

Appendix A. Test Sequences

1. Test sequence is generated based on below parameters of the EUT:

a Measured maximum power (P_{max})

b Measured Tx_power_at_SAR_design_target (P_{limit})

c Reserve_power_margin (dB)

• $P_{reserve}$ (dBm) = measured P_{limit} (dBm) – Reserve_power_margin (dB)

d SAR_time_window (100s for FCC)

2. Test Sequence 1 Waveform:

Based on the parameters above, the Test Sequence 1 is generated with one transition between high and low Tx powers. Here, high power = P_{max} ; low power = $P_{max}/2$, and the transition occurs after 80 seconds at high power P_{max} . As long as the power enforcement is taking into effective during one 100s/60s time window, the validation test with this defined test sequence 1 is valid, otherwise, select other radio configuration (band/DSI within the same technology group) having lower P_{limit} for this test. The Test sequence 1 waveform is shown below:

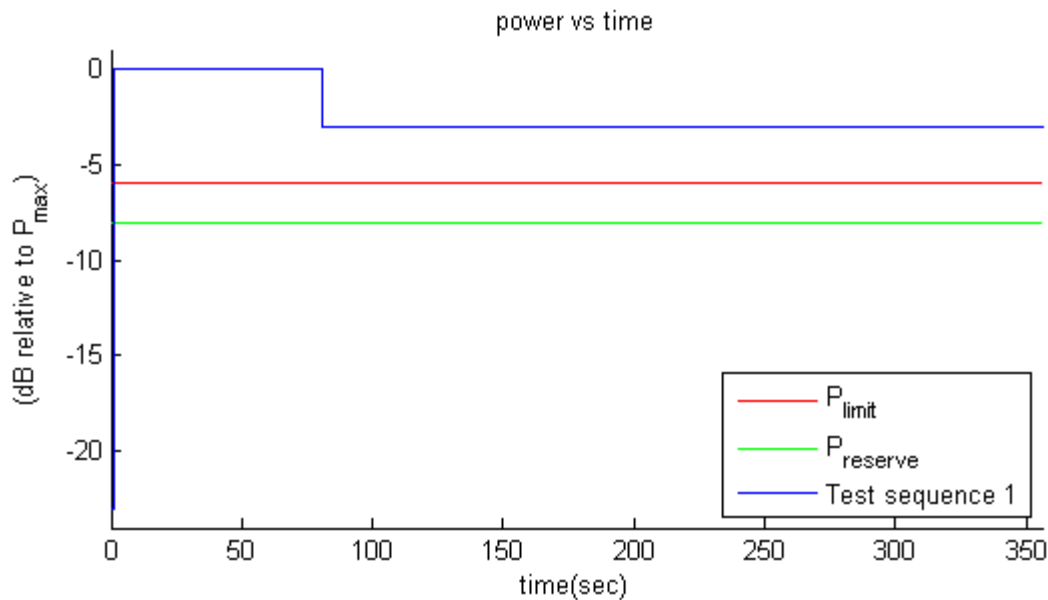


Figure A-1 Test sequence 1 waveform

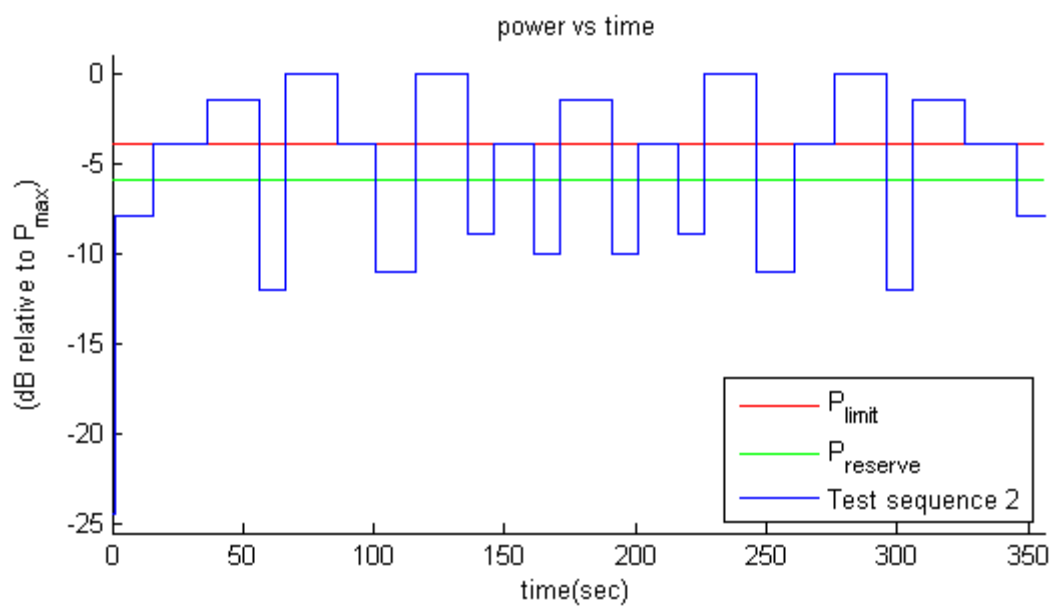
3. Test Sequence 2 Waveform:

Based on the parameters in A-1, the Test Sequence 2 is generated as described in Table 10-1, which contains two 170 second-long sequences (yellow and green highlighted rows) that are mirrored around the center row of 20s, resulting in a total duration of 360 seconds:

Table A-1 Test Sequence 2

Time duration (seconds)	dB relative to P_{limit} or $P_{reserve}$
15	$P_{reserve}$
20	P_{limit}
20	$(P_{limit} + P_{max})/2$ averaged in mW and rounded to nearest 0.1 dB step
10	$P_{reserve}$
20	P_{max}
15	P_{limit}
15	$P_{reserve}$
20	P_{max}
10	$P_{reserve}$
15	P_{limit}
10	$P_{reserve}$
