# 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:

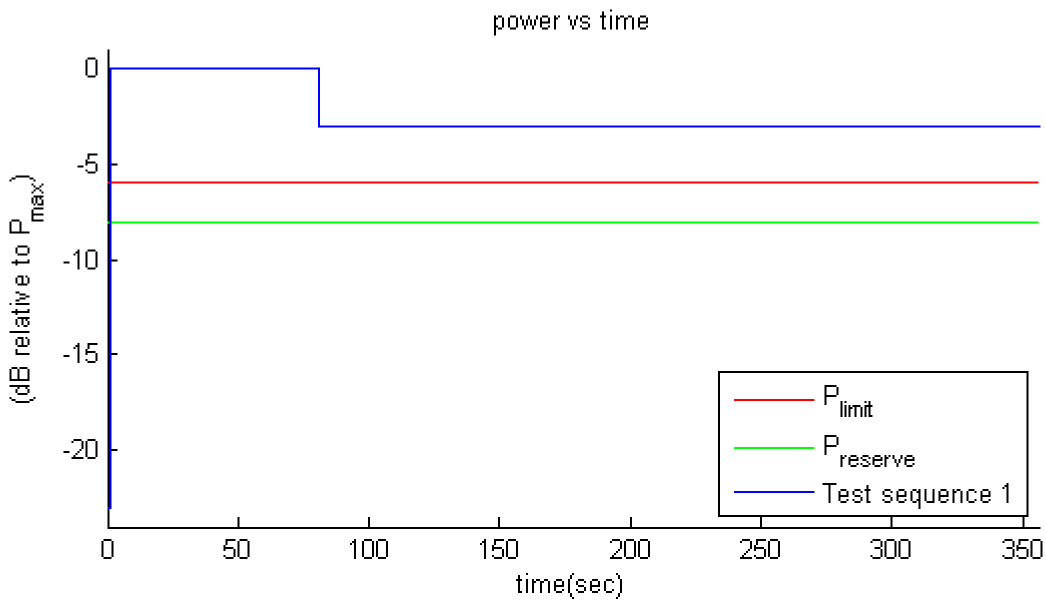



**Figure A-1 Test sequence 1 waveform**

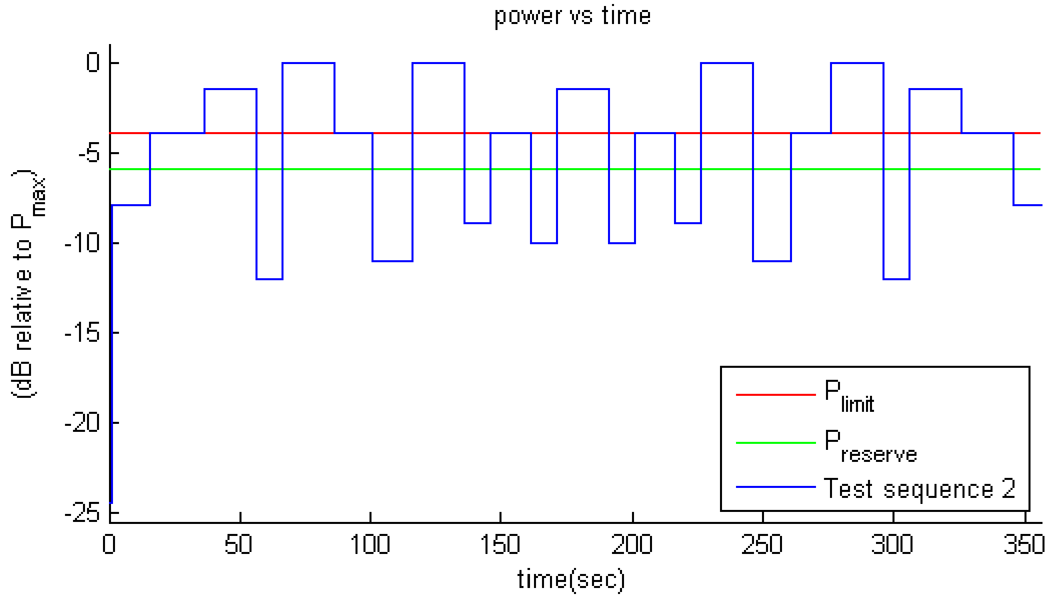
3. Test Sequence 2 Waveform:

