Demonstrating Exemption From Routine Evaluation For Unintentional Radiators Operating Under Part 15 Subpart B And/Or Part 18 Of FCC Rules

47 CFR 1.1307 (b) (3) (i) (A) limits the exemption from routine evaluation based on an available maximum time-averaged power of no more than 1mW, where the maximum available RF power for an RF source is the maximum available RF power (into a matched load) as averaged over a *time-averaging period*[1]. For unintentional radiators the available power cannot be measured since there are no specific rf terminals. By their very definition, any rf radiated from the device is unintentional; the rf sources are timing signals that are being conducted along transmission lines and the radiation mechanisms are the traces, wiring, slots and apertures within the device.

These devices are designed to minimize the levels of the radiated rf to meet the extremely low radiated emissions limits of FCC Part 15.109 or of Part 18 for the purposes of avoiding rf interference, or EMI, to devices designed for the reception of rf. We note that within some bands Part 18 devices have no limit and these emissions will be considered separately.

ITU-REC-K.52 2016, section 8.1.1 includes the following argument for the exclusion of unintentional radiators, specifically telecommunications equipment, from an analysis for rf exposure. *Unintentional emitters may produce EMF due to spurious emissions. There are EMC emission standards that limit the magnitude of these spurious fields. Typically, the fields produced by telecommunication equipment that is an unintentional emitter are significantly below the safety limits established by ICNIRP and national standards.* ***The limits established for EMC compliance are orders of magnitude below the EMF safety limits****. Even if equipment exceeds the emission limits at certain frequencies, experience indicates that the fields produced are still orders of magnitude below the safety limits. Thus, telecommunication equipment that is an unintentional emitter does not need an EMF safety assessment to assure compliance with safety limits.*

To support the statements in ITU-REC-K.52 related to **the limits established for EMC compliance are orders of magnitude below the EMF safety limits** consider the 15.109 Class A, 15.109 Class B and Part 18 Consumer Limits. The limits are specified in terms of electric field strength at distances of 3m, 10m, 30m or 300m depending on the rule part and frequency range. These limits can be converted to an effective radiated power (e.r.p.) using Frii's equation as shown in the following tables.

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[1] 47 CFR 1.1307 (b) (2)

Frequency (MHz)		15.109 Class B Limit			
From	To	dBuV/m	Distance (m)	e.r.p. (dBm)	e.r.p. (uW)
30	88	40.0	3	-57.4	0.0018
88	216	43.5	3	-53.9	0.0041
216	960	46.0	3	-51.4	0.0073
960	1000	54.0	3	-43.4	0.0457
1000	40000	54.0	3	-43.4	0.0457

Frequency (MHz)		15.109 Class A Limit			
From	To	dBuV/m	Distance (m)	e.r.p. (dBm)	e.r.p. (uW)
30	88	40.0	10	-46.9	0.0203
88	216	43.5	10	-43.4	0.0457
216	960	46.0	10	-40.9	0.0813
960	1000	54.0	10	-32.9	0.5083
1000	40000	54.0	10	-32.9	0.5083

Frequency (MHz)		Part 18 Consumer Device Limit			
From	To	dBuV/m	Distance (m)	e.r.p. (dBm)	e.r.p. (uW)
0.009	30	28.0	300	-29.4	1.1436
30	1000	28.0	300	-29.4	1.1436
1000	40000	28.0	300	-29.4	1.1436

A first approximation for the absolute maximum total power that could be radiated by an unintentional radiator, assuming that the device has emissions that are at the limit at every measurement bandwidth across the entire frequency range of measurement would show a total e.r.p. of 1.85mW for a Class B digital device, 20.6mW for a Class A digital device and 58.4 mW for a Part 18 consumer device.

However, no unintentional radiators have an emissions profile with a contiguous spectrum of signals at the radiated emissions limit, rather a more typical profile would have at most a dozen signals close to (within 10dB) of those limit lines within each measurement frequency range (below 30 MHz, 30 MHz - 1GHz and 1 - 40 GHz). Using a worst case of 12 emissions within each frequency range for a Part 18 Consumer Device, the device with the highest radiated emissions limit, the total radiated power would be 36 x 1.14uW or approximately 40 uW (0.04 mW).

Analysis of the radiated emissions profiles of 15 different unintentional radiators, ranging from a server to a system of laptop with SSD drive, using Frii's equation to determine the total erp of the highest emissions shows a total eirp less than 6.7uW (most devices were below 1uW). The total eirp of all 15 devices was 9.9uW. Refer to the spreadsheet "*15 product data.xlsx*" attached to this document.

While the emissions limits are specified for the far field the rf exposure assessment will need to consider use at smaller distances of e.g. 20cm mobile devices and less than 20cm for portable devices. For mobile and fixed systems, where the devices will be at least 20cm from persons, demonstrating that the erp is significantly lower than the 1mW threshold should be adequate to demonstrate that the available power from an rf exposure perspective is also significantly lower than 1mW and exempt the unintentional radiator from routine rf exposure evaluation.

For portable devices used within 20cm of persons the available rf power is more difficult to estimate because the gains of the "antennas" radiating the rf energy are unknown, after all these are unintentional emissions. If we assumed a lossy antenna gain of -20dB (numeric gain of 0.01) the total "available" power from any of the 15 systems described previously would still be only 670uW (and this was for a larger server system that would not be a portable device). To effectively couple the available rf power from the device into adjacent structures and persons requires purposeful design.

For example inductive wireless power transfer devices require multi-turn coil antennas in both the transmitters and receivers to enable the coupling of sufficient rf energy to charge a battery. It has been demonstrated that these intentional radiators designed for near-field coupling comply with rf exposure requirements for portable devices when operating at powers of 5 Watts or more at distances of 0mm separation. Further, SAR measurements for Near Field Communications (NFC) devices operating at 13.56 MHz, where available energy is of the order of 250mW or more, have resulted in almost immeasurable SAR values. If intentional radiators designed for near-field coupling comply with rf exposure requirements we suggest that the available power to be coupled into persons close to the system for the majority of consumer products will remain negligible relative to the 1mW exclusion threshold.