20	$(P_{limit} + P_{max})/2$ averaged in mW and rounded to nearest 0.1 dB step
10	$P_{reserve}$
15	P_{limit}
10	$P_{reserve}$
20	P_{max}
15	$P_{reserve}$
15	P_{limit}
20	P_{max}
10	$P_{reserve}$
20	$(P_{limit} + P_{max})/2$ averaged in mW and rounded to nearest 0.1 dB step
20	P_{limit}
15	$P_{reserve}$

The Test Sequence 2 waveform is shown in Figure A-2.



Appendix B Test Procedures for sub6 NR + LTE Radio

Appendix B provides the test procedures for validating Qualcomm Smart Transmit feature for LTE + Sub6 NR non-standalone (NSA) mode transmission scenario, where sub-6GHz LTE link acts as an anchor.

B.1 Time-varying Tx power test for sub6 NR in NSA mode

Follows Section 3.2.1 to select test configurations for time-varying test. This test is performed with two pre-defined test sequences (described in Section 3.1) applied to Sub6 NR (with LTE on all-down bits or low power for the entire test after establishing the LTE+Sub6 NR call with the callbox). Follow the test procedures described in Section 3.3.1 to demonstrate the effectiveness of power limiting enforcement and that the time averaged Tx power of Sub6 NR when converted into 1gSAR values does not exceed the regulatory limit at all times (see Eq. (1a) and (1b)). Sub6 NR response to test sequence1 and test sequence2 will be similar to other technologies (say, LTE), and are shown in Sections 5

B.2 Switch in SAR exposure between LTE vs. Sub6 NR during transmission

This test is to demonstrate that Smart Transmit feature accurately accounts for switching in exposures among SAR for LTE radio only, SAR from both LTE radio and sub6 NR, and SAR from sub6 NR only scenarios, and ensures total time-averaged RF exposure compliance with FCC limit.

