



RF Exposure (RFx) Mobile and Portable Device Review and Approval Procedures

October 2005
TCB Workshop

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- For any new or different device types, test methods, or test systems, FCC wants to have at least several comprehensive filings completed and documented through the FCC formal application process
 - to build consolidated knowledge base
 - provide basis for deriving uniform review and approval procedures
- §2.962(c)(3) “TCB shall have the technical expertise and capability to test the equipment it will certify”
- §2.962(c)(4) “recognize situations where interpretations of the regulations or test procedures may be necessary” and “obtain current and correct technical regulation interpretations”
- §2.962(f)(5)(i) “TCB may not... certify equipment for which the Commission rules or requirements do not exist or for which the application of the rules or requirements is unclear” = TCB cannot do interpretations



Overview

- TCB Exclusion List
- TCB SAR thresholds
- Modular Approval requirements and procedures
- 15.247/15.407 802.11abg proposed procedures
- Test configurations for laptops, portables
- Collocation conditions and requirements
- Permissive change considerations and grant notes

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TCB EXCLUSION LIST & PROCEDURES – Chronology

- R&O FCC 98-338 (Dec98) initiates TCBs – eqpt. approvals targeted to begin ASAP (2-yr suggested in NPRM FCC 98-92)
- DA 99-1640 (Aug00) defined basic eqpt. scopes, except RFx:
 - “The measurement procedures for licensed PCS devices and UNII devices and the procedures for determining RF exposure for hand-held transmitters have not been published. Accreditation and designation of a TCB to certify such equipment will be withheld until the appropriate procedures have been published.”
- DA 00-1223 (Jun00) green-lights 13 TCBs – RFx not released:
 - “In accordance with our policy stated in the August 17, 1999, Public Notice, we are restricting TCBs from approving equipment in scopes A and B for which there is no documented test procedure.”
- Nov00 webpost at OET Lab. Div. Electronic Filing Interpretations Database (IDB) of *Appendix A: TCB Exclusion List* (aka Y2k TCB Excl. List, TCB Can-Do list), and *TCB RF Exposure Procedures: Transmitter Categories* (aka Y2k TCB Excl. List, TCB Can-Do list)
- OET 65 Suppl. C (Jun01) defined handset SAR test procedures – based on draft IEEE Std 1528
- Aug01 TCB Parts 22,24 handset SAR review training removed exclusion for participants of Y2K TCB Excl List Tx Categ. IV) a) Part 22, b) Part 24-only
- Apr02 TCB general RFx training sets stage for qualified participants to use Jul02 TCB Excl List:
 - “Each TCB location must have a least one person on staff who has completed the Part 22 Subpart H and Part 24 Subpart E handset SAR training, and the fixed, mobile, and portable transmitters RF exposure procedures training.”
- Jun03 ET Docket 03-137 Notice of Proposed Rulemaking (NPRM) for RF exposure
- Jan04 NPRM comments close
- Mar04 OET/Lab KDB publ. 447498 Mobile&Portable Eqpt. Auth. Procedures
- May05 draft testing and review & approval procedures for 802.11abg, certain MIMO, 3-6 GHz SAR – FINAL RELEASE PENDING as of 9/23/05
- Sep05 - July02 TCB Excl List still active; Report & Order Dkt 03-137 still in preparation



TCB Exclusion List (July '02)

- Transmitter (Tx) Category I) a): devices should be evaluated according to most recent versions of FCC documents including:
 - FCC OET Bulletin 65 Supplement C
 - FCC RF exposure (RFx) TCB training notes - list below; milestone sessions were Aug01, Apr02, May03
 - Various RFx-related OET/Lab Knowledge Database (KDB) webposts
 - KDB publ. 447498 Mar04 Mobile/Portable EA Procedures
- Transmitter Category I) a) with footnote 4 means portable transmitters not listed in 2.1093 with power above low threshold needs SAR evaluation to qualify for TCB approval

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TCB and FCC each have archives - filenames may vary.