Further evidence of the negligible contribution of the unintentional rf sources within a device can be observed from the Specific Absorption Rate (SAR) measurements used to support compliance with rf exposure requirements for portable intentional radiators (refer to the SAR Plots attachment). The SAR measurement test reports include plots showing the levels of rf from the intentional radiator. The plots show the distribution of the rf energy with the "hot spots" where the rf (and corresponding SAR values) are highest are located by the antennas and antenna feed points. The fields quickly drop off away from the hot spot and there are no other emissions registered within 20dB of those hot spots. This demonstrates that the rf exposure contribution from the unintentional rf sources, which are active during these SAR tests for the intentional radiators, are not measurable even when compared to relatively low power (< 10mW) bluetooth intentional radiators.

Even after considering the frequency response of the SAR systems (4MHz - 6GHz) and the linearity of the measurement probes the fact that the contribution from any of the unintentional rf sources is not measurable and significantly more more than 20dB below the levels contributed by the intentional radiators that exceed the 1mW available power threshold.

We do acknowledge that some unintentional radiators that are constantly switching high voltages (100's of volts) and / or currents (10's of amps), and those devices that take advantage of the unrestricted field strength limits in the ISM bands defined in Part 18 of the FCC's rules, may require measurements to determine the rf exposure. These measurements should be limited to the fundamental switching frequencies or ISM frequencies as applicable. The KDB should include examples of devices where the exemption requested above would not apply and the procedures to use to demonstrate compliance for those devices (e.g. rf exposure measurement at specific frequencies based on the attributes of the device).

We respectfully request that the KDB 447498 D01 v7 allow a **categorical** exclusion from routine evaluation *or inherent compliance statement* for unintentional radiators that comply with the unintentional radiated emissions limits with the exceptions noted in the previous paragraph.

Part 2 - Assessment Of Exemption From Routine Evaluation When Considering Composite Devices Consisting Of Unintentional And Intentional Radiators.

As almost all intentional radiators are composite devices that incorporate unintentional radiators (e.g. also fall under the scope of a Part 15 B digital device or receiver) the FCC rules pose a particular problem when applying the procedures to allow exemption from routine evaluation.

47 CFR 1.1307 (b) (3) (ii) (A) limits the exemption from routine evaluation based on an available maximum time-averaged power of no more than 1mW to cases where all rf sources meet the 1mW exemption and the aggregate power across all sources is below 1mW or the sources are separated by at least 2cm.

Applying the rules as written would require routine evaluation of the unintentional radiator for composite devices that includes intentional radiators with an output power exceeding 1mW. The proposed solution for problem 1 is predicated on the total available power from the unintentional radiator being significantly below 1mW. The contribution to the total rf exposure ratio for the unintentional radiator will be significantly less than that of the intentional radiator to the extent that it would be smaller than the measurement uncertainties associated with rf exposure measurements for the intentional radiator subject to routine evaluation.

We request that the FCC OET guidance policies allow the rf sources of the unintentional radiator in a composite device to continue to be exempt from routine evaluation when they qualify under the blanket exemption described in the previous section.

Current FCC policies, such as the permissive change procedures in KDB 178919, separate the contributions from the intentional and unintentional radiators when determining the appropriate compliance procedures. Separating the unintentional radiator aspects of rf exposure, specifically the assessment described in 47 CFR 1.1307 (b) (3) (ii) (A), from those of the intentional radiators does not, therefore, set a new precedent and avoids unnecessary, overly burdensome, technically and economically irrelevant practices for performing routine evaluation for the unintentional rf sources where test procedures and measurement guidance do not exist.

Class A (10m)
Class B (3m)

Product 1 — Class B

Frequency (in MHz)	Corrected meter reading (in dBuV/m)	Convert Log (in dBm)	Convert Linear (in uW)
30.6	39.0	-56.2	0.002384
32.0	36.9	-58.3	0.001470
36.6	34.3	-60.9	0.000808
39.2	32.7	-62.5	0.000559
47.9	34.4	-60.8	0.000826
68.9	30.7	-64.5	0.000353
106.7	37.7	-57.5	0.001767
166.9	32.2	-63.0	0.000498
750.0	44.8	-50.4	0.009062
904.2	29.6	-65.6	0.000274
1088.8	24.9	-70.3	0.000093
1291.9	24.6	-70.6	0.000087
1347.7	30.8	-64.4	0.000361
1373.0	29.4	-65.8	0.000261
1429.4	28.3	-66.9	0.000203
1437.0	29.0	-66.2	0.000238
1506.2	29.4	-65.8	0.000261
3200.5	35.6	-59.6	0.001090
5000.5	44.4	-50.8	0.008265

Product 2 — Class B

Frequency (in MHz)	Corrected meter reading (in dBuV/m)	Convert Log (in dBm)	Convert Linear (in uW)
44.5	25.2	-70.0	0.000099
72.4	25.7	-69.5	0.000111
157.1	26.7	-68.5	0.000140
171.6	25.5	-69.7	0.000106
353.5	27.3	-67.9	0.000161
355.4	34.6	-60.6	0.000865
466.6	29.8	-65.4	0.000287
477.6	31.7	-63.5	0.000444
838.6	33.0	-62.2	0.000599
1325.4	29.6	-65.6	0.000274
1325.6	26.0	-69.2	0.000119
1904.8	33.5	-61.7	0.000672
1993.0	33.5	-61.7	0.000672
2022.1	33.9	-61.3	0.000737
2039.1	33.6	-61.6	0.000687
2042.7	35.2	-60.0	0.000994
2073.8	34.3	-60.9	0.000808
2145.2	32.9	-62.3	0.000585
2275.0	34.9	-60.3	0.000927
2276.2	34.8	-60.4	0.000906
2576.7	34.8	-60.4	0.000906
2674.2	34.2	-61.0	0.000789
2792.2	33.5	-61.7	0.000672
2822.9	31.5	-63.7	0.000424
2864.1	31.3	-63.9	0.000405
4986.3	33.8	-61.4	0.000720