Test procedure:

1. Measure conducted Tx power corresponding to P_{limit} for LTE and sub6 NR in selected band. Test condition to measure conducted P_{limit} is:

Establish device in call with the callbox for LTE in desired band. Measure conducted Tx power corresponding to LTE P_{limit} with Smart Transmit enabled and *Reserve_power_margin* set to 0 dB, callbox set to request maximum power.

Repeat above step to measure conducted Tx power corresponding to Sub6 NR P_{limit} . If testing LTE+Sub6 NR in non-standalone mode, then establish LTE+Sub6 NR call with callbox and request all down bits for radio1 LTE. In this scenario, with callbox requesting maximum power from Sub6

NR, measured conducted Tx power corresponds to radio2 P_{limit} (as radio1 LTE is at all-down bits)

2. Set *Reserve_power_margin* to actual (intended) value with EUT setup for LTE + Sub6 NR call. First, establish LTE connection in all-up bits with the callbox, and then Sub6 NR connection is added with callbox requesting UE to transmit at maximum power in Sub6 NR. As soon as the Sub6 NR connection is established, request all- down bits on LTE link (otherwise, Sub6 NR will not have sufficient RF exposure margin to sustain the call with LTE in all-up bits). Continue LTE (all-down bits)+Sub6 NR transmission for more than one time-window duration to test predominantly Sub6 NR SAR exposure scenario (as SAR exposure is negligible from all-down bits in LTE). After at least one time-window, request LTE to go all-up bits to test LTE SAR and Sub6 NR SAR exposure scenario. After at least one more time-window, drop (or request all-down bits) Sub6 NR transmission to test predominantly LTE SAR exposure scenario. Continue the test for at least one more time-window. Record the conducted Tx powers for both LTE and Sub6 NR for the entire duration of this test.

3. Once the measurement is done, extract instantaneous Tx power versus time for both LTE and Sub6 NR links. Similar to technology/band switch test in Section 3.3.3, convert the conducted Tx power for both these radios into 1gSAR value (see Eq. (6a) and (6b)) using corresponding technology/band P_{limit} measured in Step 1, and then perform 100s running average to determine time-averaged 1gSAR versus time as illustrated in Figure 3-1. Note that here it is assumed both radios have Tx frequencies < 3GHz, otherwise, 60s running average should be performed for radios having Tx frequency between 3GHz and 6GHz.

4. Make one plot containing: (a) instantaneous Tx power versus time measured in Step2.

5. Make another plot containing: (a) instantaneous 1gSAR versus time determined in Step 3, (b) computed time-averaged 1gSAR versus time determined in Step 3, and (c) corresponding regulatory $1gSAR_{limit}$ of 1.6W/kg.

The validation criteria is, at all times, the time-averaged 1gSAR versus time shall not exceed the regulatory $1gSAR_{limit}$ of 1.6W/kg.

Appendix C DASY6 System Validation

C.1 SAR system verification and validation

Table C-1 provides the list of calibrated equipment for SAR measurement system verification.

Table C-1 List of calibrated equipment

	Name	Type	Serial Number	Calibration Date	Valid Period
01	Network analyzer	E5071C	MY46110673	January 4, 2022	One year
02	Power sensor	NRP110T	101139	January 13, 2022	One year
03	Power sensor	NRP110T	101159		
05	Signal Generator	E4438C	MY49071430	January 13, 2022	One Year
06	Amplifier	60S1G4	0331848	No Calibration Requested	
07	Dual directional coupler	778D	MY48220216	No Calibration Requested	
08	Dual directional coupler	772D	MY46151265	No Calibration Requested	
09	BTS	CMW500	170672	April 04 2022	One year
10	5G Wireless Test Platform	E7515B	MY60192696	July 15,2022	One year
11	E-field Probe	SPEAG EX3DV4	3617	March 11, 2022	One year
12	DAE	SPEAG DAE4	777	January 7 2022	One year
13	Dipole Validation Kit	SPEAG D1750V2	1003	July 18,2022	One year
14	Dipole Validation Kit	SPEAG D1900V2	5d101	July 26,,2022	One year
15	Dipole Validation Kit	SPEAG D2600V2	1012	July 20,2022	One year
16	Dipole Validation Kit	SPEAG D3500V2	1016	July 01,2022	One year

