Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	48.3 Ω - 8.2 jΩ
Return Loss	- 21.5 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	50.1 Ω - 2.4 jΩ
Return Loss	- 32.3 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	52.8 Ω - 1.7 jΩ
Return Loss	- 30.0 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	53.3 Ω + 2.8 jΩ
Return Loss	- 27.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.190 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

DASY5 Validation Report for Head TSL

Date: 09.02.2021

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1221

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 4.49 S/m; ε_r = 34.8; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5300 MHz; σ = 4.59 S/m; ε_r = 34.6; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5600 MHz; σ = 4.88 S/m; ε_r = 34.2; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5800 MHz; σ = 5.09 S/m; ε_r = 33.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

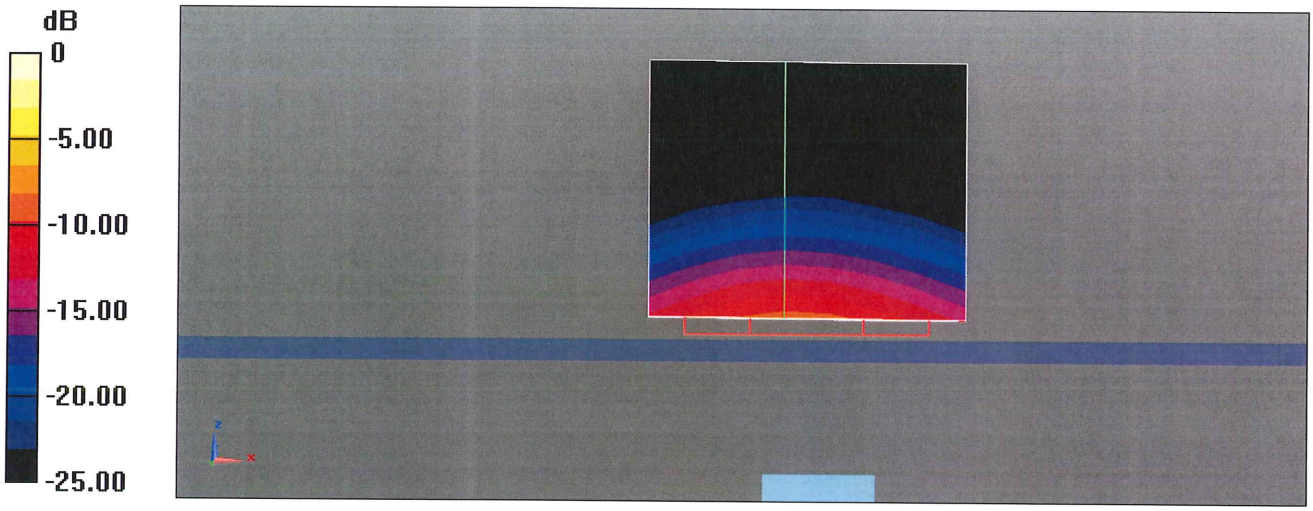
- Probe: EX3DV4 - SN3503; ConvF(5.8, 5.8, 5.8) @ 5200 MHz, ConvF(5.49, 5.49, 5.49) @ 5300 MHz, ConvF(5.1, 5.1, 5.1) @ 5600 MHz, ConvF(5.01, 5.01, 5.01) @ 5800 MHz; Calibrated: 30.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 78.03 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 28.2 W/kg
SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.30 W/kg
Smallest distance from peaks to all points 3 dB below = 7.2 mm
Ratio of SAR at M2 to SAR at M1 = 69.7%
Maximum value of SAR (measured) = 18.1 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 78.34 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 29.1 W/kg
SAR(1 g) = 8.26 W/kg; SAR(10 g) = 2.37 W/kg
Smallest distance from peaks to all points 3 dB below = 7.2 mm
Ratio of SAR at M2 to SAR at M1 = 70%
Maximum value of SAR (measured) = 18.8 W/kg

