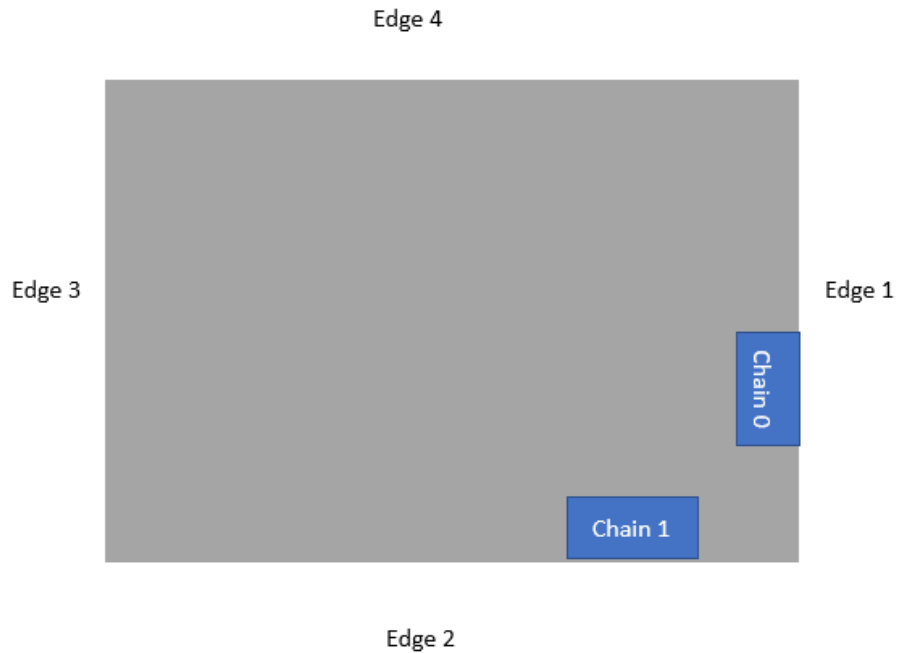


## Appendix B: Antenna Dimensions and Separation Distances

**Front View**



Chain 0 Antenna to surface					Chain 1 Antenna to surface				
Front	Edge 1	Edge 2	Edge 3	Edge 4	Front	Edge 1	Edge 2	Edge 3	Edge 4
< 5	< 5	72	318	196	< 5	58	< 5	248	268

Unit : mm

## Appendix C: SAR System Check Plots

Date: 2021/11/20

Test Laboratory: Underwriters Laboratories Taiwan Co., Ltd

### System Performance Check-5250MHz

**DUT: D5GHzV2 - SN1244; Type: D5GHzV2; Serial: SN1244**

Communication System: UID 0, CW (0); Communication System Band: D5GHz (5000.0 - 6000.0 MHz);

Frequency: 5250 MHz; Communication System PAR: 0 dB; PMF: 1

Medium parameters used:  $f = 5250$  MHz;  $\sigma = 4.655$  S/m;  $\epsilon_r = 36.609$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN3826; ConvF(5.06, 5.06, 5.06) @ 5250 MHz; Calibrated: 2021/7/28
  - Modulation Compensation:
- Sensor-Surface: 1.4mm (Mechanical Surface Detection),  $z = 1.0$ , 22.0
- Electronics: DAE3 Sn528; Calibrated: 2021/7/26
- Phantom: ELI v5.0\_1213; Type: QDOVA001BB; Serial: 1213
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

**Configuration/5250MHz/Area Scan (91x91x1):** Interpolated grid:  $dx=1.000$  mm,  $dy=1.000$  mm

Maximum value of SAR (interpolated) = 18.8 W/kg

**Configuration/5250MHz/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm

Reference Value = 67.14 V/m; Power Drift = 0.07 dB

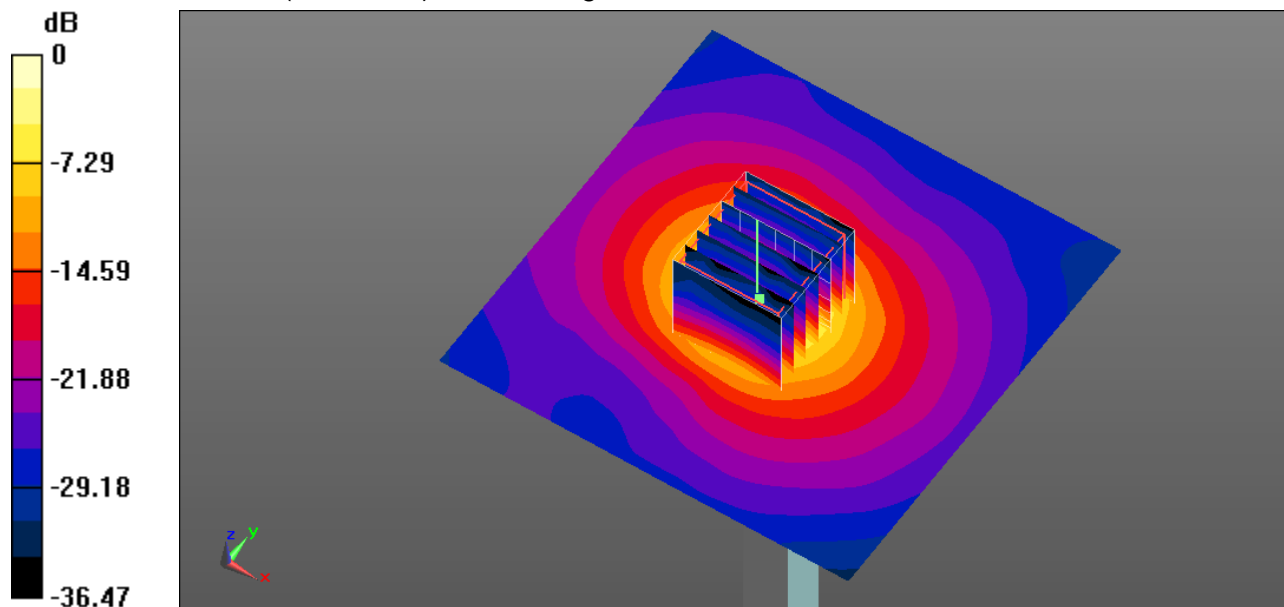
Peak SAR (extrapolated) = 32.2 W/kg

**SAR(1 g) = 7.73 W/kg; SAR(10 g) = 2.14 W/kg**

Smallest distance from peaks to all points 3 dB below = 6.8 mm

Ratio of SAR at M2 to SAR at M1 = 64.3%

Maximum value of SAR (measured) = 19.0 W/kg



0 dB = 19.0 W/kg = 12.79 dBW/kg

Date: 2021/11/23

Test Laboratory: Underwriters Laboratories Taiwan Co., Ltd

**System Performance Check-D5800V2 SN1244****DUT: D5GHzV2 - SN1244; Type: D5GHzV2; Serial: SN1244**

Communication System: UID 0, CW (0); Communication System Band: D5GHz (5000.0 - 6000.0 MHz);

Frequency: 5800 MHz; Communication System PAR: 0 dB; PMF: 1

Medium parameters used:  $f = 5800$  MHz;  $\sigma = 5.374$  S/m;  $\epsilon_r = 33.972$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN3826; ConvF(4.74, 4.74, 4.74) @ 5800 MHz; Calibrated: 2021/7/28
  - Modulation Compensation:
- Sensor-Surface: 1.4mm (Mechanical Surface Detection),  $z = 1.0, 22.0$
- Electronics: DAE3 Sn528; Calibrated: 2021/7/26
- Phantom: ELI v5.0\_1213; Type: QDOVA001BB; Serial: 1213
- DASYS 52.10.4(1527); SEMCAD X 14.6.14(7483)