Note: According to KDB 865664 D01, longer calibration intervals of up to three years may be considered when it is demonstrated that the SAR target, impedance and return loss of a dipole have remain stable according to the KDB requirements, refer to the appendix I for details in Part1 report.

The system verification was performed using a dipole antenna against the flat section of the SAM phantom. Table C-2 shows the verification test results. The measured SAR values for the frequency bands of interest were within $\pm 10\%$ of the corresponding target SAR levels.

Table C-1 System validation results

Calibration Date	Frequency	Target value (W/kg)		Measured value (W/kg)		Deviation	
		10 g Average	1 g Average	10 g Average	1 g Average	10 g Average	1 g Average
2022/11/10	1750 MHz	19.3	36.8	19.2	36.3	-0.52%	-1.41%
2022/11/11	1900 MHz	20.7	39.7	20.3	39.2	-2.03%	-1.36%
2022/11/12	2600 MHz	25.2	55.8	24.7	56.0	-2.06%	0.36%
2022/11/13	3500 MHz	25.3	67.50	25.2	66.2	-0.40%	-1.93%

Table C-2 Tissue dielectric properties at the time of testing

Measurement Date yyyy/mm/dd	Frequency	Type	Permittivity ϵ	Drift (%)	Conductivity σ (S/m)	Drift (%)
2022/11/10	1750 MHz	Head	41.84	4.39	1.355	-1.09
2022/11/11	1900 MHz	Head	41.43	3.58	1.442	3.00
2022/11/12	2600 MHz	Head	40.43	3.64	1.956	-0.20
2022/11/13	3500 MHz	Head	39.39	3.85	2.81	-3.44

1750 MHz

Date: 11/10/2022

Electronics: DAE4 Sn777

Medium: H700-6000M

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.355$ S/m; $\epsilon_r = 41.84$; $\rho = 1000$ kg/m³

Ambient Temperature: 23.3°C Liquid Temperature: 22.5°C

Communication System: CW (0) Frequency: 1750 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN3617 ConvF(8.21, 8.21, 8.21)

Area Scan (61x61x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm

Maximum value of SAR (interpolated) = 14.3 W/kg

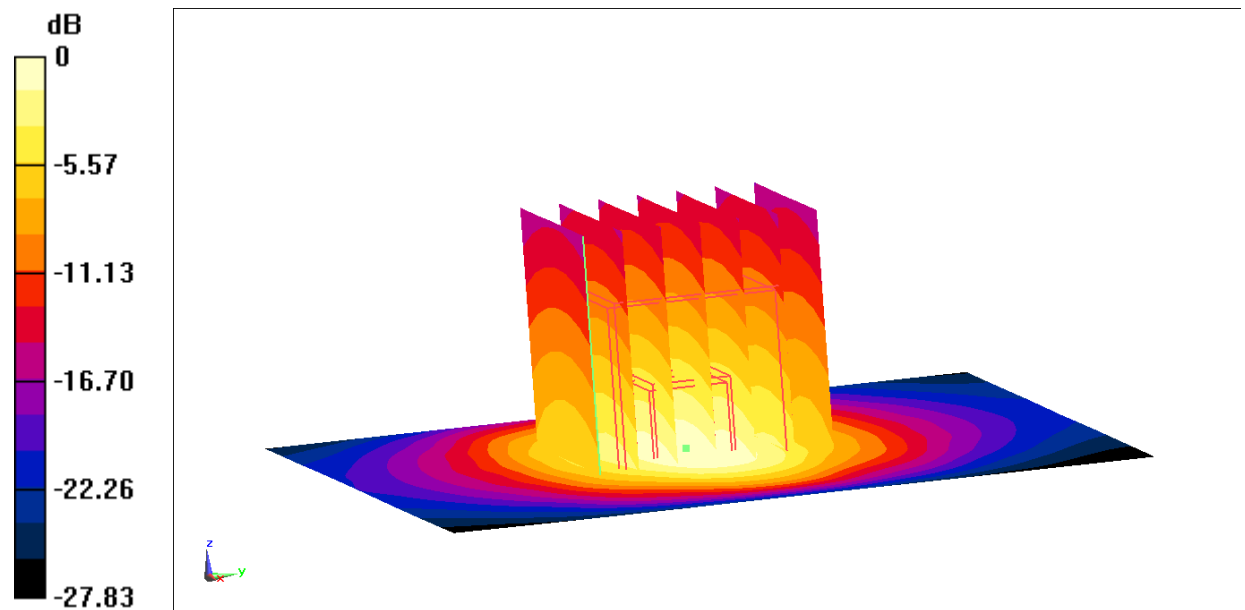
Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 97.27 V/m; Power Drift = -0.11 dB