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 | $P_{reser}$ |
| 20 | $P_{limit}$ |
| 20 | $(P_{limit} + P_{max})/2$ averaged in mW and rounded to nearest 0.1 dB step |
| 10 | $P_{reser}$ |
| 20 | $P_{max}$ |
| 15 | $P_{limit}$ |
| 15 | $P_{reser}$ |
| 20 | $P_{max}$ |
| 10 | $P_{reser}$ |
| 15 | $P_{limit}$ |
| 10 | $P_{reser}$ |
| 20 | $(P_{limit} + P_{max})/2$ averaged in mW and rounded to nearest 0.1 dB step |
| 10 | $P_{reser}$ |
| 15 | $P_{limit}$ |
| 10 | $P_{reser}$ |
| 20 | $P_{max}$ |
| 15 | $P_{reser}$ |
| 15 | $P_{limit}$ |
| 20 | $P_{max}$ |
| 10 | $P_{reser}$ |
| 20 | $(P_{limit} + P_{max})/2$ averaged in mW and rounded to nearest 0.1 dB step |
| 20 | $P_{limit}$ |
| 15 | $P_{reser}$ |

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 ±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; σ = 1.355 S/m; εr = 41.84; ρ = 1000 kg/m3

Ambient Temperature:23.3℃          Liquid Temperature: 22.5℃

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

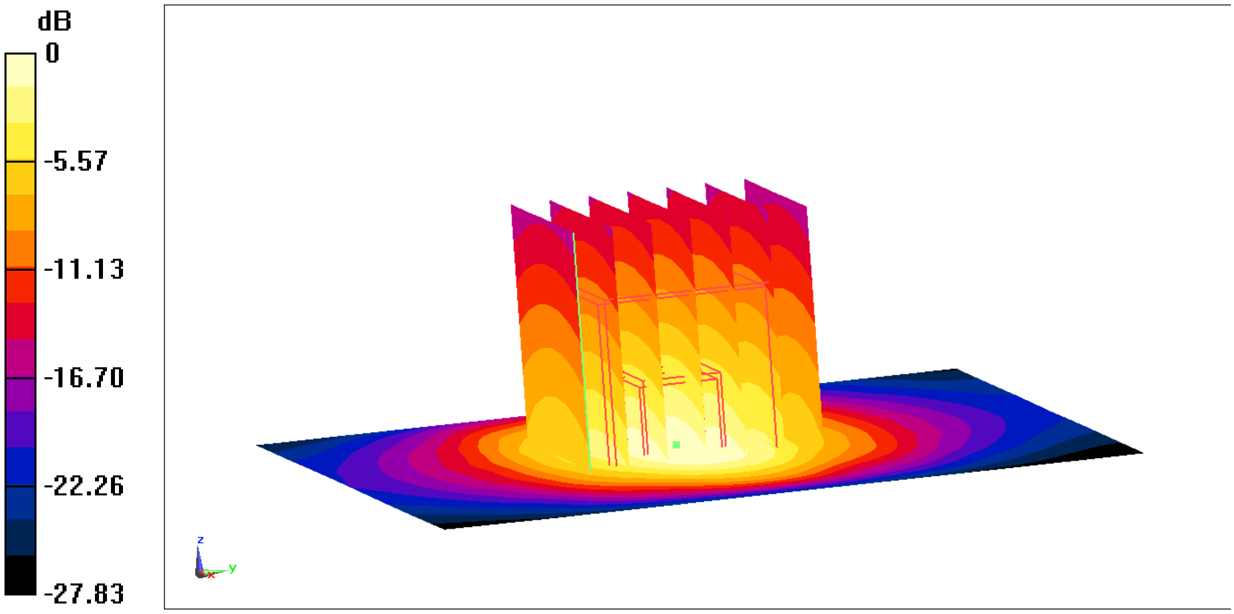
Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