The following lists most but maybe not all main Powerpoint files, and not all supplemental files.

- Dec99: (TCB-RF-exposure.doc)
- Sep00 & Oct00: (8SAR-Heirman1.ppt)
- Mar01: (TCB Taiwan Session 8a.ppt, TCB-rfexp.doc)
- Jul01: (TCB NIST Session 17 rf exposure.ppt)
- Aug01: dedicated handset SAR & examples
- Feb02: (TCB_ieee1528D.ppt), (TCB_miscE.ppt), (TCBreviewtraining.ppt)
- Apr02: dedicated general fixed, mobile, portable RFx
- Oct02: Parts 22/24 handsets & general RFx (TCB_apr02_harrington.ppt), (SuppC-april2002training.ppt), (Day 3 Session 2 TCB training_tim.ppt), (Day 3 Session 6 TCB training_martin.ppt), (Day 4 Session 2 TCB training_perrine.ppt)
- May03: (Session 4abcd_FCC_RFx_P1528_ver2.ppt), (Session 5_SuppC-may2003trainingpostupdate23may.ppt), (Session 6_Portable_ver2.ppt), (Session 7_Fixedpostupdate23may.ppt), (Session 8_Mobilepostupdate23may.ppt)
- May03 (NIST): (12 - USA Perrine FCC New Certification Issues & RF Safety.ppt), (13 - USA Harrington FCC RF Exposure & Portable Transmitters.ppt)
- Oct03: (Martin'spt1_RFXmiscupdate.ppt), (Martin'sPt2_Handset RFx issueslatest1.ppt), (Tim'sPt1_oct15_portable_module_other_rev2a.ppt)
- Feb04: (TCB Update Trainingrev4.ppt), (TCB Training-Harrington-final_re-pdf.pdf)
- Oct04: (71-RFX interpretations update-MP.ppt)
- Feb05: (KC-80-211 SAR v2.ppt), (TH-RF Safety_rev2.ppt)
- May05: (KC - RFx Above 3G R2.ppt), (KC - 802 RFx Config R2.ppt), (TH - RFx Discussions.ppt)



Appendix A: TCB Exclusions List

Revised: 17 July 2002

Transmitters included in a TCB Scope and identified in the following **do not** qualify for TCB approval. Review & Approval procedures are described in a separate document that will be revised as evaluation and approval procedures are updated.

Transmitter Category	Exclusions List
I) All Transmitters	<ul style="list-style-type: none"> a) devices not evaluated according to most recent versions of FCC OET 65 Supplement C or other applicable FCC policies, procedures, and TCB training notes b) applications for equipment approval or permissive change requiring any change in equipment class (e.g., TNB to TNE, etc.) or change in RF exposure limits or exposure category c) devices employing numerical simulation or computational modeling techniques to show RF exposure compliance d) transmitters operating in non-US protocols or radio services (e.g., PHS, etc.)
II) Portable Transmitters	<ul style="list-style-type: none"> a) devices with operating frequencies above 6 GHz b) devices in standalone configurations with <u>output power</u>¹ greater than the <u>high threshold</u>² c) transmitters that are implanted or operated within a person's body d) devices operating according to occupational exposure requirements, except for push-to-talk radios e) devices containing multiple transmitters that transmit simultaneously, when <u>routine SAR evaluation</u>³ is required for the highest output (dominant) transmitter, and any of the other (non-dominant) transmitters is operating at higher than 5 mW f) devices containing multiple transmitters with simultaneous transmission, when <u>routine SAR evaluation</u> is not required, and the sum of the individual ratios of the <u>output power</u> divided by the <u>high threshold</u> is greater than one (1) g) modules for operation in licensed services that are not configured in a dedicated host device h) unlicensed modules used alone or with another transmitter <ul style="list-style-type: none"> 1) without simultaneous transmission, and the <u>output power</u> of any transmitter is greater than 100 mW with operating frequency less than or equal to 3 GHz OR 50 mW with frequency greater than 3 GHz but less than or equal to 6 GHz 2) with simultaneous transmission, and the sum of the individual ratios of the <u>output power</u> divided by the <u>low threshold</u>² is greater than one (1)

¹ Each TCB location must have a least one person on staff who has completed the Part 22 Subpart H and Part 24 Subpart E handset SAR training, and the fixed, mobile, and portable transmitters RF exposure procedures training. Additional training will be provided in the future on requirements for new procedures and technology. Training workshops will be repeated as necessary to accommodate new TCBs.