Product 3 — Class B

Frequency (in MHz)	Corrected meter reading (in dBuV/m)	Convert Log (in dBm)	Convert Linear (in uW)
120.0	29.0	-66.2	0.000238
959.6	33.2	-62.0	0.000627
217.9	29.9	-65.3	0.000293
119.9	29.8	-65.4	0.000287
30.3	29.8	-65.4	0.000287
264.0	36.6	-58.6	0.001372
548.1	36.2	-59.0	0.001251
829.2	36.2	-59.0	0.001251
157.2	28.7	-66.5	0.000222
454.5	35.4	-59.8	0.001041
217.8	28.2	-67.0	0.000198
105.7	27.9	-67.3	0.000185
130.8	27.6	-67.6	0.000173
750.0	34.6	-60.6	0.000865
319.4	34.5	-60.7	0.000846
196.1	27.4	-67.8	0.000165
264.0	34.3	-60.9	0.000808
136.9	27.2	-68.0	0.000157
872.6	34.1	-61.1	0.000771
357.7	33.8	-61.4	0.000720
1570.7	33.4	-61.8	0.000657
1499.2	31.6	-63.6	0.000434
1569.8	30.7	-64.5	0.000353
4999.9	33.2	-62.0	0.000627

Product 4

Frequency (in MHz)
205.7
148.3
210.1
151.9
143.2
152.9
146.2
161.6
144.8
149.5
147.2
202.1
194.6
198.5
319.3
104.4
206.1
148.2
149.1
214.3
2131.2
2128.4
2126.8
1993.3
1423.7
1421.6
1998.1
1418.8
2124.3
1415.1

	Product 1	Product 2	Product 3
Sumed Power per product (in uW)	0.000029	0.000014	0.000014

Highest across all 15 products (in mW)	0.006736	**6.7 uW**
Sum of 15 products (in mW)	0.009917	**9.9 uW**

Class B			Product 5	Class B			Product 6	Class A			Product 7	Class B
Corrected meter reading (in dBuV/m)	Convert Log (in dBm)	Convert Linear (in uW)	Frequency (in MHz)	Corrected meter reading (in dBuV/m)	Convert Log (in dBm)	Convert Linear (in uW)	Frequency (in MHz)	Corrected meter reading (in dBuV/m)	Convert Log (in dBm)	Convert Linear (in uW)	Frequency (in MHz)	Corrected meter reading (in dBuV/m)
23.0	-72.2	0.000060	148.5	20.6	-74.6	0.000034	31.0	20.3	-64.5	0.000356	148.3	16.1
22.7	-72.5	0.000056	223.8	18.8	-76.5	0.000023	42.1	23.3	-61.4	0.000719	345.3	21.9
22.4	-72.8	0.000052	297.0	23.2	-72.0	0.000062	49.6	24.8	-60.0	0.000995	445.2	22.6
21.7	-73.5	0.000044	333.0	26.5	-68.8	0.000133	66.1	29.6	-55.2	0.003013	594.5	23.1
21.6	-73.6	0.000043	445.5	23.0	-72.3	0.000059	99.2	32.3	-52.5	0.005610	769.1	26.1
21.3	-73.9	0.000040	594.0	29.6	-65.6	0.000274	800.0	38.3	-46.5	0.022336	900.1	26.5
31.8	-63.4	0.000454	742.5	28.3	-66.9	0.000202	537.0	31.9	-52.9	0.005176	49.4	21.4
31.6	-63.6	0.000434	891.0	29.2	-66.1	0.000247	625.0	37.2	-47.6	0.017378	148.3	22.3
31.4	-63.8	0.000414	129.1	20.1	-75.1	0.000031	716.0	34.6	-50.2	0.009528	161.0	22.8
31.2	-64.0	0.000396	330.4	26.3	-69.0	0.000127	750.0	32.2	-52.6	0.005483	266.7	22.2
31.2	-64.0	0.000396	1782.0	51.9	-43.4	0.046158	800.0	33.4	-51.4	0.007228	382.1	23.7
31.0	-64.2	0.000378	3261.0	51.8	-43.5	0.045107	875.0	33.1	-51.6	0.006871	882.6	26.3
30.9	-64.3	0.000369	5403.0	48.5	-46.8	0.021098	1124.9	41.6	-43.2	0.048084	2207.0	45.4
30.6	-64.6	0.000345	3261.0	48.2	-47.0	0.019826	2400.8	36.7	-48.0	0.015704	2224.6	34.6
37.1	-58.1	0.001539	5981.0	48.7	-46.5	0.022451	4999.9	52.5	-32.2	0.598412	6338.3	36.4
29.5	-65.7	0.000267	9993.0	36.8	-58.4	0.001436	2097.7	32.3	-52.4	0.005715	6355.0	48.4
29.4	-65.8	0.000261	19650.0	45.6	-49.7	0.010781	4400.2	40.6	-44.2	0.037844	6950.0	48.3
29.1	-66.1	0.000244	26160.0	48.4	-46.8	0.020809	5000.1	46.2	-38.6	0.137404	6967.5	36.6
28.5	-66.7	0.000212	21360.0	45.9	-49.3	0.011621	7999.9	46.7	-38.1	0.154170	3193.0	47.5
27.4	-67.8	0.000165	25450.0	48.7	-46.6	0.021991	9999.8	46.5	-38.3	0.147911	3210.7	35.5
27.8	-67.4	0.000181					8000.0	48.9	-35.9	0.260016	5930.5	36.2
27.1	-68.1	0.000154					10000.1	50.2	-34.5	0.351560	5947.0	54.3
26.7	-68.5	0.000140									9755.0	48.1
27.3	-67.9	0.000161									9772.3	37.3
44.4	-50.8	0.008265									28823.5	32.1
44.2	-51.0	0.007893									30051.5	32.2
44.0	-51.2	0.007538									30791.5	32.7
43.9	-51.3	0.007366									28419.2	35.4
43.9	-51.3	0.007366									29590.5	33.4
43.3	-51.9	0.006416									30591.5	34.8
		0.000052				0.000222				0.001842		

