RF exposure is evaluated with a duty factor of 50% when the actual operating duty factor is  $\leq 50\%$ .<sup>28</sup> Devices supporting higher duty factors shall be evaluated at the maximum duty factor; for example, devices supporting operator-assisted PSTN calls. Contact the

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<sup>23</sup> See footnote 18, *supra*.

<sup>24</sup> See footnote 3, *supra*.

<sup>25</sup> Hand-held and hand-operated devices are inherently designed to only transmit while operated in the user's hands.

<sup>26</sup> See footnote 3, *supra*. The cellphone procedures in KDB 648474 may apply when the same types of transmitters described in the procedures are used and next to the ear, head exposure conditions, does not apply.

<sup>27</sup> These provisions are limited to radios with a mechanical PTT button and no other operating modes.

<sup>28</sup> Transmit and receive duty factors of PTT devices are generally considered to be 50%.



FCC Laboratory when unable to test a device at the required duty factor due to hardware limitations or other reasons.

b) Portable PTT devices

- i) The power thresholds and operating conditions in Table 1 are used to determine SAR test requirements for PTT radios required to comply with the general population exposure limit. When the occupational exposure limit applies, these power thresholds are increased by a factor of five (5) to determine the test requirements. SAR is required for PTT devices with maximum output power greater than these thresholds.<sup>29</sup> SAR evaluation is also required for separation distances smaller than those in Table 1. Contact the FCC Laboratory to determine if SAR evaluation is necessary for other frequencies or when the SAR is very low.

**Table 1 - SAR Evaluation Power Thresholds for PTT devices,  $f \leq 0.5$  GHz**

<b>Exposure Conditions</b>	<b>mW</b>
<b>Held to face <math>\geq 2.5</math> cm</b>	250
<b>Body-worn <math>\geq 1.5</math> cm</b>	200
<b>Body-worn <math>\geq 1.0</math> cm</b>	150

Notes:

1. The time-averaged output power, corresponding to the required PTT duty factor, is compared with these thresholds.
2. The closest distance between the user and the device or its antenna is used to determine the power thresholds.

- ii) Additional SAR evaluation with a SAM phantom is required for PTT devices with held-to-ear operating mode.<sup>30</sup> Contact the FCC Laboratory for device operating and test configurations.

**6) Test Reduction Considerations**

- a) For devices operating with passive accessories, such as optional/additional batteries, body-worn or other audio accessories that are not primary radiating elements, but can introduce SAR changes, a manufacturer may submit an inquiry to the FCC Laboratory to request for test reduction prior to commencement of testing. The KDB inquiry should at least include:
  - i) a detail test plan based on the SAR impact of each accessory
  - ii) a detailed explanation of the features and parameters considered; for example, material, construction, separation distance and similarity etc

<sup>29</sup> PTT radios should be tested according to procedures described in the “Body-Worn and Other Configurations” section of OET Bulletin 65 Supplement C 01-01 (Appendix D).

<sup>30</sup> See footnote 27, *supra*.

- b) Devices with multiple and optional antennas do not qualify for the same test reduction intended for passive accessories. Since antennas are primary radiating elements, each antenna must be tested independently to determine the highest exposure conditions and the highest exposure configuration tested for each antenna should be used to determine the possible test reduction for the accessories used with that antenna
- c) When the number of test frequencies or specific frequency channels are not specified in the FCC procedures or KDB publications, the following equation should be used to determine the number of required test channels to ensure sufficient frequency channels have been tested for the frequency range and transmission bandwidth used for the transmitter. A KDB inquiry is required to determine if a reduced number of channels may be used for testing an if a PBA is required for TCB approval
  - i)  $N_c = \text{Round} \left[ 100 \left( \frac{f_{\text{high}} - f_{\text{low}}}{f_c} \right)^{0.5} \times \left[ \frac{f_c}{100} \right]^{0.2} \right]$ ; where  $N_c$  is the number of test channels,  $f_{\text{high}}$  and  $f_{\text{low}}$  are the highest and lowest frequencies within the transmission band and  $f_c$  is the mid-band frequency.

## 7) Stand-alone mobile devices<sup>31</sup>

- a) When routine evaluation is required, MPE measurement or computational modeling is used to show compliance for § 2.1091(c).
- b) For transmitters that are categorically excluded by § 2.1091(c), a separation distance smaller than that provided by conservative MPE estimates (simple calculations) may be used when justified according to MPE measurement or computational modeling results, provided the smaller distance is applicable for the operation of the transmitter and its antenna(s).
- c) A minimum separation distance of 20 cm is required and must be supported by the operating and installation configurations of the transmitter and its antenna(s).