² Output power for portable transmitters is the higher of the conducted or radiated (EIRP) source-based time-averaged output.

³ In the following table, f_{GHz} is mid-band frequency in GHz, and d is the distance to a person's body, excluding hands, wrists, feet, and ankles.

⁴ Routine SAR evaluation refers to that specifically required by § 2.1093, using measurements or computer simulation. When routine SAR evaluation is not required, portable transmitters with output power greater than the applicable low threshold require SAR evaluation to qualify for TCB approval.

TCB and FCC each have archives - filenames may vary

The following lists most but maybe not all main Powerpoint files, and not all supplemental files



General TCB Exclusions

- SAR evaluation based on computational modeling
- Portable devices operating above 6.0 GHz (unclear evaluation methods to MPE limits)
- SAR for bare, uninstalled modules/antennas
- Applications containing non-compliant data
- SAR for vehicle-mount transmitters

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General TCB Exclusions

- Any non-conventional operating configurations and exposure conditions (e.g., labels), or new technology and design (e.g., WiMAX)
- May05 draft 3-6 GHz SAR TCB review & approval procedures – final release pending
- 802.11a/b/g MIMO, phased-array, beam-forming and multiple antenna configurations NOT described in May05 TCB training notes



Thresholds for TCB SAR

Exposure category	<u>low threshold</u>	<u>high threshold</u>
general population	(60/ f_{GHz}) mW, $d < 2.5$ cm (120/ f_{GHz}) mW, $d \geq 2.5$ cm	(900/ f_{GHz}) mW, $d < 20$ cm
occupational	(375/ f_{GHz}) mW, $d < 2.5$ cm (900/ f_{GHz}) mW, $d \geq 2.5$ cm	(2250/ f_{GHz}) mW, $d < 20$ cm

- f_{GHz} is the mid-band frequency in a transmission band
- Power is source-based time-averaged, conducted or radiated - whichever is higher
- For PTT with body-worn and face-held modes, d is distance from device case to a person's body; for modules with antennas inside laptops, d is distance from antenna to a person's body

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GHz	60/f uncontrolled $d < 2.5$ cm	120/f uncontrolled $d \geq 2.5$ cm	375/f body-worn controlled $d < 2.5$ cm	900/f face-held controlled $d \geq 2.5$ cm	2250/f controlled high
0.15	400	800	2500	6000	15000
0.3	200	400	1250	3000	7500
0.45	133	267	833	2000	5000
0.83	72	145	452	1084	2711
0.9	67	133	417	1000	2500
1.6	38	75	234	563	1406
1.9	32	63	197	474	1184
2.45	24	49	153	367	918
3.00	20	40	125	300	750
6.00	10	20	63	150	375



TCB, FCC 15C, 15E SAR

● $f \leq 3$ GHz

- FCC – SAR requested for 2.4 GHz devices $P > 50$ -100 mW and antenna $d \leq 2.5$ cm from person's body
- TCB – SAR requested for devices $P >$ (low threshold) in TCB Exclusion List

● $f > 3$ GHz

- FCC – SAR data is requested for 15C devices $P > 50$ mW and antenna $d \leq 2.5$ cm from person's body
- TCB – may not approve 15C devices $P >$ (low threshold) in TCB Exclusion List (release of standardized SAR test procedures for 3-6 GHz is pending)
- SAR routine evaluation is required for 15.407 devices (e.g., some 802.11a)