		Product 8	Class B			Product 9	Class A			Product 10	Class A	
Convert Log (in dBm)	Convert Linear (in uW)	Frequency (in MHz)	Corrected meter reading (in dBuV/m)	Convert Log (in dBm)	Convert Linear (in uW)	Frequency (in MHz)	Corrected meter reading (in dBuV/m)	Convert Log (in dBm)	Convert Linear (in uW)	Frequency (in MHz)	Corrected meter reading (in dBuV/m)	Convert Log (in dBm)
-79.2	0.000012	51.3	25.4	-69.9	0.000103	250.0	27.3	-57.5	0.001782	537.0	30.9	-53.9
-73.3	0.000046	117.3	21.4	-73.9	0.000041	433.1	27.2	-57.6	0.001750	625.0	33.2	-51.6
-72.6	0.000055	152.2	23.6	-71.6	0.000069	500.0	32.7	-52.1	0.006194	715.9	29.7	-55.1
-72.1	0.000061	179.4	21.5	-73.7	0.000043	625.0	38.0	-46.7	0.021232	750.0	29.9	-54.8
-69.2	0.000121	251.2	31.4	-63.8	0.000415	750.0	33.2	-51.5	0.007015	799.8	30.2	-54.6
-68.8	0.000133	303.5	30.5	-64.7	0.000338	833.0	30.3	-54.5	0.003581	987.7	26.8	-57.9
-73.9	0.000041	55.3	22.3	-72.9	0.000051	33.9	22.1	-62.7	0.000542	158.4	25.8	-59.0
-73.0	0.000050	111.5	21.5	-73.7	0.000042	57.7	26.9	-57.9	0.001618	214.3	22.8	-61.9
-72.4	0.000058	155.1	22.4	-72.9	0.000052	65.0	27.6	-57.2	0.001910	537.0	32.2	-52.6
-73.0	0.000050	224.0	23.5	-71.7	0.000067	424.6	30.5	-54.3	0.003707	625.0	32.0	-52.8
-71.5	0.000071	253.5	31.9	-63.3	0.000466	500.0	35.8	-48.9	0.012794	750.0	31.5	-53.3
-68.9	0.000128	306.9	30.5	-64.8	0.000333	625.0	35.5	-49.3	0.011830	799.8	26.6	-58.2
-49.9	0.010333	1475.6	40.7	-54.6	0.003485	1534.9	42.8	-42.0	0.063826	1297.2	41.1	-43.7
-60.6	0.000861	4160.7	42.6	-52.6	0.005498	1897.4	43.2	-41.6	0.069024	1596.1	36.9	-47.9
-58.9	0.001298	4805.7	41.0	-54.2	0.003804	2137.8	41.1	-43.7	0.042560	2399.9	42.1	-42.7
-46.9	0.020618	1477.6	37.7	-57.5	0.001763	1593.0	37.5	-47.3	0.018578	1298.7	39.4	-45.4
-46.9	0.020382	19488.4	31.8	-63.4	0.000455	1849.4	39.0	-45.8	0.026242	1592.3	35.2	-49.6
-58.6	0.001381	19868.1	31.5	-63.8	0.000419	3586.9	36.1	-48.7	0.013583	2398.4	41.9	-42.8
-47.7	0.016914	20250.5	31.1	-64.2	0.000383							
-59.8	0.001053	19495.3	32.0	-63.3	0.000472							
-59.0	0.001263	20158.2	31.9	-63.3	0.000468							
-41.0	0.080213	21100.4	29.6	-65.6	0.000274							
-47.2	0.019242	30171.4	35.4	-59.9	0.001031							
-57.9	0.001612	30872.5	37.9	-57.4	0.001833							
-63.1	0.000490	31470.7	36.1	-59.1	0.001231							
-63.0	0.000503	29724.4	32.7	-62.5	0.000561							
-62.5	0.000561	30940.4	35.2	-60.0	0.001001							
-59.9	0.001033	32101.6	35.8	-59.5	0.001130							
-61.9	0.000649											
-60.4	0.000906											
	0.000180				0.000024				0.000308			

Convert Linear (in uW)	Product 11 Frequency (in MHz)	Class A Corrected meter reading (in dBuV/m)	Convert Log (in dBm)	Convert Linear (in uW)
0.004121	172.7	21.7	-63.1	0.000492
0.006934	181.3	20.2	-64.6	0.000345
0.003090	560.4	23.0	-61.8	0.000668
0.003289	625.0	34.0	-50.7	0.008453
0.003508	750.0	34.8	-50.0	0.010023
0.001607	916.0	28.7	-56.1	0.002449
0.001253	30.4	20.3	-64.5	0.000358
0.000641	53.8	20.6	-64.2	0.000381
0.005559	150.7	26.0	-58.7	0.001340
0.005260	155.3	25.0	-59.8	0.001054
0.004656	750.0	33.0	-51.8	0.006577
0.001531	912.5	30.1	-54.7	0.003381
0.043053	1094.6	32.3	-52.5	0.005662
0.016331	1265.5	36.3	-48.5	0.014289
0.053456	2198.1	34.5	-50.3	0.009419
0.028708	1279.3	35.0	-49.8	0.010495
0.011066	1460.4	31.7	-53.1	0.004943
0.052000	2190.0	34.9	-49.8	0.010375
0.000246				0.000091

Product 12 Frequency (in MHz)	Class A Corrected meter reading (in dBuV/m)	Convert Log (in dBm)	Convert Linear (in uW)
31.5	30.1	-54.6	0.003443
67.0	23.1	-61.7	0.000673
125.0	27.9	-56.9	0.002042
155.6	23.4	-61.4	0.000729
193.1	21.8	-63.0	0.000500
200.0	23.3	-61.5	0.000706
240.0	23.7	-61.1	0.000785
250.0	23.9	-60.8	0.000826
374.4	26.0	-58.8	0.001315
480.0	23.2	-61.5	0.000703
500.0	26.1	-58.6	0.001368
625.0	29.6	-55.2	0.003055
720.0	25.6	-59.2	0.001208
749.6	34.2	-50.6	0.008710
800.0	25.6	-59.2	0.001199
933.1	36.7	-48.1	0.015668
1000.0	27.6	-57.2	0.001919
64.8	14.3	-70.5	0.000090
125.0	25.5	-59.3	0.001175
135.7	23.1	-61.7	0.000676
165.5	18.2	-66.6	0.000221
195.2	22.4	-62.4	0.000579
200.0	22.2	-62.6	0.000556
250.0	29.1	-55.7	0.002698
374.4	24.0	-60.8	0.000828
500.0	25.5	-59.3	0.001186
624.8	30.3	-54.5	0.003581
720.0	24.2	-60.6	0.000875
749.6	36.7	-48.1	0.015560
933.1	38.7	-46.1	0.024831
1000.0	27.7	-57.1	0.001972