## 8) Transmitters and modules for use in mobile exposure conditions that allow simultaneous transmission

- a) Transmitters and modules certified for mobile or portable exposure conditions and categorically excluded by § 2.1091(c) can be incorporated in mobile host devices without further testing or certification when:
  - i) The closest separation among all simultaneous transmitting antennas is  $\geq 20$  cm;<sup>32</sup> or
  - ii) The antenna separation distance and MPE compliance boundary requirements that enable all simultaneous transmitting antennas incorporated within the host to comply with MPE limits are specified in the application filing of at least one of the certified transmitters incorporated in the host device.<sup>33</sup> In addition, when transmitters

<sup>31</sup> A stand-alone mobile device may contain a single transmitter, or multiple transmitters that do not transmit simultaneously.

<sup>32</sup> The term “antennas” includes all antennas and radiating structures that may influence exposure compliance.

<sup>33</sup> Each transmitter must comply with the operating requirements and restrictions for all transmitters incorporated within the host. When routine evaluation is not required, MPE compliance requirements for simultaneous transmission can often be estimated for certain generic or specific configurations according to antenna output power, antenna-to-antenna and antenna-to-user separation

certified for portable use are incorporated in a mobile host device the antenna(s) must be  $\geq 5$  cm from all other simultaneous transmitting antennas. All antennas must be at least 20 cm from users and nearby persons.

**9) Use of occupational and general population limits and exposure conditions**

- a) Occupational exposure limits generally do not apply to consumer devices and radio services supporting public networks and unlicensed frequencies.
- b) RF exposure training instructions and labeling are required for users to comply with the occupational exposure requirements. Information must be included in the equipment authorization application to ensure that occupational exposure limits are only applied to “work-related” conditions, where users must be “fully aware of” and be able to “exercise control over” their exposure to qualify for the higher exposure limits.
- c) Occupational training and labeling are not required for devices that comply with the general population exposure limits.

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distances to establish the required separation distances and compliance boundary for the specified exposure conditions. A compliance boundary is the perimeter that provides the required user separation distances in all directions surrounding the antennas where MPE limits are met for simultaneous transmission.

Change Notice:

447498 D01 Mobile Portable RF Exposure v03r01 has been changed to a new revision under the same Version: 447498 D01 Mobile Portable RF Exposure v03r02

Page 4: 3 (b) (ii) (1) (b) “SAR-to-antenna-separation ratios” changed to “SAR to peak location separation ratios” for clarification.

Page 4: Footnote 17 “SAR-to-antenna-separation ratio” changed to “SAR to peak location separation ratio” for clarification.

Page 5: 4 (b) (iii) (1) “SAR-to-antenna-separation ratios” changed to “SAR to peak location separation ratios” for clarification.

447498 D01 Mobile Portable RF Exposure v03r02 has been changed to a new revision under the same Version: 447498 D01 Mobile Portable RF Exposure v03r03

Page 3 Note <sup>13</sup> : This provision applies to devices with high SAR and users can freely operate such devices in different hosts where SAR may change due to design and operating variations.” **has been changed to** “ *This provision applies to devices with high SAR and users can freely operate such devices in different hosts where SAR may change due to design and operating variations. These devices fall under the Section 2(e) in the TCB exclusion list.*”

**Attachment 2 (447498 D02 SAR Procedures for Dongle Xmtr v02)****SAR Measurement Procedures for USB Dongle Transmitters**

The procedures in this attachment are intended for USB dongle transmitters with internal antennas, which are referred to as “simple dongles”.<sup>34</sup> If the dongle has a built-in external antenna or one that can swivel or rotate, there could be more than four orientations that may require testing. If the USB connector can swivel or rotate, there are also other conditions that may need consideration. For devices that connect to a USB port but do not operate like the typical simple dongle, a KDB inquiry should be submitted to determine test requirements.

**Simple Dongle Procedures**

Test all USB orientations (see chart below - A: Horizontal-Up, B: Horizontal-Down, C: Vertical-Front, and D: Vertical-Back) with a device-to-phantom separation distance of 5 mm or less, according to KDB 447498 requirements. These test orientations are intended for the exposure conditions found in typical notebook/netbook/laptop computers with either horizontal or vertical USB connector configurations at various locations in the keyboard section of the computer. Current generation notebook/netbook/laptop computers should be used to establish the required SAR measurement separation distance. The same test separation distance must be used to test all frequency bands and modes in each USB orientation. The typical Horizontal-Up USB connection (A), found in the majority of notebook/netbook/laptop computers, must be tested using an appropriate host computer. A notebook/netbook/laptop with either Vertical-Front (C) or Vertical-Back (D) USB connection should be used to test one of the vertical USB orientations. If a suitable host computer is not available for testing the Horizontal-Down (B) or the remaining Vertical USB orientation, a high quality USB cable, 12 inches or less, may be used for testing these other orientations. It must be documented that the USB cable has no influence to the radiating characteristics and output power of the transmitter.