**Configuration/5800MHz/Area Scan (91x91x1):** Interpolated grid:  $dx=1.000$  mm,  $dy=1.000$  mm

Maximum value of SAR (interpolated) = 20.6 W/kg

**Configuration/5800MHz/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm

Reference Value = 63.51 V/m; Power Drift = 0.16 dB

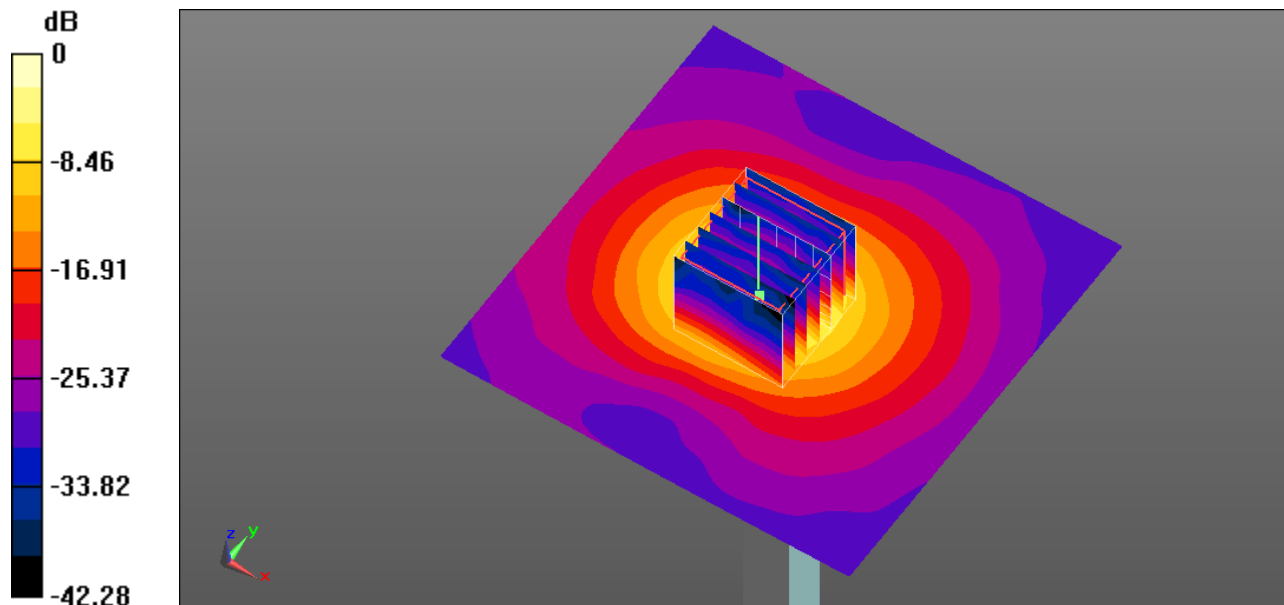
Peak SAR (extrapolated) = 36.2 W/kg

**SAR(1 g) = 7.91 W/kg; SAR(10 g) = 2.15 W/kg**

Smallest distance from peaks to all points 3 dB below = 7.4 mm

Ratio of SAR at M2 to SAR at M1 = 60.6%

Maximum value of SAR (measured) = 20.9 W/kg



0 dB = 20.9 W/kg = 13.20 dBW/kg

Date: 2021/11/25

Test Laboratory: Underwriters Laboratories Taiwan Co., Ltd

**System Performance Check-5250MHz****DUT: D5GHzV2 - SN1244; Type: D5GHzV2; Serial: SN1244**

Communication System: UID 0, CW (0); Communication System Band: D5GHz (5000.0 - 6000.0 MHz);

Frequency: 5250 MHz; Communication System PAR: 0 dB; PMF: 1

Medium parameters used:  $f = 5250$  MHz;  $\sigma = 4.801$  S/m;  $\epsilon_r = 35.172$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN3826; ConvF(5.06, 5.06, 5.06) @ 5250 MHz; Calibrated: 2021/7/28
  - Modulation Compensation:
- Sensor-Surface: 1.4mm (Mechanical Surface Detection),  $z = 1.0$ , 22.0
- Electronics: DAE3 Sn528; Calibrated: 2021/7/26
- Phantom: ELI v5.0\_1213; Type: QDOVA001BB; Serial: 1213
- DASYS 52.10.4(1527); SEMCAD X 14.6.14(7483)

**5250MHz/Area Scan (91x91x1):** Interpolated grid:  $dx=1.000$  mm,  $dy=1.000$  mm

Maximum value of SAR (interpolated) = 19.1 W/kg

**5250MHz/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm

Reference Value = 60.45 V/m; Power Drift = 0.14 dB

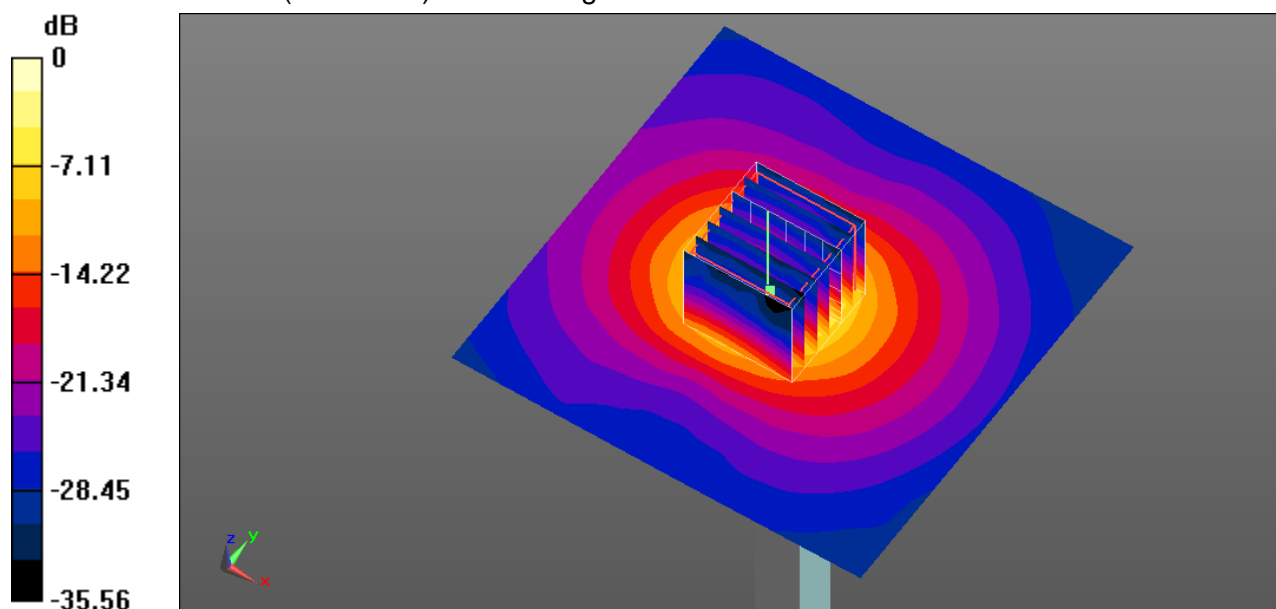
Peak SAR (extrapolated) = 31.1 W/kg

**SAR(1 g) = 7.69 W/kg; SAR(10 g) = 2.14 W/kg**

Smallest distance from peaks to all points 3 dB below = 7.5 mm

Ratio of SAR at M2 to SAR at M1 = 64.5%

Maximum value of SAR (measured) = 19.2 W/kg



0 dB = 19.2 W/kg = 12.83 dBW/kg

Date: 2021/11/26

Test Laboratory: Underwriters Laboratories Taiwan Co., Ltd

**System Performance Check-D5800V2 SN1244****DUT: D5GHzV2 - SN1244; Type: D5GHzV2; Serial: SN1244**

Communication System: UID 0, CW (0); Communication System Band: D5GHz (5000.0 - 6000.0 MHz);

Frequency: 5800 MHz; Communication System PAR: 0 dB; PMF: 1

Medium parameters used:  $f = 5800$  MHz;  $\sigma = 5.378$  S/m;  $\epsilon_r = 34.109$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN3826; ConvF(4.74, 4.74, 4.74) @ 5800 MHz; Calibrated: 2021/7/28
  - Modulation Compensation:
- Sensor-Surface: 1.4mm (Mechanical Surface Detection),  $z = 1.0, 22.0$
- Electronics: DAE3 Sn528; Calibrated: 2021/7/26
- Phantom: ELI v5.0\_1213; Type: QDOVA001BB; Serial: 1213
- DASYS 52.10.4(1527); SEMCAD X 14.6.14(7483)