RFx - Other Rule Parts

- 4.9 GHz Band Service (90Y), 3650 MHz Wireless Broadband Service (90Z) – portable devices file at FCC (3-6 GHz SAR proc.)
- UPCS (15D) – SAR routine evaluation
- WMTS (95H) - routine evaluation
 - WMTS device filings with power under 1 mW require a statement of compliance
 - Confirm/document output power
 - Filing of RF exposure compliance supporting information is not expected to be necessary, but information may be requested/reviewed by FCC

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RFx - Other Rule Parts

- MICS (95I) – routine evaluation with FDTD computational modeling – file at FCC
- Implant transmitters in Part 15
 - All transmitters regulated by FCC must comply with RF exposure requirements
 - Implants file at FCC not TCB - TCB Excl List Tx Categ II) c)
 - FCC has processed 900 MHz implants
 - SAR evaluation procedures and liquids undefined for frequencies below about 100 MHz
 - Please consult with FCC Lab before testing and filing



Mar04 KDB Mobile/Portable Proc.

● Harrington session:

- 2) Mobile PTT – Parts 80, 90
- 3) 15.247, 15.407 portable transmitters SAR conditions
- 4) Modules used in portable devices
- 5) Collocated co-transmitting within portable or mobile devices
- 6) SAR test procedures for devices operating at frequencies not covered by IEEE Std 1528
- 7) SAR test procedures and positions for portable transmitters – notebook (laptop) computers, PDAs, smart-phones, etc.

● Perrine session:

- 1) Portable push-to-talk (PTT) – Parts 80, 90, 95
- 8) Use of occupational and general population limits and exposure conditions – Parts 80, 90, 95



Modules & Modular Approvals

- Module (Generic) = transmitter operating either internally or externally as part of another device or product
- Module-type device approval options:
 - DA-00-1407 Part 15
 - Modular Approval (MA)
 - Limited Modular Approval (LMA)
 - Licensed-radio-services modules
 - For use only in fixed/mobile exposure conditions
 - No portable modules in undefined end-use configurations
 - Module-type device evaluated in specific final product(s) (not Modular Approval)

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- DA-00-1407 defines MA & LMA, but strictly speaking does not define “Full Modular Approval (FMA)” – please avoid term “full modular approval”
- Dec02 – Licensed transmitters may be approved as modules for installation into other final devices provided the following criteria are met:
 - The final device is designed for mobile or fixed operation [Portable is not permitted – Reference TCB Exclusion List (17 July 2002) l(g)].
 - The maximum antenna gain to allow compliance with RF exposure requirements is listed on the Grant of Certification for the module
 - The licensed module must have a FCC ID label on the module itself. That FCC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily removed. If not, a second label must be placed on the outside of the final device that contains the following text: Contains “FCC ID: xxxyyyzzz”
 - The Grant should include the following words in the device description or grant notes: “modular transmitter” or “transmitter module”
 - NOTE: Gain calculation for licensed modules must account not just for compliance with MPE but also with applicable ERP/EIRP limits.



Modules in Portable Conditions

- SAR data for module tested in one final-product is generally applicable only for that product
- SAR test procedures for “stand-alone” modules have not been established and therefore are not applicable for compliance demonstration purposes
 - For example, un-installed bare antenna tests for mini-PCI cards
 - Extender-card tests for integral-antenna-PCMCIA cards not applicable, but under consideration TBA
- Module RFx requirements to be updated pending R&O in ET Dkt 03-137 – module RFx evaluation procedures updated soon thereafter

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•Above based on KDB publ. 447498 Mar04 Mobile and Portable Device RF Exposure Equipment Authorization Procedures, 4)



Modules in Portable Conditions

- Using specific-host SAR evaluations
- Lower-power “host-independent” modules (below thresholds, no SAR test)
- 3-host SAR testing for PCMCIA cards and similar packages (generic modules, LMA)
 - 3-host tests requested for licensed-service devices Parts 22H, 24E, 90-SMR
 - 3-host tests requested for 15.247 with $P > 100$ mW and $f < 3$ GHz; no test if $P < 50$ mW; otherwise 1-host test
 - 3-host tests requested for 15.247 with $P > 50$ mW and $f > 3$ GHz; no test if $P < 25$ mW; otherwise 1-host test
 - 3-host tests requested for 15.407 (5 GHz) $P > 50$ mW; otherwise 1-host test (= 2.1093 routine evaluation)