**Dongles with Swivel or Rotating Connectors**

A swivel or rotating USB connector may enable the dongle to connect in different orientations to host computers. When the antenna is built-in within the housing of a dongle, a swivel or rotating connector may allow the antenna to assume different positions. The combination of these possible configurations must be considered to determine the SAR test requirements. When the antenna is located near the tip of a dongle, it may operate at closer proximity to users in certain connector orientations where dongle tip testing may be required.

The 5 mm test separation distance used for testing simple dongles has been established based on the overall host platform (notebook/netbook/laptop) and device variations, and varying user operating configurations and exposure conditions expected for a peripheral device. The same test distance should generally apply to dongles with swivel or rotating connectors. The procedures described for simple dongles should be used to position the four surfaces of the dongle at 5 mm from the phantom to evaluate SAR. At least one of the horizontal and one of the vertical positions should be tested using an applicable laptop/notebook/netbook host. If the antenna is within 1 cm from the tip of the dongle (the end without the USB connector), the tip of the dongle should also be tested at 5 mm perpendicular to the phantom. For antennas located within 2.5 cm from the USB connector and if the dongle can be positioned at 45° – 90° from the

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<sup>34</sup> These simple dongles typically look like a USB memory stick.

horizontal position, (A) or (B), testing in one or more of these configurations may need to be considered. A KDB inquiry should be submitted to determine the applicable test configurations.

**Dongles with External, Swivel or Rotating Antennas**

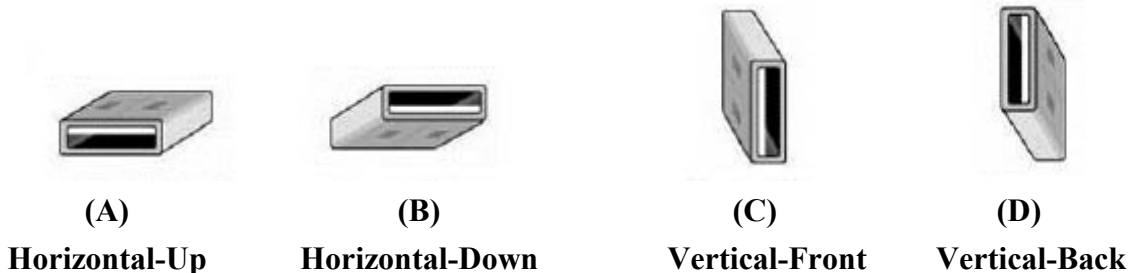
For dongles with external antennas or antennas that may swivel or rotate, a KDB inquiry to the FCC Laboratory should be submitted to determine the applicable test configurations. The inquiry should identify if the antenna may transmit in its stowed position and if a swivel or rotating USB connector is also used. Depending on the antenna configurations used in the individual dongle design and its operating configurations, different test separation distance may apply and must be determined on a case-by-case basis.

**Other SAR Test Considerations**

USB dongles have a rather small footprint; therefore, the SAR scan resolutions should be smaller than those typically used for testing devices with larger form factors, to maintain acceptable uncertainty for the interpolation and extrapolation algorithms used in the 1-g SAR analysis. In addition, when USB cables are used to connect a dongle to the host for SAR testing, the dongle should be supported in several cm of Styrofoam to minimize any field perturbation effects due to test device holder used to position the dongle for SAR testing. Dongles with certain spacers, contours or tapering added to the housing should generally be tested according to the 5 mm test separation requirement required for simple dongles, which is based on overall host platform, device and user operating configurations and exposure conditions of a peripheral device as compare to individual use conditions.

USB dongle transmitters need to show compliance at a test separation distance of 5 mm. When the SAR is  $\geq 1.2$  W/kg, application for equipment certification requires a PBA for TCB approval. Preliminary data submitted through KDB inquiries showing compliance at test distances greater than 5 mm are usually inapplicable and insufficient for the FCC to determine if potential exposure concerns may be eliminated to enable the device to satisfy compliance. The information must clearly demonstrate that the likelihood of non-compliance is remote. When the SAR is  $\geq 1.2$  W/kg, especially  $> 1.5$  W/kg, certain caution statements, labels and other means to ensure compliance may be required.

**USB Connector Orientations Implemented on Laptop Computers**



Note: these are USB connector orientations on laptop computers; USB dongles have the reverse configuration for plugging into the corresponding laptop computers.