**Configuration/5800MHz/Area Scan (91x91x1):** Interpolated grid:  $dx=1.000$  mm,  $dy=1.000$  mm

Maximum value of SAR (interpolated) = 20.8 W/kg

**Configuration/5800MHz/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm

Reference Value = 63.38 V/m; Power Drift = 0.16 dB

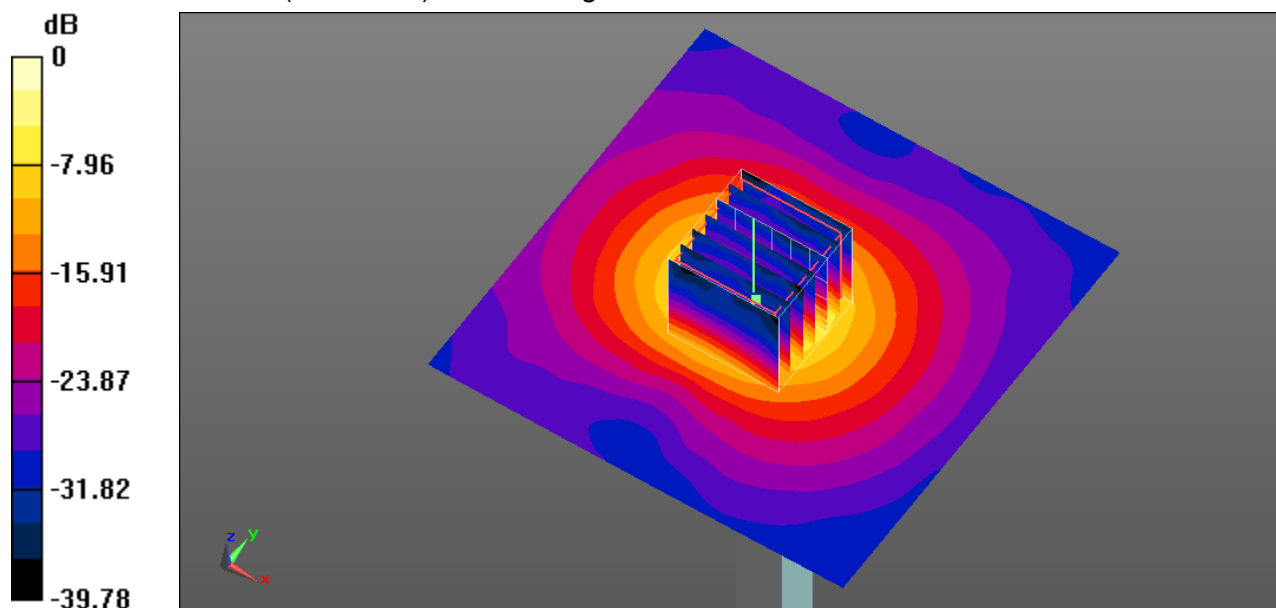
Peak SAR (extrapolated) = 36.4 W/kg

**SAR(1 g) = 7.99 W/kg; SAR(10 g) = 2.21 W/kg**

Smallest distance from peaks to all points 3 dB below = 7.5 mm

Ratio of SAR at M2 to SAR at M1 = 61%

Maximum value of SAR (measured) = 21.0 W/kg



0 dB = 21.0 W/kg = 13.22 dBW/kg

## Appendix D: Highest SAR Test Plots

Date: 2021/11/25

Test Laboratory: Underwriters Laboratories Taiwan Co., Ltd

### Wi-Fi 5 GHz\_Chain 0\_Edge 1\_ch36

Communication System: UID 0, 802.11a/ac 5GHz (0) (0); Communication System Band: 802.11a;  
Frequency: 5180 MHz; Communication System PAR: 0 dB; PMF: 1

Medium parameters used:  $f = 5180$  MHz;  $\sigma = 4.711$  S/m;  $\epsilon_r = 35.351$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: EX3DV4 - SN3826; ConvF(5.06, 5.06, 5.06) @ 5180 MHz; Calibrated: 2021/7/28
  - Modulation Compensation:
- Sensor-Surface: 1.4mm (Mechanical Surface Detection),  $z = -49.0, 22.0$
- Electronics: DAE3 Sn528; Calibrated: 2021/7/26
- Phantom: ELI v5.0\_1213; Type: QDOVA001BB; Serial: 1213
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

**Bottom/802.11a/Area Scan (121x151x1):** Interpolated grid:  $dx=1.000$  mm,  $dy=1.000$  mm  
Maximum value of SAR (interpolated) = 1.60 W/kg

**Bottom/802.11a/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm

Reference Value = 5.739 V/m; Power Drift = 0.14 dB

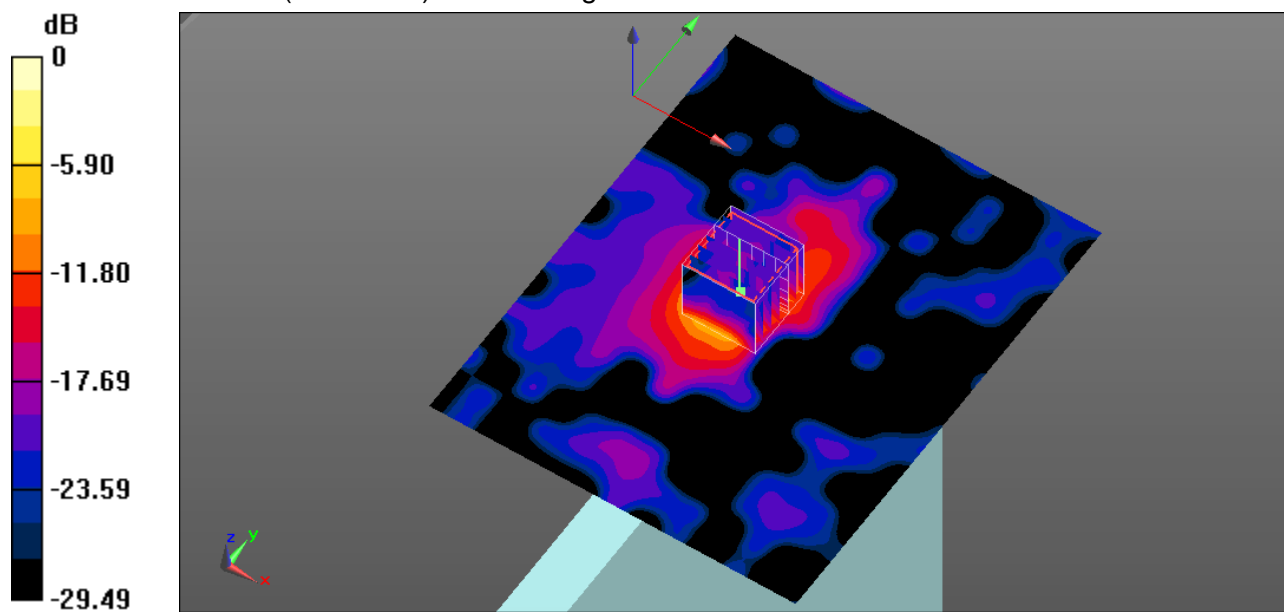
Peak SAR (extrapolated) = 2.88 W/kg

**SAR(1 g) = 0.615 W/kg; SAR(10 g) = 0.164 W/kg**

Smallest distance from peaks to all points 3 dB below = 5.1 mm

Ratio of SAR at M2 to SAR at M1 = 62.9%

Maximum value of SAR (measured) = 1.65 W/kg



Date: 2021/11/20

Test Laboratory: Underwriters Laboratories Taiwan Co., Ltd

**Wi-Fi 5 GHz\_Chain 1\_Edge 2\_ch46**

Communication System: UID 0, 802.11a/ac 5GHz (0) (0); Communication System Band: 802.11n40;

Frequency: 5230 MHz; Communication System PAR: 0 dB; PMF: 1

Medium parameters used:  $f = 5230$  MHz;  $\sigma = 4.643$  S/m;  $\epsilon_r = 36.523$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: EX3DV4 - SN3826; ConvF(5.06, 5.06, 5.06) @ 5230 MHz; Calibrated: 2021/7/28
  - Modulation Compensation:
- Sensor-Surface: 1.4mm (Mechanical Surface Detection),  $z = -49.0, 22.0$
- Electronics: DAE3 Sn528; Calibrated: 2021/7/26
- Phantom: ELI v5.0\_1213; Type: QDOVA001BB; Serial: 1213
- DASYS 52.10.4(1527); SEMCAD X 14.6.14(7483)