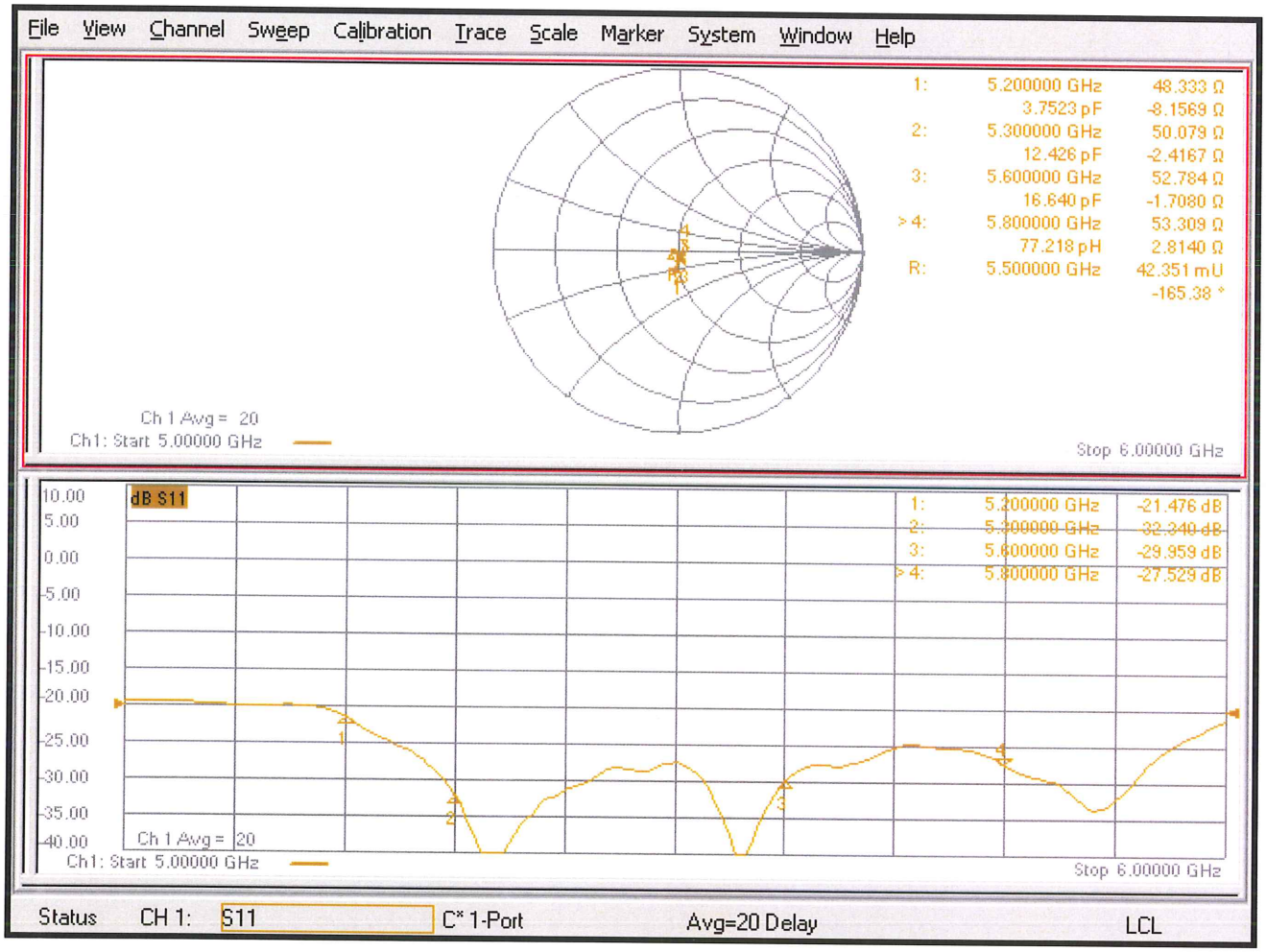
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 79.37 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 31.3 W/kg
SAR(1 g) = 8.53 W/kg; SAR(10 g) = 2.43 W/kg
Smallest distance from peaks to all points 3 dB below = 7.2 mm
Ratio of SAR at M2 to SAR at M1 = 68.6%
Maximum value of SAR (measured) = 19.8 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 76.74 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 32.4 W/kg
SAR(1 g) = 8.25 W/kg; SAR(10 g) = 2.33 W/kg
Smallest distance from peaks to all points 3 dB below = 7.2 mm
Ratio of SAR at M2 to SAR at M1 = 66.3%
Maximum value of SAR (measured) = 19.6 W/kg