Product 12 Frequency (in MHz)	Class A Corrected meter reading (in dBuV/m)	Convert Log (in dBm)	Convert Linear (in uW)
1654.0	40.9	-43.9	0.040832
1862.0	42.1	-42.7	0.053580
2196.0	41.6	-43.1	0.048529
2868.0	44.1	-40.7	0.085114
4797.0	55.1	-29.6	1.088930
5997.0	48.1	-36.6	0.216770
1862.0	42.8	-42.0	0.063387
2196.0	45.6	-39.2	0.120781
2558.0	44.2	-40.6	0.087700
2788.0	46.3	-38.4	0.143549
4785.0	43.1	-41.6	0.068549
4986.0	47.9	-36.9	0.205589
7977.0	53.0	-31.8	0.668344
11996.0	44.5	-40.3	0.092897
1500.0	39.1	-45.7	0.027164
1758.0	42.5	-42.2	0.059704
2174.0	41.0	-43.8	0.041687
2796.0	42.7	-42.1	0.061944
4785.0	55.0	-29.7	1.061696
5997.0	46.9	-37.9	0.163305
7974.0	52.9	-31.9	0.644169
12000.0	43.2	-41.6	0.069343
1188.0	39.1	-45.7	0.027102
1868.0	42.2	-42.6	0.055335
2214.0	45.3	-39.5	0.112980
475.0	56.0	-28.8	1.327394
4977.0	49.0	-35.8	0.265461
5997.0	49.6	-35.1	0.306902
7974.0	55.1	-29.6	1.086426
12000.0	42.5	-42.3	0.059566
			0.006736

Product 13	Class B		
Frequency (in MHz)	Corrected meter reading (in dBuV/m)	Convert Log (in dBm)	Convert Linear (in uW)
34.8	21.3	-73.9	0.000040
199.7	20.5	-74.7	0.000034
208.9	19.9	-75.3	0.000029
40.0	19.6	-75.6	0.000027
946.0	24.2	-71.0	0.000079
987.3	22.6	-72.6	0.000055
72.1	21.5	-73.7	0.000042
34.8	21.1	-74.1	0.000039
194.9	19.0	-76.2	0.000024
211.3	18.8	-76.4	0.000023
933.3	23.7	-71.5	0.000070
3200.0	52.6	-42.6	0.054606
4800.2	44.5	-50.7	0.008458
6400.0	43.5	-51.7	0.006718
8060.5	40.7	-54.5	0.003526
7736.2	40.3	-54.9	0.003215
1600.0	27.7	-67.5	0.000177

0.000077

Product 14	Class B		
Frequency (in MHz)	Corrected meter reading (in dBuV/m)	Convert Log (in dBm)	Convert Linear (in uW)
188.5	39.7	-55.5	0.002801
225.1	39.4	-55.8	0.002614
217.2	38.4	-56.8	0.002076
960.0	42.7	-52.5	0.005588
216.9	34.5	-60.7	0.000846
224.9	33.0	-62.2	0.000599
1485.9	43.8	-51.4	0.007199
1489.2	43.1	-52.1	0.006127
1482.6	43.1	-52.1	0.006127
1490.1	43.1	-52.1	0.006127
1492.9	42.7	-52.5	0.005588
1496.5	42.7	-52.5	0.005588
1497.8	42.0	-53.2	0.004756
1491.8	41.6	-53.6	0.004338
1475.4	40.9	-54.3	0.003692
1452.8	39.7	-55.5	0.002801
1506.1	40.6	-54.6	0.003445
1500.1	42.2	-53.0	0.004980
1484.7	43.8	-51.4	0.007199
		-95.2	0.000000
		-95.2	0.000000
		-95.2	0.000000
		-95.2	0.000000
		-95.2	0.000000
		-95.2	0.000000
		-95.2	0.000000

0.000082

Product 15	Class B		
Frequency (in MHz)	Corrected meter reading (in dBuV/m)	Convert Log (in dBm)	Convert Linear (in uW)
30.3	23.1	-72.1	0.000061
120.0	26.0	-69.2	0.000119
125.0	28.9	-66.3	0.000233
137.3	18.1	-77.1	0.000019
150.0	25.9	-69.3	0.000117
156.0	19.2	-76.0	0.000025
195.7	24.5	-70.7	0.000085
377.7	21.1	-74.1	0.000039
382.6	20.0	-75.2	0.000030
392.7	18.6	-76.6	0.000022
400.5	17.5	-77.7	0.000017
411.3	17.7	-77.5	0.000018
463.5	18.6	-76.6	0.000022
483.6	21.7	-73.5	0.000044
960.4	24.4	-70.8	0.000083
14238.3	33.2	-62.0	0.000627
17992.3	37.1	-58.1	0.001539
17864.2	36.4	-58.8	0.001310
17784.6	36.5	-58.7	0.001340
17603.3	36.0	-59.2	0.001195
17362.1	35.7	-59.5	0.001115

0.000008

SAR Plots

The following plots are presented to demonstrate that the contribution to the rf exposure budget from the unintentional radiator within common consumer devices is negligible. The devices selected (phones, smart watches, tablets etc) contain densely packed, high speed components and any significant rf exposure levels / SAR levels from these should show up on the area scans around the intentional radiator's antenna.

0mm Rear of Phone A (PY7-77310Z)

This plot shows levels away from the active (intentional) antenna 40dB or more below the intentional levels. The highest 1g SAR value is 1.7 W/Kg (this device was being tested for extremity SAR at 0mm) and a value 40dB below this would be 0.0002 W/Kg (0.01% of the limit).