Peak SAR (extrapolated) = 16.8 W/kg

SAR(1 g) = 9.07 W/kg; SAR(10 g) = 4.81 W/kg

Maximum value of SAR (measured) = 13.9 W/kg



0 dB = 13.9 W/kg = 11.43 dBW/kg

1900 MHz

Date: 11/11/2022

Electronics: DAE4 Sn777

Medium: H700-6000M

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.442$ S/m; $\epsilon_r = 41.43$; $\rho = 1000$ kg/m³

Ambient Temperature: 23.3°C Liquid Temperature: 22.5°C

Communication System: CW (0) Frequency: 1900 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN3617 ConvF(8.08, 8.08, 8.08)

Area Scan (61x61x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm

Maximum value of SAR (interpolated) = 15.7 W/kg

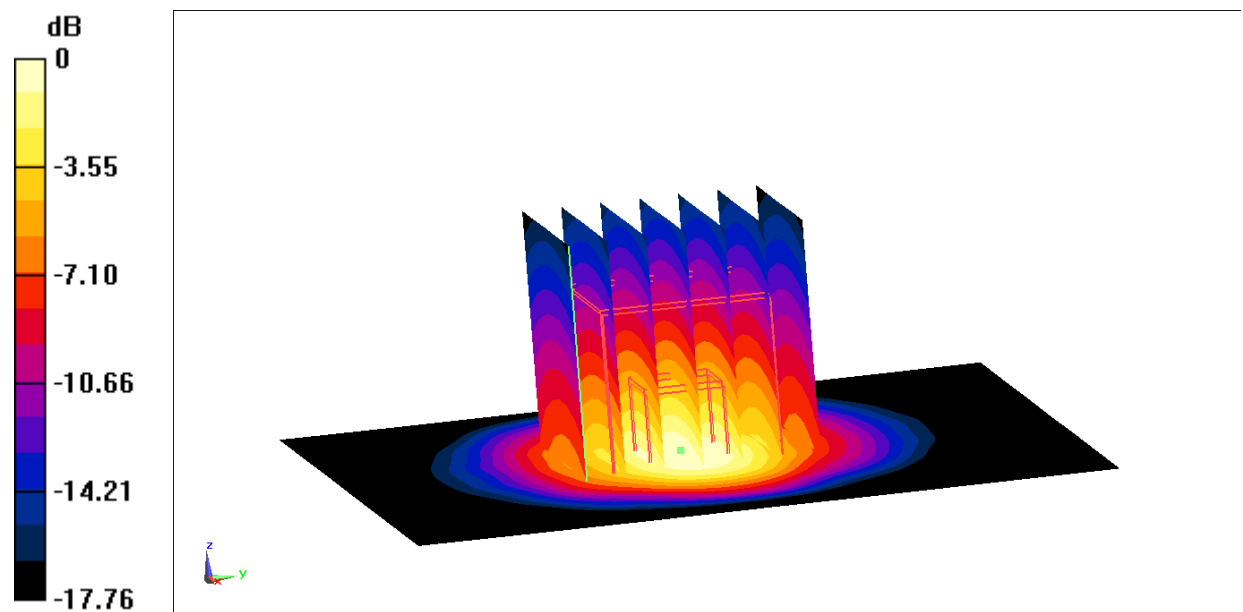
Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 100.1 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 18.6 W/kg

