Federal Communications Commission
Office of Engineering and Technology

Title: SAR Evaluation Considerations for Notebook/Netbook and Laptop Computers Supplement to KDB 616217

Short Title: SAR Supp Note and Netbook Laptop

Reason: This document is under Draft Review to add attachment 616217 D03 SAR Supp Note and Netbook Laptop V01 to publication 616217.

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Keyword: SAR, Laptop Computers, Notebook, Netbook, Antennas built-in on Display Screens
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First Category: Radio Frequency (RF) Exposure
Second Category: Specific Absorption Rate
Third Category: Non-handset SAR

Question:
What are the SAR evaluation considerations for laptop computers with antennas that are built into display screens?

Answer:
The following attached documents:
616217 D01 SAR for Laptop with Screen Ant v01 provides SAR evaluation considerations for laptop computers with antennas that are built into display screens.

616217 D02 SAR Polcy Laptop with Screen Ant v01r01 provides the equipment authorization review and approval policies for the procedures in KDB Publication 616217, SAR Evaluation Considerations for Laptop Computers with Antennas Built-in on Display Screens. with Antennas Built-in on Display Screens.

616217 D03 SAR Supp Note and Netbook Laptop V01 this attachment applies to transmitters and antennas incorporated in notebook/netbook and laptop computers for use in laptop or tablet modes

Attachment List:

616217 D01 SAR for Laptop with Screen Ant v01 ,Published on: Apr 9 2008 4:56PM (existing)
616217 D02 SAR Polcy Laptop with Screen Ant v01r01 ,Published on: Apr 9 2008 4:56PM (existing)
616217 D03 SAR Supp Note and Netbook Laptop V01. Published Date (to be added)

Attachment (616217 D03 SAR Supp Note and Netbook Laptop V01)

SAR Evaluation Considerations for Notebook/Netbook and Laptop Computers
- Supplement to KDB 616217 -

This supplement applies to transmitters and antennas incorporated in notebook/netbook and laptop computers for use in laptop or tablet modes, including those with display screens less than 12".[1] The procedures may be used to determine SAR evaluation requirements for portable or mixed mobile and portable exposure conditions, to supplement the procedures in KDB 616217 that are intended for larger laptop computers.[2] Test requirements for both individual and simultaneous transmitting transmitters and antennas operating in display screens and keyboards of notebook/netbook/laptop computers are considered in this document. Based on the test conditions applied to individual transmitters for equipment certification, these supplemental procedures can provide certain options to minimize unnecessary tests and permissive changes for incorporating approved transmitters and antennas in qualified hosts. This document does not address user installed external, peripheral transmitters and antenna configurations, such as USB, CardBus or ExpressCard devices that are described in section 2 of KDB 447498. The procedures in this supplement are not intended for hand-held devices that may transmit in close proximity to users, such as UMPC or devices with similar form factor, which may need additional consideration.

Individual Transmitter and Antenna Considerations

When individual transmitters and antennas are tested in notebook/netbook/laptop computer(s) using the most conservative exposure configurations required by the intended host(s), according to procedures in sections 2 and 4 of KDB 447498, additional tests and certifications are typically not required to incorporate the approved configurations in qualified host products. However, when more conservative exposure conditions are introduced in subsequent products; for example, to incorporate the transmitter or new antenna configurations at even closer separations to users, Class II permissive change approvals are necessary.

Antenna gain is a far field parameter. It is generally not directly related to near-field exposure conditions, which can be highly dependent on the RF current distribution characteristics of the individual transmitter, antennas and host configurations. Without taking into consideration the near-field exposure characteristics and parameters it would be inappropriate to assume that lower gain antennas always result in lower SAR; therefore, antenna gain is generally not used to assess the SAR evaluation requirements of devices operating at close proximity to users.

As described in KDB 616217, SAR evaluation is typically not required when the maximum transmitter and antenna output power are $\leq 60/f_{(GHz)}$ mW.[3] The procedures allow the number of SAR tests to be reduced when antennas are installed to operate at $\geq (5 + \frac{1}{2} \cdot n)$ cm from users.[4] These options may continue to be applied to notebooks/netbooks/laptops provided the antennas are installed in host

[1] See KDB Publication 447498 for definitions of laptop and tablet operating modes. Display screens are measured diagonally.

[2] When different transmitters and antennas transmit simultaneously according to mobile and portable exposure requirements, the notebook/netbook/laptop computer is operating in a mixed mobile and portable exposure conditions.

[3] Time-averaged conducted output power, consistent with SAR and near-field exposure requirements.

[4] The threshold distance $(5 + \frac{1}{2} \cdot n)$ cm is computed according to $n = P/(60/f)-1$; where n is the number of times the antenna output power (P) is $> 60/f$. P and $(\frac{1}{2} \cdot n)$ are rounded respectively to the nearest mW and cm to determine the distance.

computers with the required minimum separation distance from users. The trade-off between test conservativeness and implementation flexibility needs careful consideration in the initial equipment approval for transmitters and modules intended for OEM integration because more relaxed exposure conditions requiring little or no tests generally come with restrictions. This may necessitate further testing and equipment approval to incorporate the transmitter and antenna(s) in unqualified host devices and configurations. It is recommended that grantees of individual transmitters take into consideration the implementation flexibilities required by their OEM integrators and distributors to streamline test and equipment certification requirements.