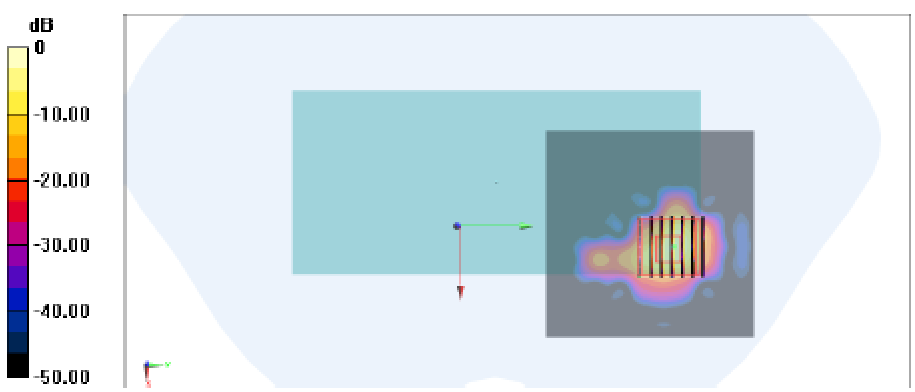
#51_WLAN5GHz_802.11ac-VHT80 MCS0_Back_0mm_Ch155

Communication System: 802.11ac; Frequency: 5775 MHz;Duty Cycle: 1:1
Medium: HSL_5G_200810 Medium parameters used: f = 5775 MHz; σ = 5.183 S/m; ε_r = 35.826; ρ = 1000 kg/m^3
Ambient Temperature：23.4 ℃; Liquid Temperature：22.4 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3642; ConvF(4.17, 4.17, 4.17) @ 5775 MHz; Calibrated: 2020/4/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn376; Calibrated: 2019/12/6
- Phantom: SAM_Right; Type: SAM; Serial: TP:1681
- Measurement SW: DASY52, Version 52.10 (4);SEMCAD X Version 14.6.14 (7483)

Area Scan (81x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 3.04 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 12.17 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 11.5 W/kg
SAR(1 g) = 1.69 W/kg; SAR(10 g) = 0.324 W/kg
Maximum value of SAR (measured) = 5.99 W/kg



0 dB = 5.99 W/kg = 7.77 dBW/kg

0mm Rear of Smart Watch (BCG-A2376)

This plot shows levels away from the active (intentional) antenna at levels below 25% of the highest peak SAR value. The highest 10g SAR value for the intentional signal is 0.02 W/Kg (this device was being tested for extremity SAR at 0mm) and a value of 25% of this would be 0.005 W/Kg (0.3% of the limit). These levels are still likely sourced by the intentional radiator and not the unintentional signals indicating they would be even lower.

DUT: BCG-A2376; Type: Watch; Serial: GY6CR005Q620

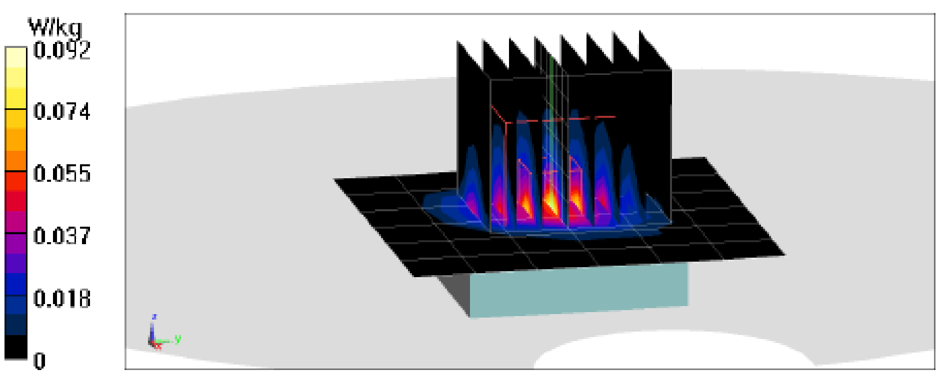
Communication System: UID 0, Bluetooth; Frequency: 2441 MHz; Duty Cycle: 1:1
Medium: 2450 MHz Body Medium parameters used (interpolated):
f = 2441 MHz; σ = 1.999 S/m; ε_r = 51.282; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 07-27-2020; Ambient Temp: 23.3°C; Tissue Temp: 22.9°C

Probe: EX3DV4 - SN3949; ConvF(7.75, 7.75, 7.75) @ 2441 MHz; Calibrated: 8/29/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 8/12/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1596
Measurement SW: DASY52, Version 52.10 (4);SEMCAD X Version 14.6.14 (7483)

Mode: Bluetooth, Extremity SAR, Ch 39, 1 Mbps, Back Side Titanium, Sport Wrist Band

Area Scan (7x7x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x8x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.198 V/m; Power Drift = 0.17 dB
Peak SAR (extrapolated) = 0.117 W/kg
SAR(10 g) = 0.020 W/kg
Smallest distance from peaks to all points 3 dB below: Larger than measurement grid
Ratio of SAR at M2 to SAR at M1 = 47.3%



Left Touch - Bluetooth of Smart Phone (LM-X320EMW)

This plot shows levels away from the active (intentional) antenna at levels 40dB or more below the intentional signal. The zoomed hot spot clearly shows some levels at 30 to 40dB below the hot spot level which are likely related to the intentional signal, but even if not at 30dB lower than the highest 1g SAR value of 0.096 W/Kg they would be 0.00096 W/Kg (0.06% of the limit).