**Bottom/802.11a/Area Scan (81x121x1):** Interpolated grid:  $dx=1.000$  mm,  $dy=1.000$  mm

Maximum value of SAR (interpolated) = 3.85 W/kg

**Bottom/802.11a/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm

Reference Value = 12.46 V/m; Power Drift = -0.02 dB

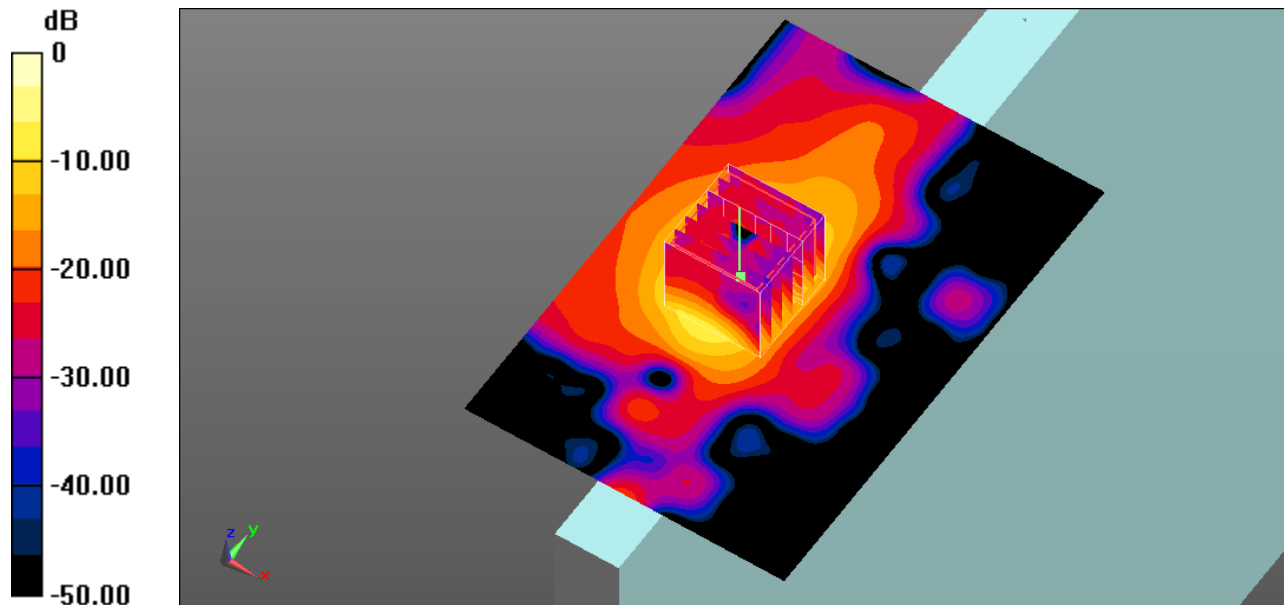
Peak SAR (extrapolated) = 7.09 W/kg

**SAR(1 g) = 1.4 W/kg; SAR(10 g) = 0.373 W/kg**

Smallest distance from peaks to all points 3 dB below = 4.8 mm

Ratio of SAR at M2 to SAR at M1 = 59.6%

Maximum value of SAR (measured) = 3.84 W/kg



0 dB = 3.84 W/kg = 5.84 dBW/kg

Date: 2021/11/26

Test Laboratory: Underwriters Laboratories Taiwan Co., Ltd

**Wi-Fi 5 GHz\_Chain 0\_Edge 1\_ch149**

Communication System: UID 0, 802.11a/ac 5GHz (0) (0); Communication System Band: 802.11a;

Frequency: 5745 MHz; Communication System PAR: 0 dB; PMF: 1

Medium parameters used:  $f = 5745$  MHz;  $\sigma = 5.32$  S/m;  $\epsilon_r = 34.176$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: EX3DV4 - SN3826; ConvF(4.74, 4.74, 4.74) @ 5745 MHz; Calibrated: 2021/7/28
  - Modulation Compensation:
- Sensor-Surface: 1.4mm (Mechanical Surface Detection),  $z = -49.0, 22.0$
- Electronics: DAE3 Sn528; Calibrated: 2021/7/26
- Phantom: ELI v5.0\_1213; Type: QDOVA001BB; Serial: 1213
- DASYS 52.10.4(1527); SEMCAD X 14.6.14(7483)

**Bottom/802.11a/Area Scan (121x151x1):** Interpolated grid:  $dx=1.000$  mm,  $dy=1.000$  mm

Maximum value of SAR (interpolated) = 1.35 W/kg

**Bottom/802.11a/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm

Reference Value = 3.145 V/m; Power Drift = 0.09 dB

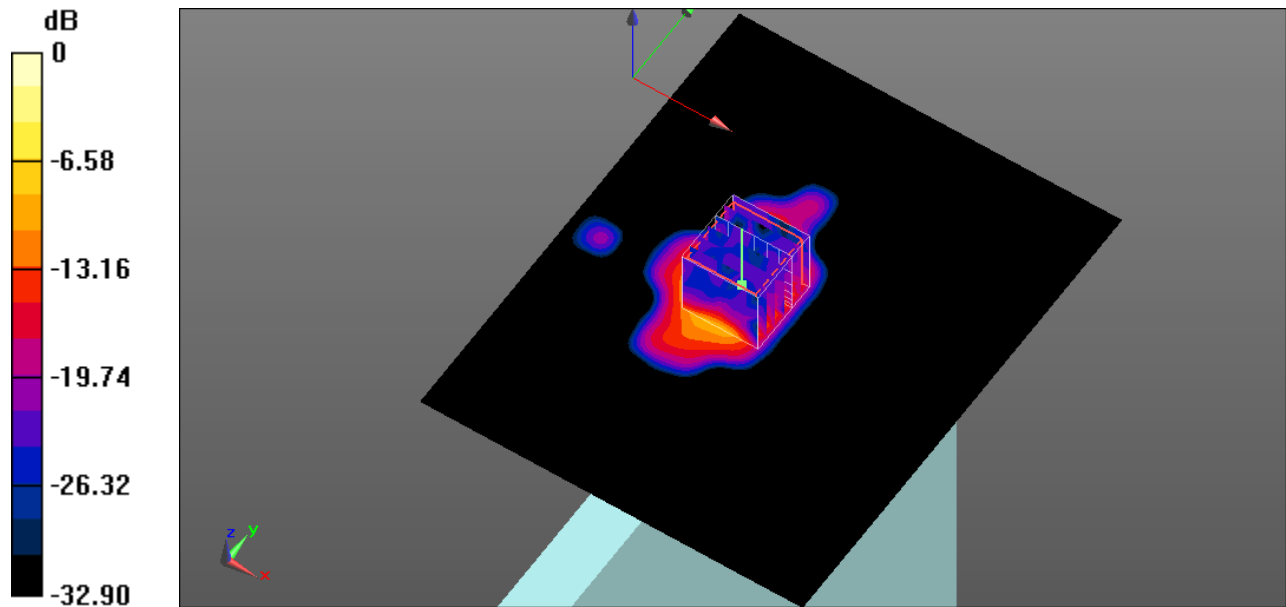
Peak SAR (extrapolated) = 2.39 W/kg

**SAR(1 g) = 0.472 W/kg; SAR(10 g) = 0.117 W/kg**

Smallest distance from peaks to all points 3 dB below = 5.6 mm

Ratio of SAR at M2 to SAR at M1 = 58.7%

Maximum value of SAR (measured) = 1.24 W/kg



0 dB = 1.24 W/kg = 0.93 dBW/kg



Date: 2021/11/23

Test Laboratory: Underwriters Laboratories Taiwan Co., Ltd

**Wi-Fi 5 GHz\_Chain 1\_Edge 2**

Communication System: UID 0, 802.11a/ac 5GHz (0) (0); Communication System Band: 802.11n40;

Frequency: 5795 MHz; Communication System PAR: 0 dB; PMF: 1

Medium parameters used:  $f = 5795$  MHz;  $\sigma = 5.37$  S/m;  $\epsilon_r = 34.002$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: EX3DV4 - SN3826; ConvF(4.74, 4.74, 4.74) @ 5795 MHz; Calibrated: 2021/7/28
  - Modulation Compensation:
- Sensor-Surface: 1.4mm (Mechanical Surface Detection),  $z = -49.0, 22.0$
- Electronics: DAE3 Sn528; Calibrated: 2021/7/26
- Phantom: ELI v5.0\_1213; Type: QDOVA001BB; Serial: 1213
- DASYS 52.10.4(1527); SEMCAD X 14.6.14(7483)