Simultaneous Transmission Considerations

When multiple transmitters and antennas transmit simultaneously in a notebook/netbook/laptop computer, the following may be used to determine simultaneous transmission SAR evaluation reduction or exclusion requirements. The procedures apply to antennas in the display screen and keyboard; i.e., the entire computer, for both laptop and tablet operating mode and conditions.[5] If antennas are incorporated in the display only and providing more than 5 cm separation from users, the procedures in KDB 616217 may continue to be applied. However, it is unacceptable to mix the simultaneous transmission procedures in this supplement with those in KDB 616217.

1. Identify all possible combinations of simultaneous transmission configurations for all transmitters and antennas installed in the display screen and keyboard of intended host configurations
2. Transmitters/antennas operating from external card slots and or connectors of the hosts must be more than 5 cm from any simultaneous transmitting antennas to ensure possible combined exposures due to user installed transmitters, such as Card Bus and USB devices, are insignificant[6]
3. For each simultaneous transmission configuration identified in (1) above, the following must be clearly described in the SAR report or Class I permissive change documentation to determine the SAR test reduction and exclusion requirements:[7, 8]
    a. FCC ID of all transmitters, maximum average conducted output power in each transmission mode and frequency band, operating configurations and exposure conditions approved for the individual transmitter[9]
    b. applicable antenna locations in all host configurations identified in diagrams, drawings and/or photos, including the range of antenna-to-user and antenna-to-antenna separation distances for supporting the required test reduction and exclusion analysis or SAR test configurations[10]
    c. antenna type and physical dimensions of antennas incorporated in the intended host configurations
    d. antenna gain specified by the antenna manufacturer for antennas qualified for mobile exposure conditions

[5] See section 4 of KDB 447498 for laptop and tablet mode definitions and test requirements.
[6] Only consider the transmitters and antennas requiring SAR evaluation; i.e. > $60/f_{(GHz)}$ mW.
[7] Combinations of transmitters and antennas may transmit simultaneously at different times or under different configurations; therefore, resulting in different simultaneous transmission configurations.
[8] Class I Permissive Change documentation must be readily available upon request to support any subsequent Class II Permissive Change approvals; when necessary, the information may be included to expedite the equipment certification.
[9] Power measurements should be consistent with the wireless technology; for example, GSM/GPRS/EDGE normally reports burst average power.
[10] The closest distance between each antenna and the user and the closest distance between individual antennas should be used.

e. other relevant information and restrictions required by the equipment certifications of individual transmitters, including antenna changes

f. the range of applicable physical, mechanical and electrical variations of host configurations supported by the test results in all relevant equipment certifications

4. For each simultaneous transmission configuration identified in (1) above, if the conditions in (a) or (b) below are satisfied and fully documented in the SAR report or Class I permissive change documentation, simultaneous transmission SAR evaluation is not required for that configuration[11]

   a. when the [(∑ of the highest measured 1-g SAR for each portable transmitter/antenna included in the simultaneous transmission configuration) / 1.6 W/kg] + ∑ of [(the highest MPE for each mobile transmitter/antenna included in the simultaneous transmission configuration) / (the corresponding MPE limit)] < 1; or

   b. for antennas included in the simultaneous transmitting configuration that require SAR evaluation, when the separation distance between each antenna pair is

      i. greater than $5 \cdot [(SAR_1 + SAR_2) / 1.6]^{1.5}$ cm, rounded to the nearest cm, and

      ii. the ∑ of [(the highest MPE for each mobile transmitter/antenna included in the simultaneous transmission configuration) / (the corresponding MPE limit)] < 1

   where: ∑ in a. above excludes antennas that do not require SAR evaluation, and

   MPE does not apply to displays < 10" diagonal for both a. and b. above

5. For each simultaneous transmission configuration identified in (1) above, if it does not meet the conditions described in (4) above, submit an inquiry to the FCC Laboratory to determine the simultaneous transmission SAR evaluation procedures and if PBA or FCC filing is required

6. The following procedures may continue to be applied independently if deem appropriate by the grantee; however, it is unacceptable to mix the following procedures with the notebook/netbook/laptop procedures described in this supplement

   a. the simultaneous transmission SAR evaluation procedures in KDB 616217 and section 3 of KDB 447498

   b. the procedures in section 7 of KDB Publication 447498 for certain simple mixed mobile and portable exposure conditions

7. For other simultaneous transmission configurations and exposure conditions that have not been addressed in this supplement or other FCC test procedures, unless there is prior FCC coordination, SAR results for the required simultaneous transmission SAR evaluation are expected in the SAR report submitted for equipment certification

8. When the operating, installation and implementation requirements and restrictions required for the individual transmitters and antennas have been satisfied and SAR evaluation is not required for all the simultaneous transmission configurations identified in (1) above, provided there are no other filing requirements, RF exposure compliance may be addressed with respect to Class I permissive change requirements according to the documentation procedures in this supplement

9. The grantee must be able to ensure OEM integrators and distributors are provided the necessary installation and implementation instructions/requirements and relevant grant restrictions to incorporate the approved transmitters and antennas into qualified notebook/netbook/laptop host

[11] The documentation applies to the initial certification and subsequent permissive changes, including Class I and II.

configurations. When multiple transmitters from different grantees are incorporated in a notebook/netbook/laptop host and simultaneous transmission conditions apply, grantees must ensure OEM integrators and distributors are fully aware of the procedures in this document, including any necessary Class I permissive change documentation, and other applicable KDB publications the must be applied to determine whether a specific implementations is allowed or if additional test and certification requirements are necessary.