0 dB = 19.8 W/kg = 12.96 dBW/kg

Impedance Measurement Plot for Head TSL



Dipole Internal Calibration Record

				NO. :	
Asset No. :	E-436	Model No. :	D5GHzV2	Cal. Date :	February 9, 2021
Equipment :	ENA Network Analyzer	Serial No. :	1121	Next Cal. Date :	February 8, 2024
Environmental condition :		Temp :	23.5 ℃	R.H. :	51%

Standard List

1	IEEE Std 1528-2013	IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate(SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques, June 2013
2	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
3	KDB865664	SAR Measurement Requirements for 100 MHz to 6 GHz

Equipment Information

Equipment :	Manufacturer :	Model No. :	Serial No. :	Cal.Organization :	Cal. Date :
Power Amplifier	EMCI	EMC053035	980869	N/A	December 7, 2021
Power Meter	Anritsu	MA2487A	6K00004714	N/A	August 15, 2021
Power Sensor	Anritsu	MA2491A	34138	N/A	August 15, 2021
Directional Coupler	Woken	TS-PCC0M-05	107090019	N/A	N/A
Signal Generator	R & S	SMB100A	113244	N/A	August 2, 2021
ENA Network Analyzer	Agilent	E5071C	MY46524658	N/A	March 22, 2021