**Bottom/802.11a/Area Scan (81x121x1):** Interpolated grid:  $dx=1.000$  mm,  $dy=1.000$  mm

Maximum value of SAR (interpolated) = 1.25 W/kg

**Bottom/802.11a/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm

Reference Value = 5.934 V/m; Power Drift = 0.04 dB

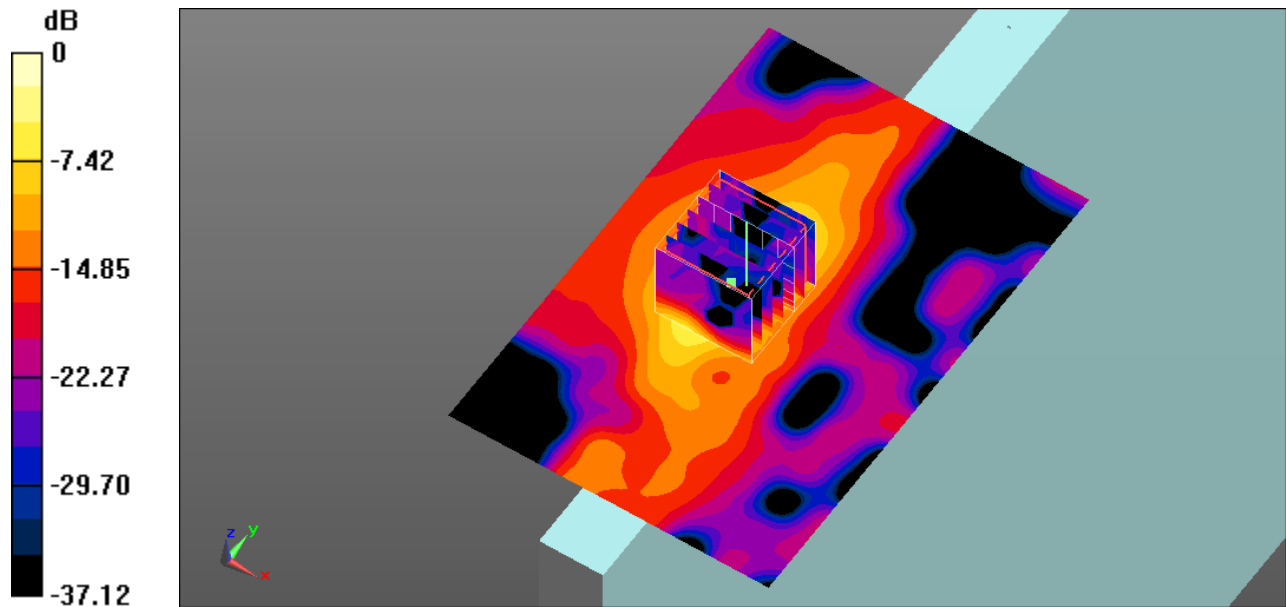
Peak SAR (extrapolated) = 2.43 W/kg

**SAR(1 g) = 0.431 W/kg; SAR(10 g) = 0.104 W/kg**

Smallest distance from peaks to all points 3 dB below = 4.7 mm

Ratio of SAR at M2 to SAR at M1 = 58.1%

Maximum value of SAR (measured) = 1.16 W/kg



0 dB = 1.16 W/kg = 0.64 dBW/kg

Date: 2021/11/25

Test Laboratory: Underwriters Laboratories Taiwan Co., Ltd

**Wi-Fi 5 GHz\_Chain 1\_Edge 2\_ch46\_Repeat 1**

Communication System: UID 0, 802.11a/ac 5GHz (0) (0); Communication System Band: 802.11n40;

Frequency: 5230 MHz; Communication System PAR: 0 dB; PMF: 1

Medium parameters used:  $f = 5230$  MHz;  $\sigma = 4.775$  S/m;  $\epsilon_r = 35.138$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: EX3DV4 - SN3826; ConvF(5.06, 5.06, 5.06) @ 5230 MHz; Calibrated: 2021/7/28
  - Modulation Compensation:
- Sensor-Surface: 1.4mm (Mechanical Surface Detection),  $z = -49.0, 22.0$
- Electronics: DAE3 Sn528; Calibrated: 2021/7/26
- Phantom: ELI v5.0\_1213; Type: QDOVA001BB; Serial: 1213
- DASYS 52.10.4(1527); SEMCAD X 14.6.14(7483)

**Bottom/802.11a/Area Scan (81x121x1):** Interpolated grid:  $dx=1.000$  mm,  $dy=1.000$  mm

Maximum value of SAR (interpolated) = 3.53 W/kg

**Bottom/802.11a/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm

Reference Value = 15.14 V/m; Power Drift = 0.02 dB

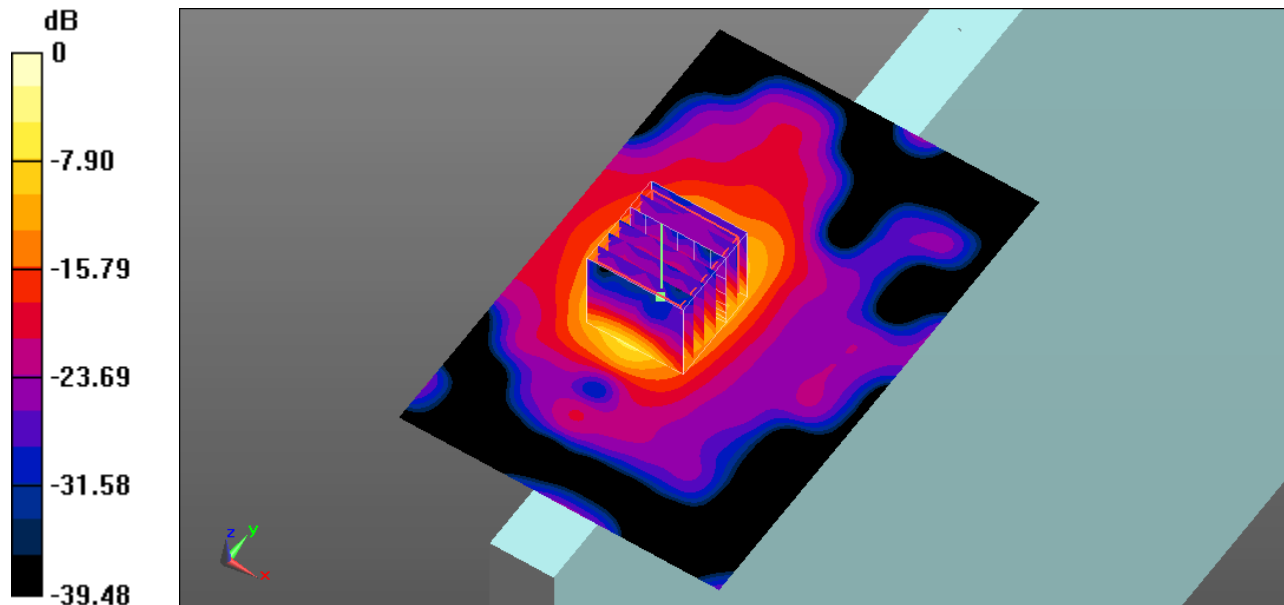
Peak SAR (extrapolated) = 6.49 W/kg

**SAR(1 g) = 1.38 W/kg; SAR(10 g) = 0.383 W/kg**

Smallest distance from peaks to all points 3 dB below = 5.6 mm

Ratio of SAR at M2 to SAR at M1 = 61%

Maximum value of SAR (measured) = 3.70 W/kg



0 dB = 3.70 W/kg = 5.68 dBW/kg

Date: 2021/11/20

Test Laboratory: Underwriters Laboratories Taiwan Co., Ltd

**Wi-Fi 5 GHz\_Chain 1\_Edge 2\_ch46\_Repeat 2**

Communication System: UID 0, 802.11a/ac 5GHz (0) (0); Communication System Band: 802.11n40;

Frequency: 5230 MHz; Communication System PAR: 0 dB; PMF: 1

Medium parameters used:  $f = 5230$  MHz;  $\sigma = 4.643$  S/m;  $\epsilon_r = 36.523$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: EX3DV4 - SN3826; ConvF(5.06, 5.06, 5.06) @ 5230 MHz; Calibrated: 2021/7/28
  - Modulation Compensation:
- Sensor-Surface: 1.4mm (Mechanical Surface Detection),  $z = -49.0, 22.0$
- Electronics: DAE3 Sn528; Calibrated: 2021/7/26
- Phantom: ELI v5.0\_1213; Type: QDOVA001BB; Serial: 1213
- DASYS 52.10.4(1527); SEMCAD X 14.6.14(7483)