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- Above from KDB publ. 447498 Mar04 Mobile and Portable Device RF Exposure Equipment Authorization Procedures, 4)
- Module RFX requirements to be updated pending R&O in ET Dkt 03-137 – module RFX evaluation procedures updated soon thereafter
- for PCMCIA and similar integral-antenna end-user-install cards: request SAR test in modern laptops with approx. 3-10mm max. thickness below card slot
 - User manual instructions and grant notes should reflect final-products used in SAR evaluation, i.e., laptop and/or PDA
- 3-host or similar SAR test procedures not established for SDIO used in smartphones; specific-host SAR evaluation may apply – contact OET/Lab before testing



SAR for Laptops, Portables

- For undefined or unclear device usage positions, when existing test positions are not applicable, applicants must declare/define product normal use positions and evaluate SAR accordingly
 - Applicant determine normal use based on product design & operation
- In general FCC filings should include SAR only for normal use positions, but data from incidental or secondary use conditions can be reported if properly justified

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SAR for Laptops, Portables

- When required by TCB thresholds or 2.1093, laptops are tested in lap-held position by placing the bottom of the laptop in direct contact against a flat phantom
 - Normal-use position: display on & **OPEN**
 - Tilting of final-product/host not needed, e.g., to bring tip of PCMCIA card into contact with phantom, unless it is normal-use position
- SAR test positions for tablet PCs
 - Slate (one-section) or convertible (hinged two-section)
 - Similar to laptops with antenna(s) in the keyboard section
 - Edge positions with 0/180 deg. landscape/portrait

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•Above based on KDB publ. 447498 Mar04 Mobile and Portable Device RF Exposure Equipment Authorization Procedures, 7)

- General filing guidance for mini-PCI and similar modules, for example in notebook computer:
 - Filings for specific laptop(s) need external and internal-as-installed antenna photos or drawings, to support RF exposure compliance
 - Final-product laptop approvals need laptop user manual describing wireless function, installation/operation, final-product operation, etc.
 - Filings containing multiple laptop models should use LMA
 - Check for undeclared and optional Bluetooth collocation
 - Include laptop DoC info/status in filing
 - C2pc filings to add final-product (host) should include final device FCC ID labeling info, including labels for other modules if applicable



SAR for Laptops, Portables

- Laptops with antennas installed at least 20 cm from the user in the lid-open position (e.g., at top of display section) operate in mobile exposure conditions - no SAR test, MPE limits apply
- For laptops with antennas in display section and with laptop lid closed, SAR tests for lap position not required, unless that is normal-use position
 - When submitted by applicant's choice, SAR data for laptop-lid-closed in lap-held position, or e.g., underarm position (like a book), is reviewed for compliance
 - See above for convertible-tablet PC positions

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•Above based on KDB publ. 447498 Mar04 Mobile and Portable Device RF Exposure Equipment Authorization Procedures, 7)



SAR for Laptops, Portables

- SAR data for “side/bystander” exposure at X cm-spacing positions not required (e.g., typical laptop configurations)
 - However, applicants can provide such data if it is declared or defined as a normal-use position (product design/operation)
 - Filing must show how spacing will be maintained
- Wireless-PDA generally hand-held-only **PORTABLE** device (wrt hand, extremity SAR limit higher) operating at 20 cm from the body (mobile wrt body)
 - When submitted by applicant’s choice, wireless-PDA lap-held SAR data is reviewed for compliance
 - User instructions may be appropriate for wireless-PDA lap-held or in-pocket incidental transmitting conditions, or SAR evaluated by applicant’s choice

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“wrt” = “with respect to”

•Above based on KDB publ. 447498 Mar04 Mobile and Portable Device RF Exposure Equipment Authorization Procedures, 7)