DUT: LM-X320EMW; Type: Bar

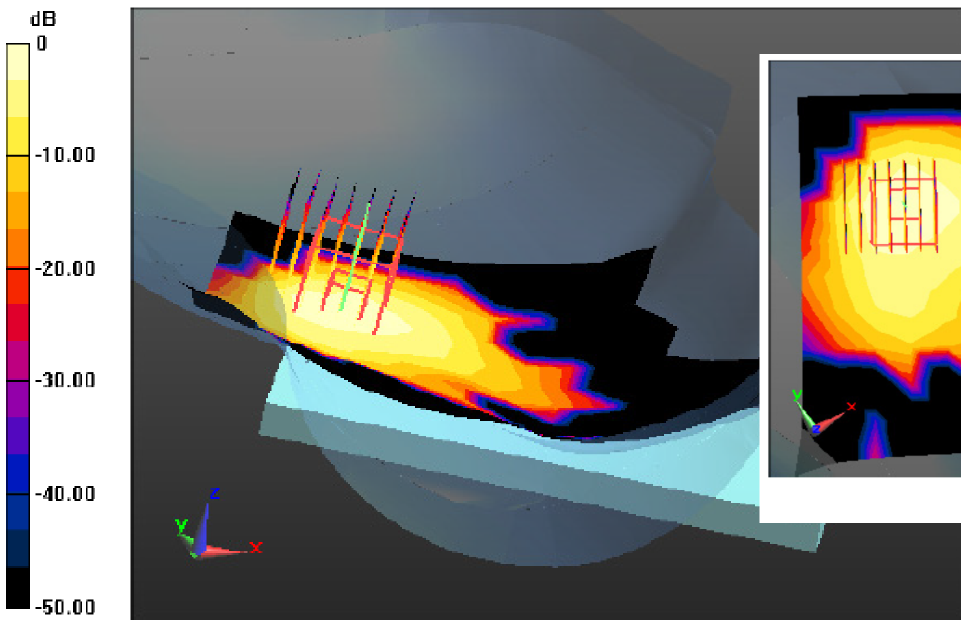
Communication System: UID 0, Bluetooth (0); Frequency: 2441 MHz;Duty Cycle: 1:1.302
Medium parameters used: f = 2441 MHz; σ = 1.845 S/m; ε_r = 38.386; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY5 Configuration:
Probe: EX3DV4 - SN3933; ConvF(7.61, 7.61, 7.61); Calibrated: 9/25/2018; Electronics: DAE4 Sn1396
Sensor-Surface: 2mm (Mechanical Surface Detection)
Phantom: SAM with CRP_2016_07_22_middle; Type: QD000P40CD; Serial: TP:1786
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

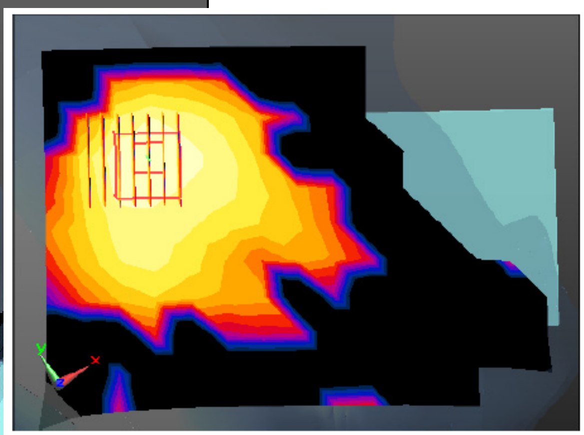
Test Date: 2019-05-14; Ambient Temp: 21.3; Tissue Temp: 21.6

Left Touch, Bluetooth BDR 1M Ch. 39, Ant Internal, Standard Battery

Area Scan (11x17x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Power Drift = 0.18 dB
Peak SAR (extrapolated) = 0.219 W/kg
SAR(1 g) = 0.096 W/kg; SAR(10 g) = 0.044 W/kg



0 dB = 0.150 W/kg



Enlarged Plot for A8

A8

Bottom Edge at 0mm NFC of Smart Phone (C3K1995)

This plot shows levels from the intentional radiator that are un-measurable which suggests that the associated unintentional radiators within the device are similarly not measurable.

PCTEST

DUT: C3K1995; Type: Portable Handset; Serial: YM212

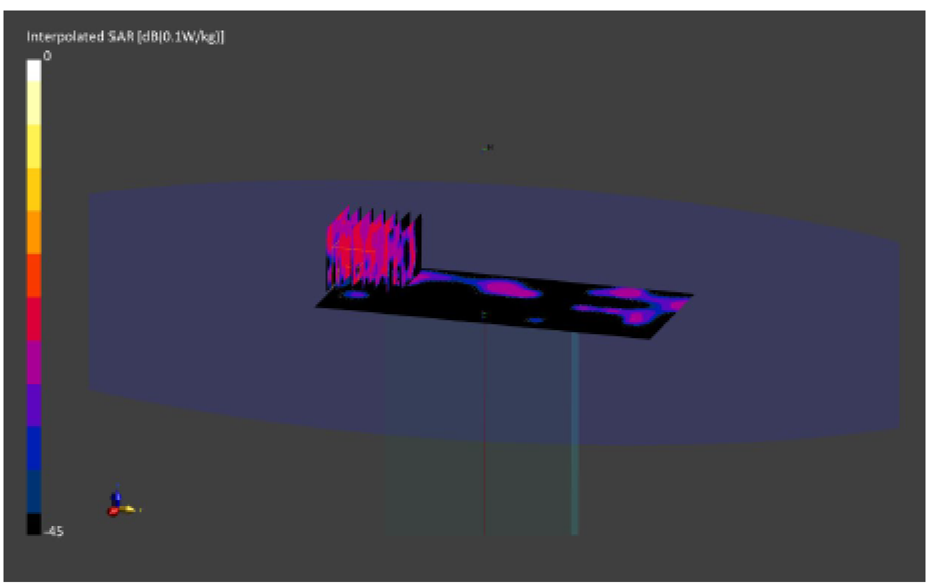
Communication System: UID:0: CW; Frequency: 13.6 MHz
Medium: 13 MHz; Medium parameters used:
f = 13.6 MHz; cond = 0.744 S/m; perm = 53.3; density = 1000 kg/m3
Phantom Section: Flat; Space: 0.00 mm

Test Date: 09/08/2021; Ambient Temp: 22.2°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN3914; ConvF:(18.18,18.18,18.18); Calibrated: 2021-05-18
Sensor-Surface: 1.4mm (VMS + 6p)
Electronics: DAE4 Sn728; Calibrated: 2021-05-11
Phantom: ELI V4.0 (20deg probe tilt); Serial: 1202
Measurement SW: DASY Module SAR V16.0.0.65