**Bottom/802.11a/Area Scan (81x121x1):** Interpolated grid:  $dx=1.000$  mm,  $dy=1.000$  mm

Maximum value of SAR (interpolated) = 3.34 W/kg

**Bottom/802.11a/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm

Reference Value = 13.99 V/m; Power Drift = 0.18 dB

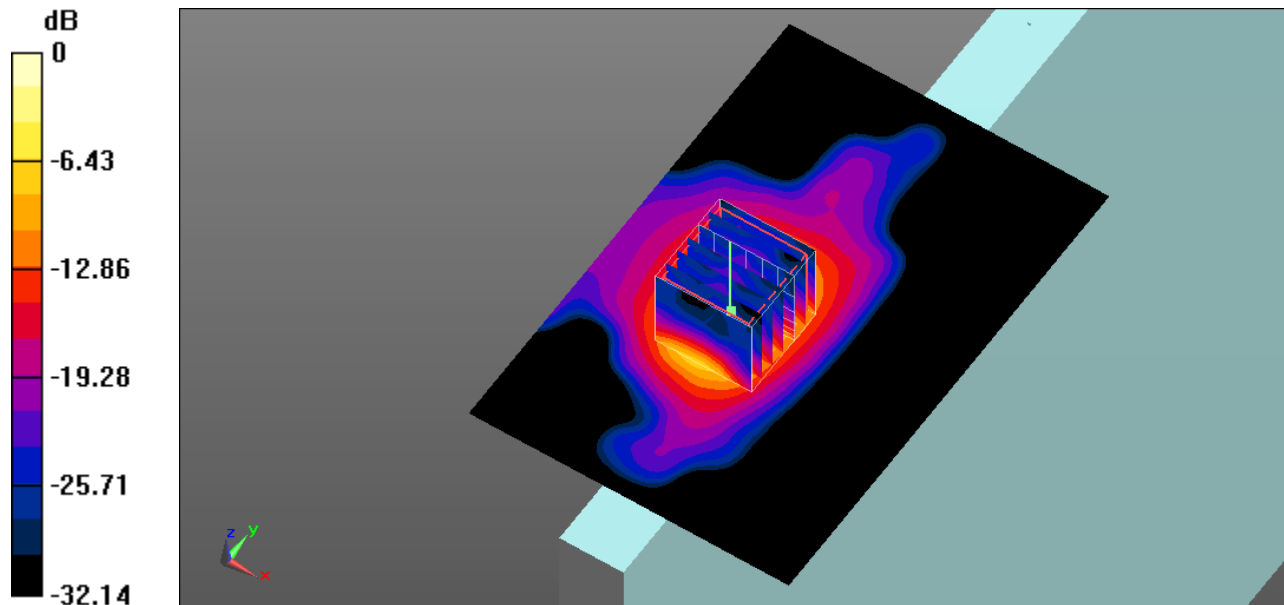
Peak SAR (extrapolated) = 6.17 W/kg

**SAR(1 g) = 1.35 W/kg; SAR(10 g) = 0.369 W/kg**

Smallest distance from peaks to all points 3 dB below = 5.6 mm

Ratio of SAR at M2 to SAR at M1 = 61.7%

Maximum value of SAR (measured) = 3.55 W/kg



0 dB = 3.55 W/kg = 5.50 dBW/kg

## **Appendix E: SAR Probe and Dipole Calibration Certificates**



In Collaboration with  
**s p e a g**  
**CALIBRATION LABORATORY**



中国认可  
国际互认  
校准  
CALIBRATION  
CNAS L0570

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com http://www.chinattl.cn

Client

UL

Certificate No: Z20-60448

## CALIBRATION CERTIFICATE

Object

D5GHzV2 - SN: 1244

Calibration Procedure(s)

FF-Z11-003-01

Calibration Procedures for dipole validation kits

Calibration date:

November 10, 2020

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)°C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106276	12-May-20 (CTTL, No.J20X02965)	May-21
Power sensor NRP6A	101369	12-May-20 (CTTL, No.J20X02965)	May-21
ReferenceProbe EX3DV4	SN 3617	30-Jan-20(SPEAG,No.EX3-3617_Jan20)	Jan-21
DAE4	SN 771	10-Feb-20(CTTL-SPEAG,No.Z20-60017)	Feb-21
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	25-Feb-20 (CTTL, No.J20X00516)	Feb-21
NetworkAnalyzerE5071C	MY46107873	10-Feb-20 (CTTL, No.J20X00515)	Feb-21

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: November 19, 2020

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY

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E-mail: cttl@chinattl.com

http://www.chinattl.cn

### Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
N/A	not applicable or not measured

### Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
- IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution Corresponds to a coverage probability of approximately 95%.



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## Measurement Conditions

DASY system configuration, as far as not given on page 1.

<b>DASY Version</b>	DASY52	V52.10.4
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Triple Flat Phantom 5.1C	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
<b>Frequency</b>	5250 MHz $\pm$ 1 MHz 5300 MHz $\pm$ 1 MHz 5600 MHz $\pm$ 1 MHz 5800 MHz $\pm$ 1 MHz	

## Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	35.9	4.71 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	35.1 $\pm$ 6 %	4.76 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	<1.0 °C	----	----

## SAR result with Head TSL at 5250 MHz

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	100 mW input power	7.73 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>77.0 W/kg <math>\pm</math> 24.4 % (k=2)</b>
<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	Condition	
SAR measured	100 mW input power	2.21 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>22.0 W/kg <math>\pm</math> 24.2 % (k=2)</b>





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### Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.0 ± 6 %	4.81 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		

### SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.85 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>78.1 W/kg ± 24.4 % (k=2)</b>
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.25 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>22.4 W/kg ± 24.2 % (k=2)</b>

### Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.5 ± 6 %	5.14 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		

### SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.10 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>80.6 W/kg ± 24.4 % (k=2)</b>
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>23.0 W/kg ± 24.2 % (k=2)</b>





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### Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.3 ± 6 %	5.31 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

### SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.81 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	77.7 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.22 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.0 W/kg ± 24.2 % (k=2)



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## Appendix (Additional assessments outside the scope of CNAS L0570)

### Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	50.8Ω - 4.35jΩ
Return Loss	- 27.2dB

### Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	49.2Ω - 2.62jΩ
Return Loss	- 31.1dB

### Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	51.9Ω - 0.76jΩ
Return Loss	- 34.1dB

### Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	51.3Ω + 0.91jΩ
Return Loss	- 36.2dB

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.062 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

## Additional EUT Data

Manufactured by	SPEAG
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## DASY5 Validation Report for Head TSL

Date: 11.10.2020

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1244**

Communication System: CW; Frequency: 5250 MHz, Frequency: 5300 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz,

Medium parameters used:  $f = 5250$  MHz;  $\sigma = 4.756$  S/m;  $\epsilon_r = 35.12$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used:  $f = 5300$  MHz;  $\sigma = 4.813$  S/m;  $\epsilon_r = 35.03$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used:  $f = 5600$  MHz;  $\sigma = 5.14$  S/m;  $\epsilon_r = 34.53$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used:  $f = 5800$  MHz;  $\sigma = 5.306$  S/m;  $\epsilon_r = 34.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(5.39, 5.39, 5.39) @ 5250 MHz; ConvF(5.29, 5.29, 5.29) @ 5300 MHz; ConvF(4.99, 4.99, 4.99) @ 5600 MHz; ConvF(5, 5, 5) @ 5800 MHz; Calibrated: 2020-01-30
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2020-02-10
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

**Dipole Calibration /Pin=100mW, d=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 70.66 V/m; Power Drift = -0.04 dB  
Peak SAR (extrapolated) = 31.0 W/kg  
**SAR(1 g) = 7.73 W/kg; SAR(10 g) = 2.21 W/kg**  
Smallest distance from peaks to all points 3 dB below = 7.2 mm  
Ratio of SAR at M2 to SAR at M1 = 65.4%  
Maximum value of SAR (measured) = 18.1 W/kg

**Dipole Calibration /Pin=100mW, d=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 70.56 V/m; Power Drift = -0.07 dB  
Peak SAR (extrapolated) = 31.8 W/kg  
**SAR(1 g) = 7.85 W/kg; SAR(10 g) = 2.25 W/kg**  
Smallest distance from peaks to all points 3 dB below = 7.2 mm  
Ratio of SAR at M2 to SAR at M1 = 64.9%  
Maximum value of SAR (measured) = 18.4 W/kg