SAR(1 g) = 9.79 W/kg; SAR(10 g) = 5.07 W/kg

Maximum value of SAR (measured) = 15.3 W/kg



0 dB = 15.3 W/kg = 11.85 dBW/kg

2600MHz

Date: 11/12/2022

Electronics: DAE4 Sn777

Medium: H700-6000M

Medium parameters used: $f = 2600$ MHz; $\sigma = 1.956$ S/m; $\epsilon_r = 40.43$; $\rho = 1000$ kg/m³

Ambient Temperature: 23.3°C Liquid Temperature: 22.5°C

Communication System: CW (0) Frequency: 2600 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN3617 ConvF(7.4, 7.4, 7.4)

Area Scan (61x61x1): Interpolated grid: $dx=1.200$ mm, $dy=1.200$ mm

Maximum value of SAR (interpolated) = 24.0 W/kg

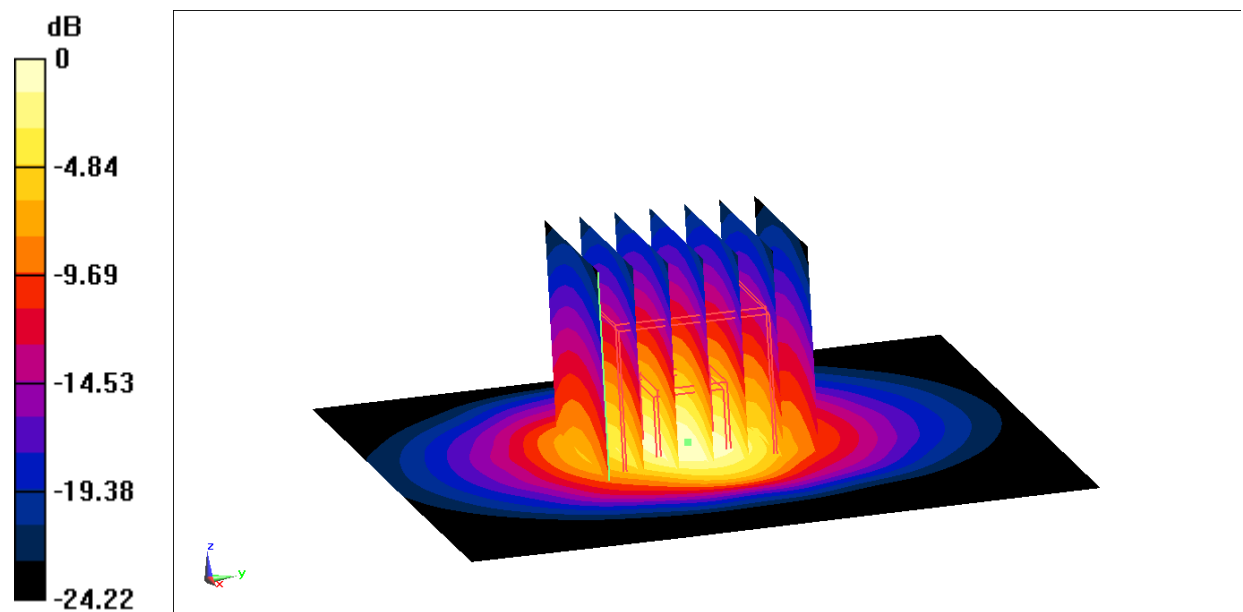
Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 106.0 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 30.7 W/kg