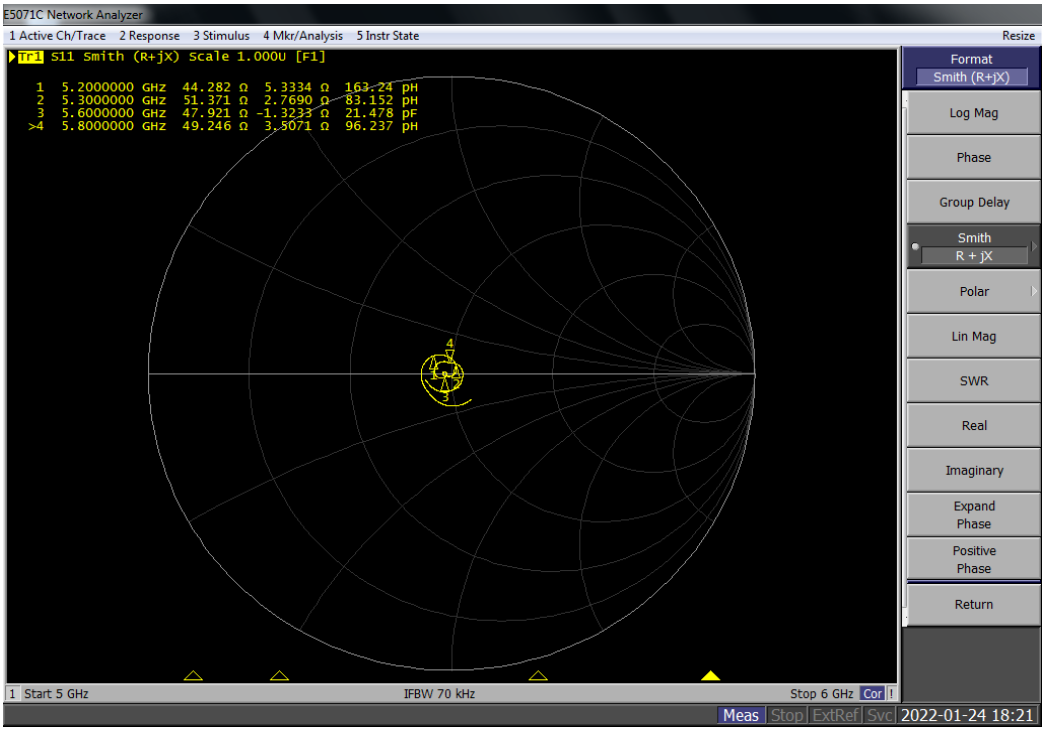
For Head Tissue

Frequency	Item	Originak Cal. Result	Verified on 2022/1/24	Deviation	Result
5.2G	Impedance, transformed to feed point(Ω)	48.3Ω-8.2jΩ	44.3Ω-5.3jΩ	<5Ω	Pass
	Return Loss(dB)	-21.5	-21.65	-0.7%	Pass
	SAR Value for 1g(mW/g)	8.04	7.83	3%	Pass
	SAR Value for 10g(mW/g)	2.3	2.26	1.7%	Pass
5.3G	Impedance, transformed to feed point	50.1Ω-2.4jΩ	51.4Ω+2.8jΩ	<5Ω	Pass
	Return Loss(dB)	-32.3	-30.4	5.9%	Pass
	SAR Value for 1g(mW/g)	8.26	8.17	1.1%	Pass
	SAR Value for 10g(mW/g)	2.37	2.35	0.8%	Pass
5.6G	Impedance, transformed to feed point	52.8Ω-1.7jΩ	47.9Ω-1.3jΩ	<5Ω	Pass
	Return Loss(dB)	-30	-31.78	-5.9%	Pass
	SAR Value for 1g(mW/g)	8.53	8.27	3.0%	Pass
	SAR Value for 10g(mW/g)	2.43	2.37	2.5%	Pass
5.8G	Impedance, transformed to feed point	53.3Ω+2.8jΩ	49.2Ω+3.5jΩ	<5Ω	Pass
	Return Loss(dB)	-27.5	-28.83	-4.8%	Pass
	SAR Value for 1g(mW/g)	8.25	8.01	2.9%	Pass
	SAR Value for 10g(mW/g)	2.33	2.27	2.6%	Pass
Note :	SAR System Uncertainty : % , (95% CONFIDENCE LEVEL , Expanded uncertainty K=2)				