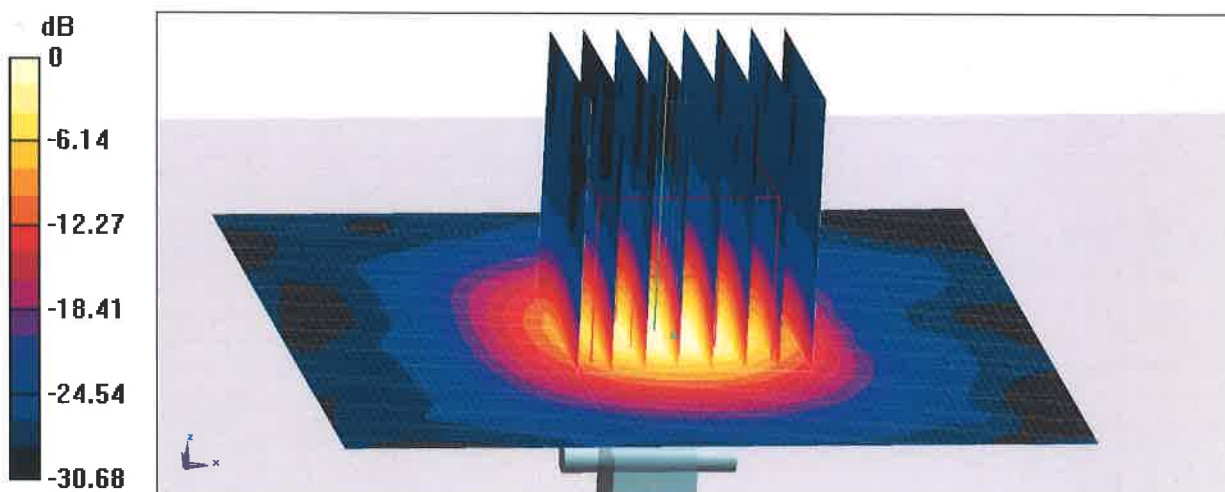


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**Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan,**  
**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 70.49 V/m; Power Drift = -0.05 dB  
Peak SAR (extrapolated) = 36.0 W/kg  
**SAR(1 g) = 8.1 W/kg; SAR(10 g) = 2.31 W/kg**  
Smallest distance from peaks to all points 3 dB below = 7.2 mm  
Ratio of SAR at M2 to SAR at M1 = 61.9%  
Maximum value of SAR (measured) = 19.9 W/kg

**Dipole Calibration /Pin=100mW, d=10mm, f=5800 MHz/Zoom Scan,**  
**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 67.57 V/m; Power Drift = -0.09 dB  
Peak SAR (extrapolated) = 35.7 W/kg  
**SAR(1 g) = 7.81 W/kg; SAR(10 g) = 2.22 W/kg**  
Smallest distance from peaks to all points 3 dB below = 7.2 mm  
Ratio of SAR at M2 to SAR at M1 = 60.7%  
Maximum value of SAR (measured) = 19.8 W/kg



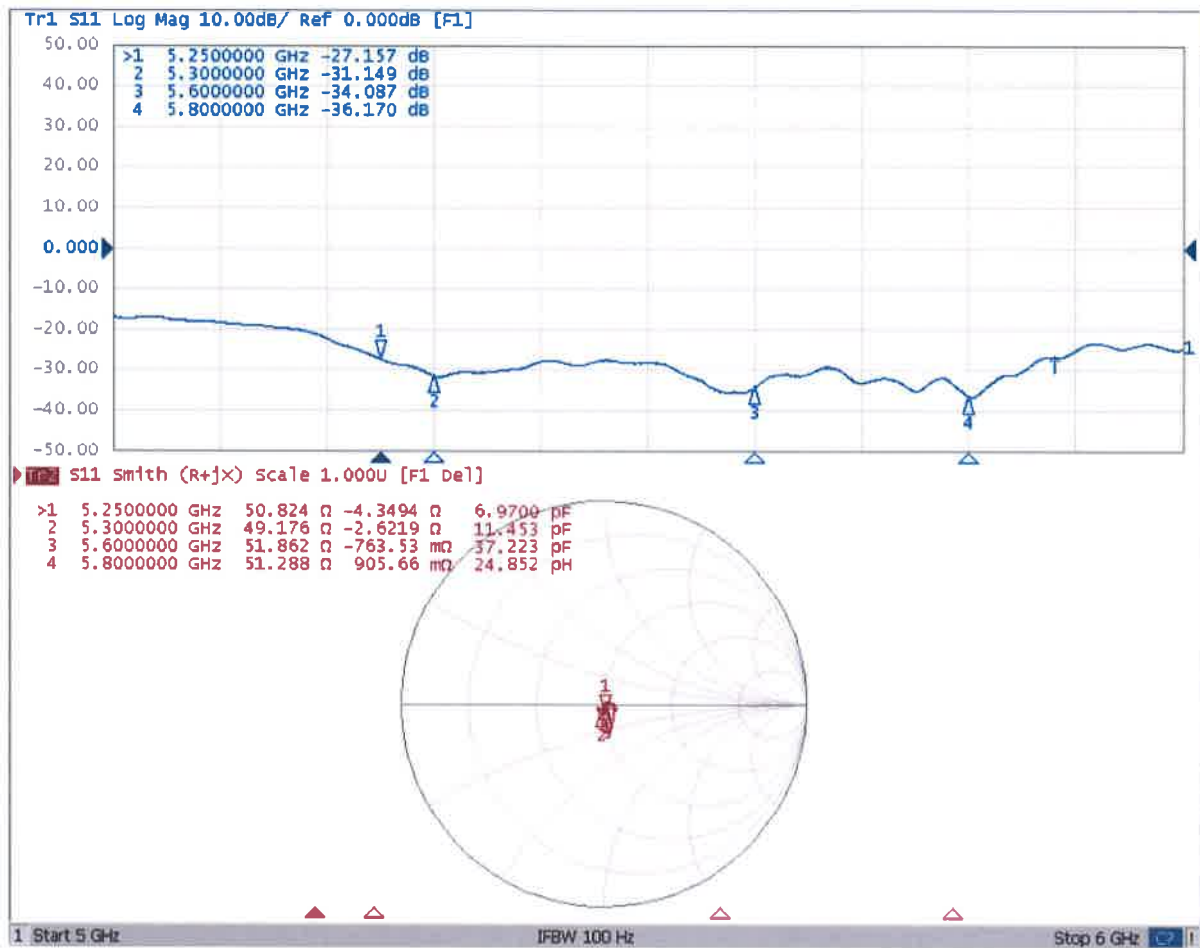
**0 dB = 19.8 W/kg = 12.97 dBW/kg**



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## Impedance Measurement Plot for Head TSL



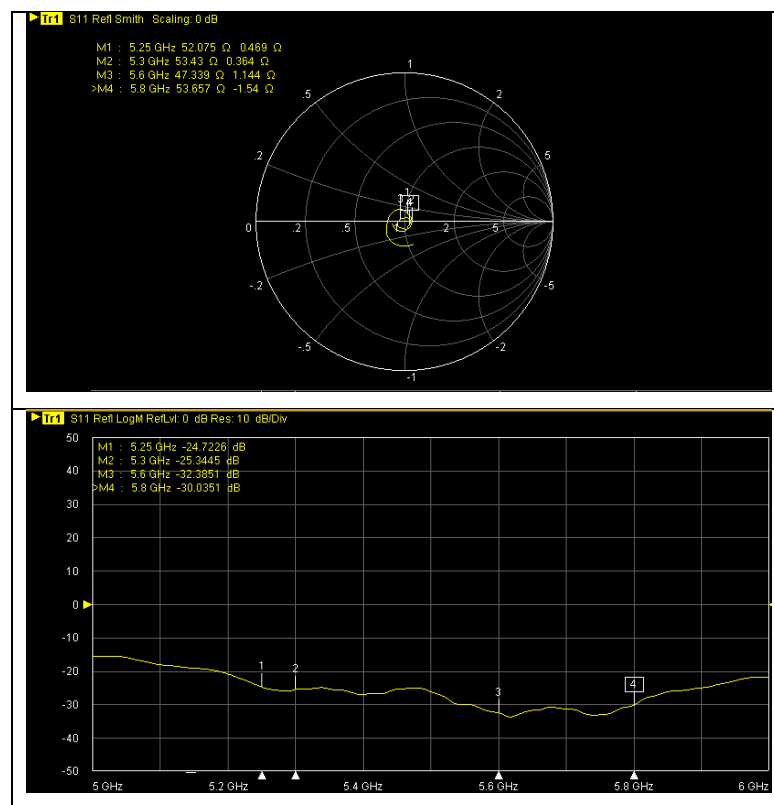
## Dipole: 5GHz, S/N: 1244, Dipole calibration

According to KDB 865664 & IEEE Std 1528 - 2013:

### 3.2.2. Dipole calibration

It is necessary to re-calibrate reference dipoles at regular intervals to confirm the electrical specifications and SAR targets. A dipole must be calibrated using a fully validated SAR system according to the tissue dielectric parameters and SAR probe calibration frequency required for device testing. It is generally unacceptable to calibrate a dipole using the SAR system that has been validated by the same dipole; therefore, dipoles should be returned to the SAR system manufacturer or its designated calibration facilities for re-calibration. However, instead of the typical annual calibration recommended by measurement standards, 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 following requirements.