Mode: NFC, Flat Configuration, Body SAR, Bottom Edge

Area Scan (48.0 x 150.0): Measurement grid: dx=12.0 mm, dy=15.0 mm
Zoom Scan (30.0 x 30.0 x 30.0): Measurement grid: dx=6.0 mm, dy=6.0 mm, dz=1.5 mm; Graded Ratio: 1.5
Reference Value = 0.00 W/kg; Power Drift = -0.19 dB
Peak SAR (extrapolated) = 0 W/kg
SAR(1 g) = 0 W/kg



Comparison of SAR Levels With and Without Intentional Radiator Active in Smart Phone

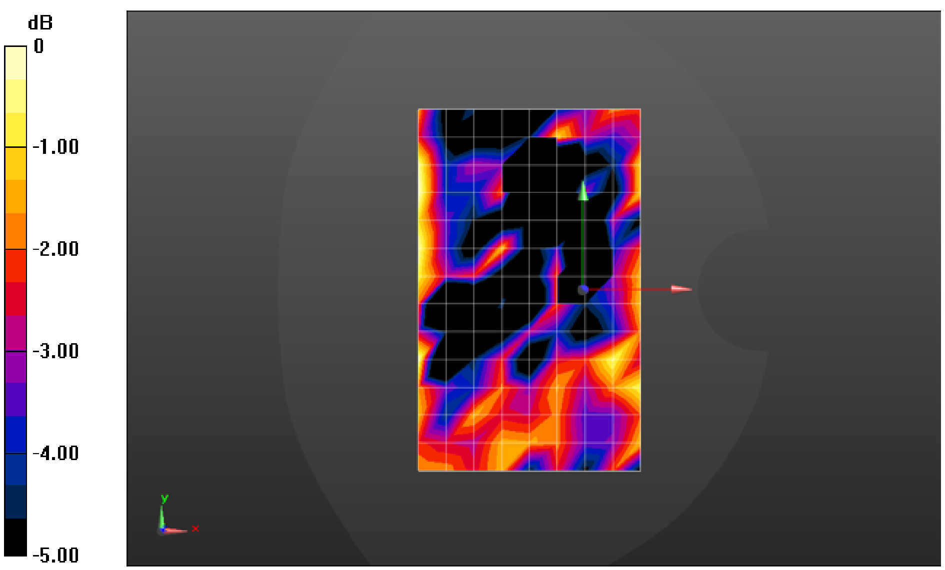
Side-by-side plots - for the unintentional radiator scan the system was exercised in airplane mode with camera on recording video and screen on. For the intentional radiator the Bluetooth was active at the low power setting. For airplane mode the highest SAR levels were **0.00187 W/Kg**, 1.5% of the Bluetooth SAR level of **0.127 W/Kg**.

Airplane mode, Display on, Front camera recording.

Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.799 S/m; ε_r = 39.496; ρ = 1000 kg/m³
Dasy Configuration:
- Area Scan Setting: Find Secondary Maximum within 2.0 dB and with a peak SAR value greater than 0.0012 W/kg
- Electronics: DAE4 Sn1359; Calibrated: 1/7/2022
- Probe: EX3DV4 - SN3991; ConvF(8.03, 8.03, 8.03) @ 2437 MHz; Calibrated: 8/20/2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: Twin-SAM V8.0 (20deg probe tilt); Type: QD 000 P41 AA; Serial: 1956

Rear/Area Scan (9x14x1): Measurement grid: dx=12mm, dy=12mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.00187 W/kg



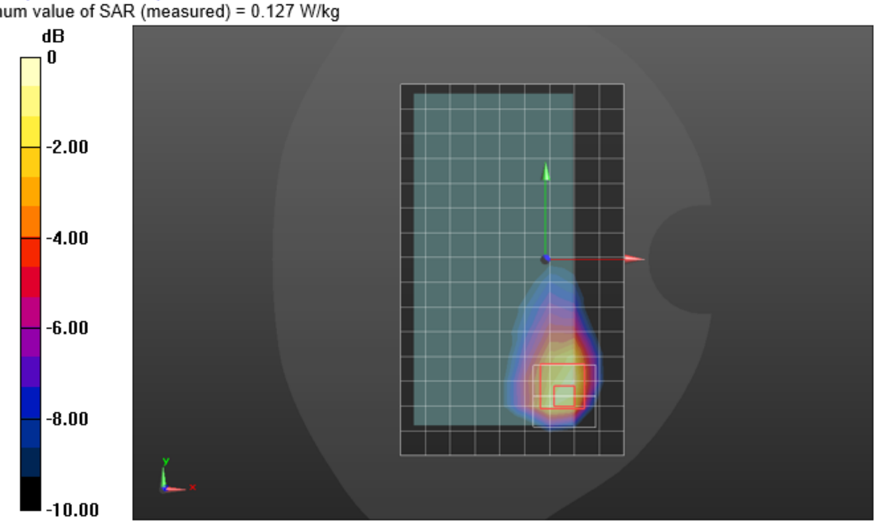
0 dB = 0.00187 W/kg = -27.28 dBW/kg

Bluetooth ANT 3 Plow

Frequency: 2441 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C
Medium parameters used (interpolated): f = 2441 MHz; σ = 1.729 S/m; ε_r = 37.417; ρ = 1000 kg/m³
DASY5 Configuration:
- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1540; Calibrated: 1/27/2021
- Probe: EX3DV4 - SN7500; ConvF(7.69, 7.69, 7.69) @ 2441 MHz; Calibrated: 3/18/2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: Twin-SAM V5.0 (30deg probe tilt); Type: QD 000 P40 CD; Serial: 1831

Rear/GFSK DH5_ch 39/Area Scan (10x16x1): Measurement grid: dx=12mm, dy=12mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.113 W/kg

Rear/GFSK DH5_ch 39/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.182 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 0.177 W/kg
SAR(1 g) = 0.068 W/kg; SAR(10 g) = 0.032 W/kg
Smallest distance from peaks to all points 3 dB below = 7.1 mm
Ratio of SAR at M2 to SAR at M1 = 39.5%
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.127 W/kg



0 dB = 0.127 W/kg = -8.96 dBW/kg