SAR for Laptops, Portables

- “Direct-connected” USB (without integral cable) differs from most PCMCIA in that port alignment may be horizontal (H), vertical (V), and 180 degrees H or V, with respect to a notebook computer host
- Grantee is responsible for SAR compliance in all such intended use positions
- 1-host SAR testing is accepted for many Part 15 and some licensed-service USB-dongle transmitters
 - 3-host SAR test results have been filed for some licensed-service USB dongles
 - IDB/KDB Mar04 webpost RFx Procedures 7)b), 7)c) are applicable



802.11abg SAR Procedures

- Final Release Pending

- Device setup – use test mode
- Output power
 - Test maximum output channels, not adjacent hi/mid/lo-frequency channels
 - Test 802.11g ch. if $P_{avg} > P_{802.11b} + 0.25$ dB
- Modulation - for default abg ch., test each higher data rate if $P_{avg} > P_{lo-rate} + 0.25$ dB
- Proprietary modes - test each turbo, half & quarter rate ch. at lowest data rate, each prop. mode, if $P_{avg} > P_{closest}$ default abg mode ch.(s)

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802.11abg Default Test Channels

Mode	GHz	Channel	Turbo Channel	Default "a-b/g" Mode Test Channels			
				§15.247		§15.407	
				802.11b	802.11g		
802.11 b/g	2.412	1		√	▽		
	2.437	6	6	√	▽		
	2.462	11		√	▽		
802.11 a	5.18	36				√	
	5.20	40	42 (5.21 GHz)				*
	5.22	44					*
	5.24	48				√	
	5.26	52	50 (5.25 GHz)			√	
	5.28	56					*
	5.30	60	58 (5.29 GHz)				*
	5.32	64				√	
	5.745	149			√		√
	5.765	153	152 (5.76 GHz)			*	
	5.785	157			√		*
5.805	161	160 (5.80 GHz)				√	
§15.247	5.825	165		√			

PROPOSED TESTING GUIDANCE – FINAL RELEASE PENDING

- select √ channels in each frequency band
- for 5 GHz bands: when highest output * is 0.25 dB > nearest √ channels, select * instead of √ channel
- for 2.4 GHz band: when ▽ channel is 0.25 dB > * & √ channel, select both √ & ▽ channels
- test all selected channels only when peak or 1-g SAR of highest output channel > 1.6 & 0.8 W/kg respectively
- test channels at lowest data rate

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MIMO, Diversity for TCB

- Legacy switched-diversity - scale measured SAR to 75% duty factor
- Other complex diversity schemes
 - 100% duty factor for spatial-multiplexing MIMO, beam-forming and other
 - Spatial-multiplex MIMO procedures for legacy cyclic-delay and simple 2-antenna beam-forming



Collocated/Co-transmit RFx

- Collocation is generally defined as co-transmitting antennas within 20 cm of each other within a device
 - Other multi-radio, multi-device situations may also constitute types of collocation
 - 1.1307(b)(3) for fixed sites
- Following concepts are **UNDER CONSIDERATION** to streamline testing and filing requirements
 - Conditions based on that SAR limit applies for any 1-g tissue in shape of cube
 - Perimeters for certain install/operate configurations, and conditions using 2.1091 categorical excl. powers
 - Grant note guidance and procedure likely to change



Collocated/Co-transmit RFx

- Transmitting conditions
 - Limited or no overlapping signal transmissions
 - Independent evaluations may be appropriate
 - Simultaneous transmission (co-transmission)
 - Independent evaluation may or may not be appropriate
 - Multi-band – e.g., phones, LAN
 - Single-band – e.g., new complex antenna configurations
- Collocated approvals are applicable only for specific combinations and configurations, i.e., based on relative positions and spacings of antennas in a specific host device