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



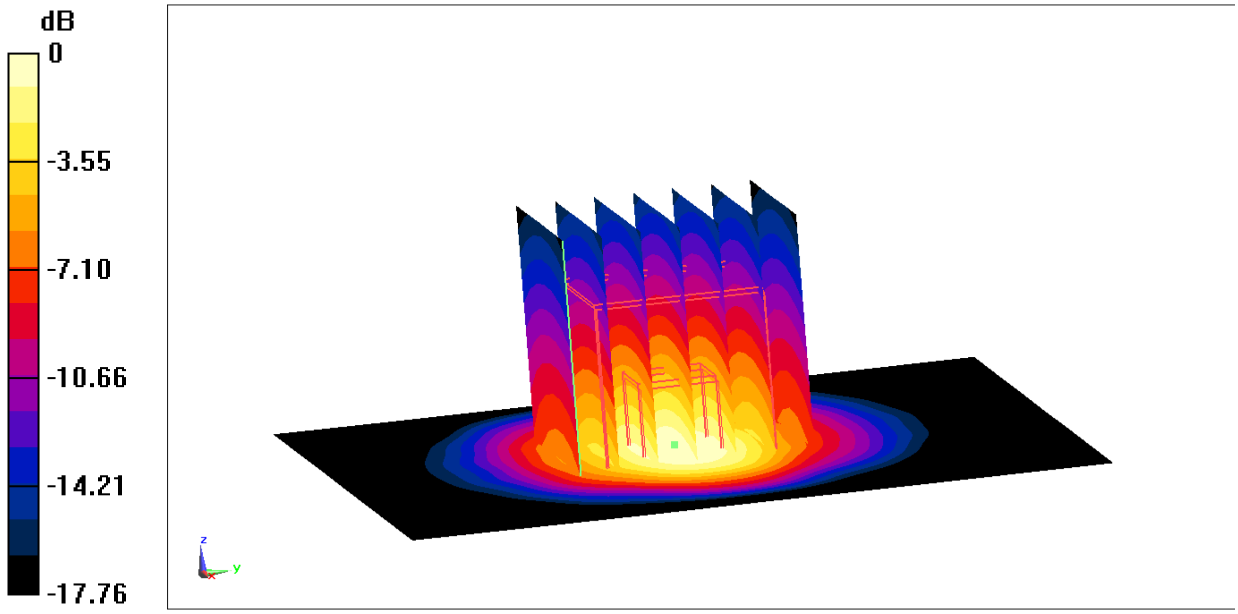

0 dB = 13.9 W/kg = 11.43 dBW/kg

## 1900 MHz

Date: 11/11/2022
Electronics: DAE4 Sn777
Medium: H700-6000M
Medium parameters used: f = 1900 MHz; σ = 1.442 S/m; εr = 41.43; ρ = 1000 kg/m3
Ambient Temperature:23.3℃　　　Liquid Temperature: 22.5℃
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=5mm, dy=5mm, dz=5mm
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; σ = 1.956 S/m; εr = 40.43; ρ = 1000 kg/m3