- 1) The test laboratory must ensure that the required supporting information and documentation are included in the SAR report to qualify for the three-year extended calibration interval; otherwise, the IEEE Std 1528-2013 recommended annual calibration applies.
- 2) Immediate re-calibration is required for the following conditions.
  - a) After a dipole is damaged and properly repaired to meet required specifications.
  - b) When the measured SAR deviates from the calibrated SAR value by more than 10% due to changes in physical, mechanical, electrical or other relevant dipole conditions; i.e., the error is not introduced by incorrect measurement procedures or other issues relating to the SAR measurement system.
  - c) When the most recent return-loss result, measured at least annually, deviates by more than 20% from the previous measurement (i.e. value in dB  $\times 0.2$ ) or not meeting the required 20 dB minimum return-loss requirement.<sup>24</sup>
  - d) When the most recent measurement of the real or imaginary parts of the impedance, measured at least annually, deviates by more than 5  $\Omega$  from the previous measurement.



### 5.25GHz

Calibration Date	Impedance R (ohm)	Delta (%)	Impedance jX (ohm)	Delta (ohm)	Return-loss (dB)	Delta (%)
2020/11/10	50.8	N/A	-4.35	N/A	-27.2	N/A
2021/11/9	52.075	1.28	0.469	4.82	-24.7226	-9.11

### 5.3GHz

Calibration Date	Impedance R (ohm)	Delta (%)	Impedance jX (ohm)	Delta (ohm)	Return-loss (dB)	Delta (%)
2020/11/10	49.2	N/A	-2.62	N/A	-31.1	N/A
2021/11/9	53.43	4.23	0.364	2.98	-25.3445	-18.51

### 5.6GHz

Calibration Date	Impedance R (ohm)	Delta (%)	Impedance jX (ohm)	Delta (ohm)	Return-loss (dB)	Delta (%)
2020/11/10	51.9	N/A	-0.76	N/A	-34.1	N/A
2021/11/9	47.339	-4.56	1.144	1.90	-32.3851	-5.03

### 5.8GHz

Calibration Date	Impedance R (ohm)	Delta (%)	Impedance jX (ohm)	Delta (ohm)	Return-loss (dB)	Delta (%)
2020/11/10	51.3	N/A	0.91	N/A	-36.2	N/A
2021/11/9	53.657	2.36	-1.54	-2.45	-30.0351	-17.03





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Client **Auden**

Certificate No: **DAE3-528\_Jul21**

## CALIBRATION CERTIFICATE

Object **DAE3 - SD 000 D03 AA - SN: 528**

Calibration procedure(s) **QA CAL-06.v30**  
**Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **July 26, 2021**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^{\circ}\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	07-Sep-20 (No:28647)	Sep-21
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-21 (in house check)	In house check: Jan-22
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-21 (in house check)	In house check: Jan-22

Calibrated by: **Adrian Gehring** **Laboratory Technician**

Signature

Approved by: **Sven Kühn** **Deputy Manager**

Issued: July 26, 2021

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.





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## Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

## Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle:* The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement:* Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

## DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1 $\mu$ V , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.715 $\pm$ 0.02% (k=2)	404.821 $\pm$ 0.02% (k=2)	404.753 $\pm$ 0.02% (k=2)
Low Range	3.97157 $\pm$ 1.50% (k=2)	3.96014 $\pm$ 1.50% (k=2)	3.96843 $\pm$ 1.50% (k=2)

## Connector Angle

Connector Angle to be used in DASY system	51.0 ° $\pm$ 1 °
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## Appendix (Additional assessments outside the scope of SCS0108)

### 1. DC Voltage Linearity

High Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	199996.41	2.36	0.00
Channel X + Input	20005.08	3.12	0.02
Channel X - Input	-19994.70	6.96	-0.03
Channel Y + Input	199995.60	1.69	0.00
Channel Y + Input	20002.40	0.42	0.00
Channel Y - Input	-20000.27	1.34	-0.01
Channel Z + Input	199996.30	1.81	0.00
Channel Z + Input	20000.97	-0.79	-0.00
Channel Z - Input	-19999.45	2.24	-0.01

Low Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	2001.32	0.25	0.01
Channel X + Input	201.90	0.37	0.18
Channel X - Input	-198.00	0.40	-0.20
Channel Y + Input	2001.10	0.10	0.01
Channel Y + Input	201.31	-0.03	-0.02
Channel Y - Input	-198.70	-0.28	0.14
Channel Z + Input	2001.11	0.05	0.00
Channel Z + Input	200.68	-0.67	-0.33
Channel Z - Input	-199.21	-0.63	0.32

### 2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading ( $\mu\text{V}$ )	Low Range Average Reading ( $\mu\text{V}$ )
Channel X	200	9.46	8.13
	- 200	-7.02	-8.71
Channel Y	200	15.42	15.28
	- 200	-16.36	-16.52
Channel Z	200	-3.94	-4.20
	- 200	2.96	2.87

### 3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X ( $\mu\text{V}$ )	Channel Y ( $\mu\text{V}$ )	Channel Z ( $\mu\text{V}$ )
Channel X	200	-	3.58	-2.25
Channel Y	200	6.49	-	4.82
Channel Z	200	7.16	5.79	-

#### 4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	15976	16027
Channel Y	15905	16338
Channel Z	16175	16109

#### 5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Input 10M $\Omega$

	Average ( $\mu$ V)	min. Offset ( $\mu$ V)	max. Offset ( $\mu$ V)	Std. Deviation ( $\mu$ V)
Channel X	1.82	-0.34	3.08	0.47
Channel Y	0.30	-0.87	1.62	0.46
Channel Z	0.72	-1.06	1.90	0.45

#### 6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

#### 7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

#### 8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

#### 9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	-0.01	-8	-9





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Client

**Auden**

**Certificate No: Z21-60263**

## CALIBRATION CERTIFICATE

Object

EX3DV4 - SN : 3826

Calibration Procedure(s)

FF-Z11-004-02

Calibration Procedures for Dosimetric E-field Probes

Calibration date:

July 28, 2021

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature( $22\pm 3$ )°C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	15-Jun-21(CTTL, No.J21X04466)	Jun-22
Power sensor NRP-Z91	101547	15-Jun-21(CTTL, No.J21X04466)	Jun-22
Power sensor NRP-Z91	101548	15-Jun-21(CTTL, No.J21X04466)	Jun-22
Reference 10dBAttenuator	18N50W-10dB	10-Feb-20(CTTL, No.J20X00525)	Feb-22
Reference 20dBAttenuator	18N50W-20dB	10-Feb-20(CTTL, No.J20X00526)	Feb-22
Reference Probe EX3DV4	SN 3617	27-Jan-21(SPEAG, No.EX3-3617_Jan21)	Jan-22
DAE4	SN 1556	15-Jan-21(SPEAG, No.DAE4-1556_Jan21)	Jan-22

Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGenerator MG3700A	6201052605	16-Jun-21(CTTL, No.J21X04467)	Jun-22
Network Analyzer E5071C	MY46110673	21-Jan-21(CTTL, No.J20X00515)	Jan-22

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: July 30, 2021

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.





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## Glossary:

TSL	tissue simulating liquid
NORM <sub>x,y,z</sub>	sensitivity in free space
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A,B,C,D	modulation dependent linearization parameters
Polarization $\Phi$	$\Phi$ rotation around probe axis
Polarization $\theta$	$\theta$ rotation around an axis that is in the plane normal to probe axis (at measurement center), i $\theta=0$ is normal to probe axis

Connector Angle information used in DASY system to align probe sensor X to the robot coordinate system

## Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Methods Applied and Interpretation of Parameters:

- NORM<sub>x,y,z</sub>**: Assessed for E-field polarization  $\theta=0$  ( $f \leq 900\text{MHz}$  in TEM-cell;  $f > 1800\text{MHz}$ : waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not effect the  $E^2$ -field uncertainty inside TSL (see below ConvF).
- NORM(f)<sub>x,y,z</sub>** = NORM<sub>x,y,z</sub> \* frequency\_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP<sub>x,y,z</sub>**: DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- A<sub>x,y,z</sub>; B<sub>x,y,z</sub>; C<sub>x,y,z</sub>; VR<sub>x,y,z</sub>; A,B,C** are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800\text{MHz}$ ) and inside waveguide using analytical field distributions based on power measurements for  $f > 800\text{MHz}$ . The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM<sub>x,y,z</sub> \* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from  $\pm 50\text{MHz}$  to  $\pm 100\text{MHz}$ .
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM<sub>x</sub> (no uncertainty required).