Collocated/Co-transmit RFX

- When collocation is not evaluated in a filing, FCC and TCB approvals use a “no collocation” grant note for single module and single transmitter approvals
 - Grant note applied for both routine evaluation and categorically-excluded devices
 - Grant note basically means collocated combinations are subject to separate evaluations
- Subsequent transmitter and module combinations are handled as Class II permissive changes (C2pc)
 - C2pc evaluates collocation with specific FCC ID(s)
 - C2pc DOES NOT “remove no-collocation” condition
- Or use new FCC ID with grantee responsibility for combination product

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Certain grant notes established as part TCB scope expansion under Nov00 TCB Review & Approval Procedures



Collocated/Co-Tx TCB Can-dos

- July02 TCB Excl List II) e)
 - Cellphone with Bluetooth $P < 5\text{mW}$
- July02 TCB Excl List II) f):
 - Final-product, multi radios within same band, when SAR evaluation is required (sum of powers above threshold), e.g., laptop with Bluetooth and 802.11g
- July02 TCB Excl List II) h):
 - Low-power modules/transmitters (sum of powers below threshold) – see Oct03 notes for example grant comments
- When SAR evaluation is not required
- Collocated mobile devices

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Above based on KDB publ. 447498 Mar04 Mobile and Portable Device RF Exposure Equipment Authorization Procedures, 5)



Collocated/Co-transmit RFx

- “Clearly defined standalone independently operated” module (Apr02 notes) = limited modular approval for use in specific device types, e.g., notebook, PDA, etc., no co-transmission
- OEM coordination/control or specific hosts are best strategies for non-standard packages
- Example grant note sentence based on Jul02 TCB Excl List multiple-module powers:
 - For portable operating configurations, neither the total peak conducted nor peak radiated (EIRP) output power of all transmitters, whether this module is integrated internally or attached directly to a device operating with it, may exceed [TCB threshold].



Mobile Evaluation Procedures

- Filings for rule parts listed in 2.1091 with output above categ. excl. power must include at least one:
 - MPE test (TCB or FCC filings)
 - Numerical model (FCC filings)
 - Other methods based on sound engineering practice (may be considered for FCC filings)
- Besides MPE, ensure antenna configurations comply with service-rule ERP/EIRP limits, if any
- 2.1033(c)(3) requires device operating and installation instructions to be submitted during equipment certification, which is requested to include antenna installation info, to support FCC RF exposure compliance

2.1091(c)	ERP, W	EIRP, W
f ≤ 1.5 GHz	1.5	2.46
f > 1.5 GHz	3	4.92

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Mobile Evaluation Procedures

- Instructions should include the minimum separation distance and other constraints required for the device and its antenna(s) to meet MPE limits
 - Minimum separation distance of 20 cm required normal use
 - Distance may be established in routine eval. (see above)
 - Most TCB and some FCC filings for categ. excl. devices are requested to include MPE estimation (e.g., OET 65 equation 4, or circular aperture equations with dish antennas)
 - Separation distance based on MPE evaluation (measurement or computer modeling) smaller than the estimated MPE distance may be used if it is applicable for the antenna installation conditions
- Antenna installation conditions should maintain the estimated minimum MPE separation distance



Mobile Evaluation-Vehicle-mount

- Radio operator is normally shielded by the vehicle structure from roof- or trunk-mounted antennas, but persons external to but near the vehicle or in the rear seat are closer to the antenna(s)
 - Radio operator may be considered to be in an occupational exposure situation if properly trained to be aware of exposures and control RF transmissions
 - Bystanders and passengers are generally considered to be in general public exposure conditions
- 90.205(r) should be accounted for in MPE evaluations, i.e., compliance distances should be determined according to allowed 20% over nominal power, unless radio is documented to not support such levels



MPE for Advanced Antennas

- MIMO and phased array systems have multiple simultaneous-Tx antennas
- Aggregate power can generally be used to estimate MPE perimeter when antennas are very close together
- Above may be used for simple beam-forming systems with two antennas, but also need to ensure maximum gain conditions
- For sectorized antenna systems, each antenna generally considered independently without overlap
- For other complex antenna systems, antenna separations relative to each other and to observation points, and separate output powers, are used to calculate (estimate) compliance boundary