Ambient Temperature:23.3℃ Liquid Temperature: 22.5℃

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

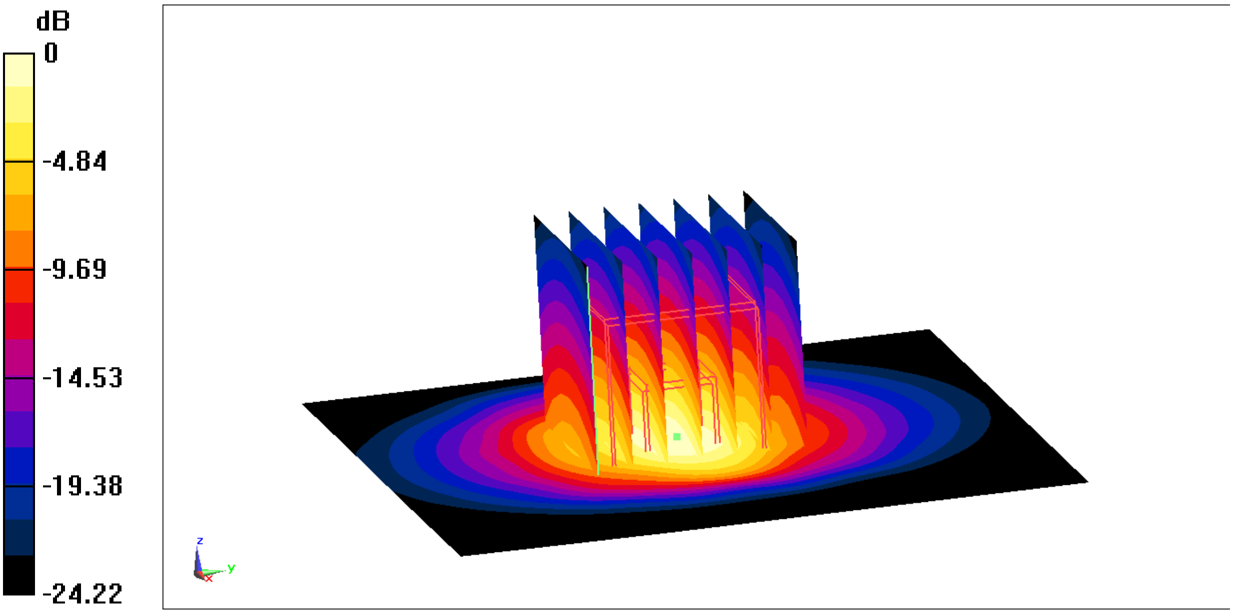
Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

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



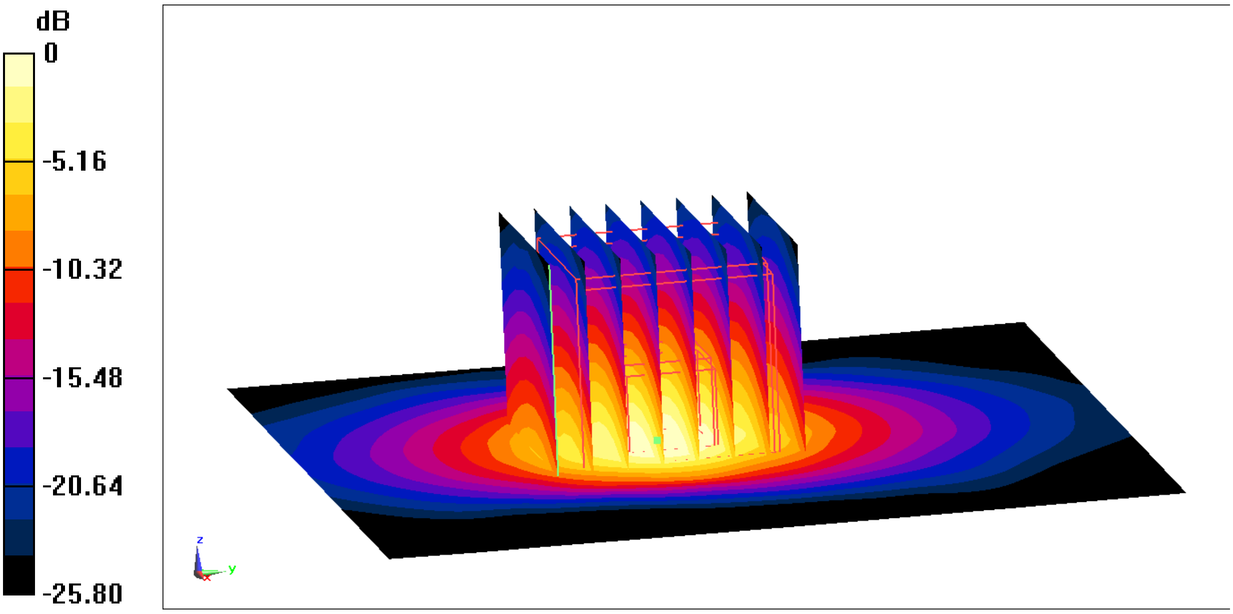

0 dB = 24.1 W/kg = 13.82 dBW/kg

# 3500MHz

Date: 11/13/2022
Electronics: DAE4 Sn777
Medium: H700-6000M
Medium parameters used: f = 3500 MHz; σ = 2.81 S/m; εr = 39.39; ρ = 1000 kg/m3
Ambient Temperature:23.3℃ Liquid Temperature: 22.5℃
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=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
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