SAR(1 g) = 14 W/kg; SAR(10 g) = 6.17 W/kg

Maximum value of SAR (measured) = 24.1 W/kg



0 dB = 24.1 W/kg = 13.82 dBW/kg

3500MHz

Date: 11/13/2022

Electronics: DAE4 Sn777

Medium: H700-6000M

Medium parameters used: $f = 3500$ MHz; $\sigma = 2.81$ S/m; $\epsilon_r = 39.39$; $\rho = 1000$ kg/m³

Ambient Temperature: 23.3°C Liquid Temperature: 22.5°C

Communication System: CW (0) Frequency: 3500 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN3617 ConvF(6.85, 6.85, 6.85)

Area Scan (91x91x1): Interpolated grid: $dx=1.000$ mm, $dy=1.000$ mm

Maximum value of SAR (interpolated) = 12.9 W/kg

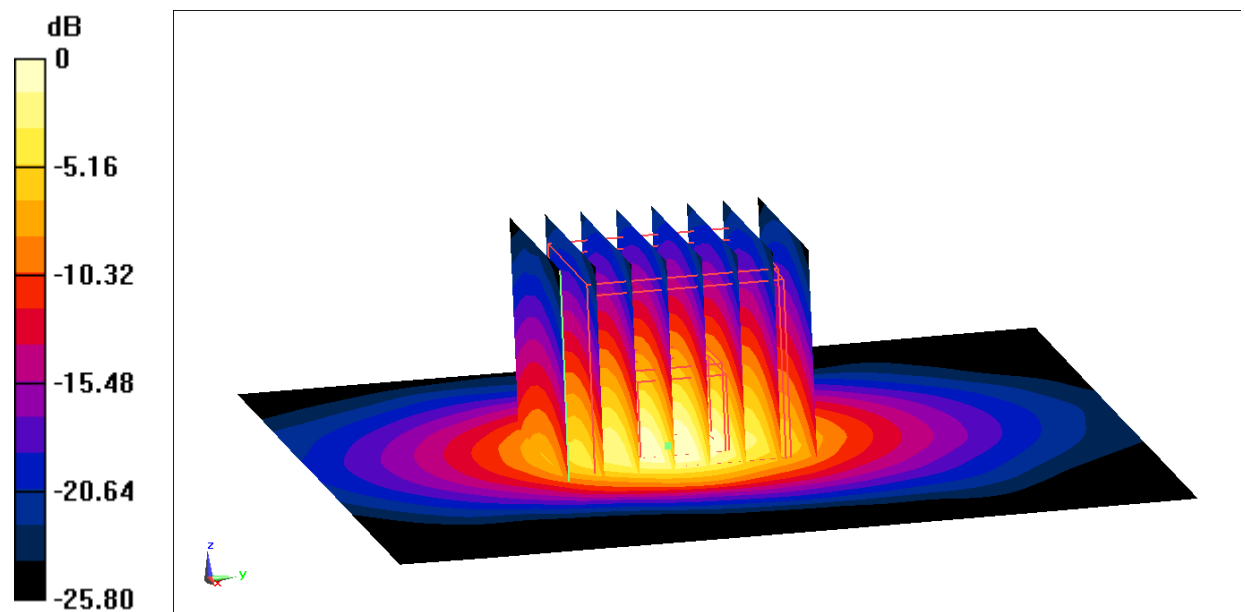
Zoom Scan (4x4x1.4mm, graded), $dist=1.4$ mm (8x8x7)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=1.4$ mm

Reference Value = 62.51 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 16.2 W/kg

SAR(1 g) = 6.62 W/kg; SAR(10 g) = 2.52 W/kg

Maximum value of SAR (measured) = 12.4 W/kg



0 dB = 12.4 W/kg = 10.93 dBW/kg