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RFX & Class II Changes

- Add mobile passive vehicle-mount antenna to portable held-to-head, body-worn and hand-held device grant (TNE, PCE, PCT, TNT)
 - New line-item radiated power where applicable
 - MPE evaluation if applicable
 - Distinct mobile and portable grant notes
- Add specific hosts/antennas for Limited Modular Approved devices (include SAR where applicable)
 - Add specific-host laptop with display-top antennas (mobile) to LMA for specific-host laptop with keyboard-antennas (portable)
 - Add specific-host laptop or PDA (portable) to LMA for access point or laptop (mobile)

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SAR & Class II Changes

- Modifications to transmitters subject to RFX routine shall apply the criteria of 2.1043(a) to determine which class of change (Class I, II, III permissive change, or new FCC ID) is applicable, separate from measurement uncertainty and production tolerances are not considered
- SAR is dependent most strongly upon near fields and RF current distributions on a device, meaning minor and simple metallic changes may cause relatively large changes in SAR



SAR & Class II Changes

- RFX requirements in Class II permissive change (C2pc) are based on comparing highest SAR for all configurations in original filing to highest SAR tested with the modified device under similar test configurations
- If highest SAR of modified device for certain configuration (such as head or body) is larger than highest SAR for original device under similar test configurations, SAR is addressed in the C2pc filing for the applicable operating configurations in each frequency band

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RFx & Grant Notes

- Consistent grant notes are used for uniformity in application processing, and may be updated as part of ongoing Lab policy reviews and concurrent with docket 03-137
- Example 15.247 desktop 100mW or less – either:
 - “The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons ...”
 - “This device is approved as a mobile device with respect to RF exposure compliance.”
- Grant note and some permissive change issues are often related to collocation, co-Tx, modular approval, or combination of these



RFx & Grant Notes

- Mobile device grants should list other distance for FCC RF exposure compliance when greater than 20 cm
- Certain devices, e.g., utility meters, operate with sufficiently low duty factor and power that 20 cm grant note should not be needed
 - transient RF exposures when persons can have incidental passage or dwell closer than 20 cm, meaning exposure conditions are not clearly fixed or portable
 - although not useable to demonstrate compliance, TCB low threshold power criteria generally implies low exposure potential



RFx & Grant Notes

- Certain details of device operating restrictions should be explained in filing to minimize lengthy grant notes
 - Devices should be fully evaluated to satisfy compliance
 - Grant conditions generally do not substitute for RFx evaluation - especially for consumer devices
- TCBs should apply sensible and practical grant notes
 - Aug02 TCB training notes include statements
 - Develop own frequently-applied note lists



Wrap-up

- Please contact FCC Lab for guidance if unclear, undefined, inconsistent review & approval guidance or procedures are encountered
- Please review TCB guidance and requirements documents before starting and while completing device reviews and approvals
- For consistency, please review recent or applicable previous grants for similar devices before completing device reviews and approvals

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TCB APPLICATION GENERAL AUDIT CONSIDERATIONS

- The application was submitted in a format that is easy to retrieve and evaluate
 - The TCB identification of confidential information and justification is supported by the Rules
 - The application demonstrates that the TCB has an understanding of the RF Safety regulations and their application
 - The information in the application is consistent between exhibits, data entries and FCC Form 731
 - The application is complete and all data required by the Rules is included
 - Based on documentation in the application, the margins of compliance of the equipment with the Rules ensure a high likelihood of compliance of the equipment in the marketplace
 - The application indicates that the TCB ensured that all applicable test procedures were followed
 - The application demonstrates that the TCB effectively evaluated the capability of the testing laboratory
 - The approval of the application demonstrates that the TCB has a correct understanding of FCC rules, policies, and interpretations
 - The information on the Grant is accurate and supported by application information
-
- Filings with output power greater than 20mW checked for proper classification as portable or mobile, or fixed (high-power, far-field)
 - Unconventional grant notes get further checks for unique designs or operating configurations
 - Confirm installation and operating instructions for reasonable and appropriate separation distances