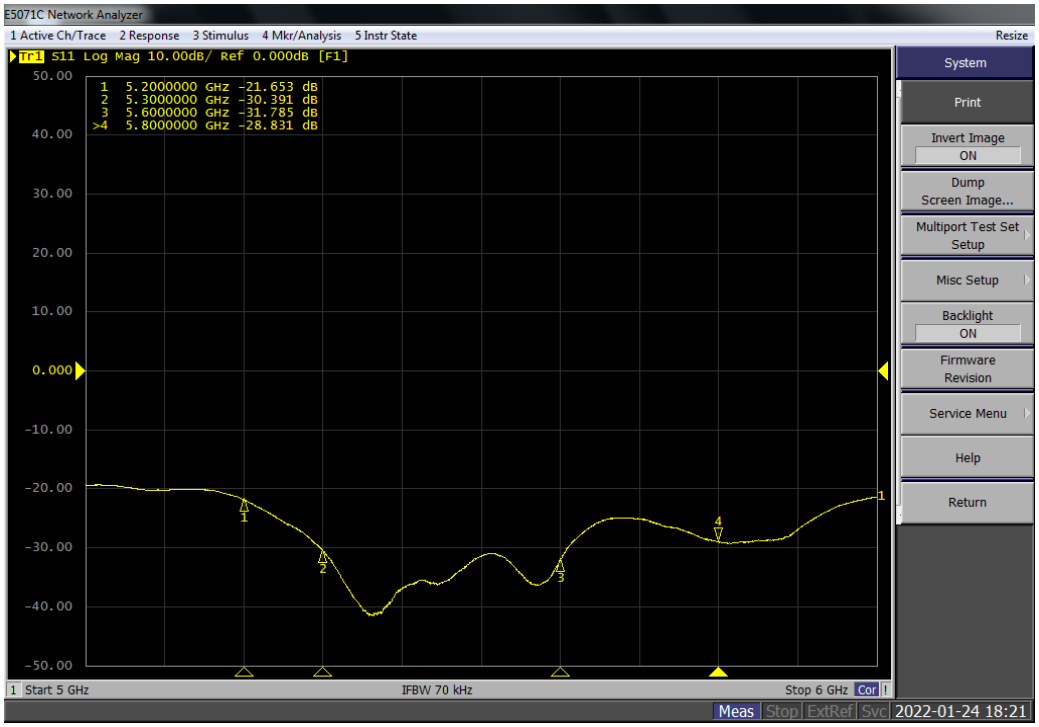
Tester : Jerry Chang

Technical Director : Peter Chen

Impedance Test-Head



Return Loss-Head



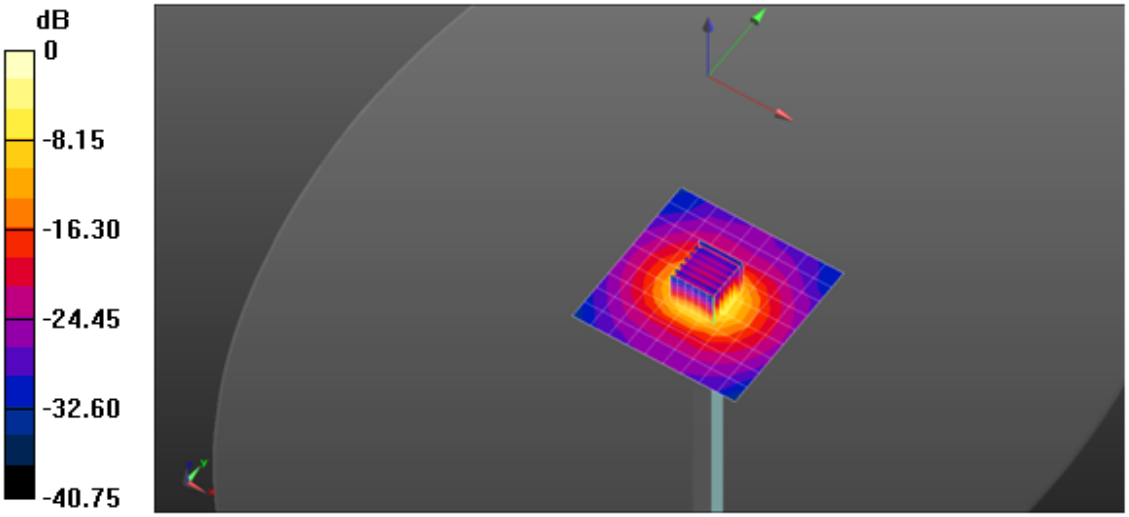
Test Laboratory: BTL Date: 2022/1/24

System Check_H5G

Frequency: 5200 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 23.0°C; Liquid Temperature: 22.0°C
Medium parameters used: f = 5200 MHz; σ = 4.777 S/m; ε_r = 35.51; ρ = 1000 kg/m^3
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 Sn1486; Calibrated: 2021/6/1
- Probe: EX3DV4 - SN7369; ConvF(5.15, 5.15, 5.15) @ 5200 MHz; Calibrated: 2021/6/3
- Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 AA; Serial: 1240

Configuration/Pin=100mW/Area Scan (10x10x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 11.6 W/kg

Configuration/Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 61.34 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 29.9 W/kg
SAR(1 g) = 7.83 W/kg; SAR(10 g) = 2.26 W/kg
Smallest distance from peaks to all points 3 dB below = 7.5 mm
Ratio of SAR at M2 to SAR at M1 = 56.3%
Maximum value of SAR (measured) = 19.2 W/kg



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

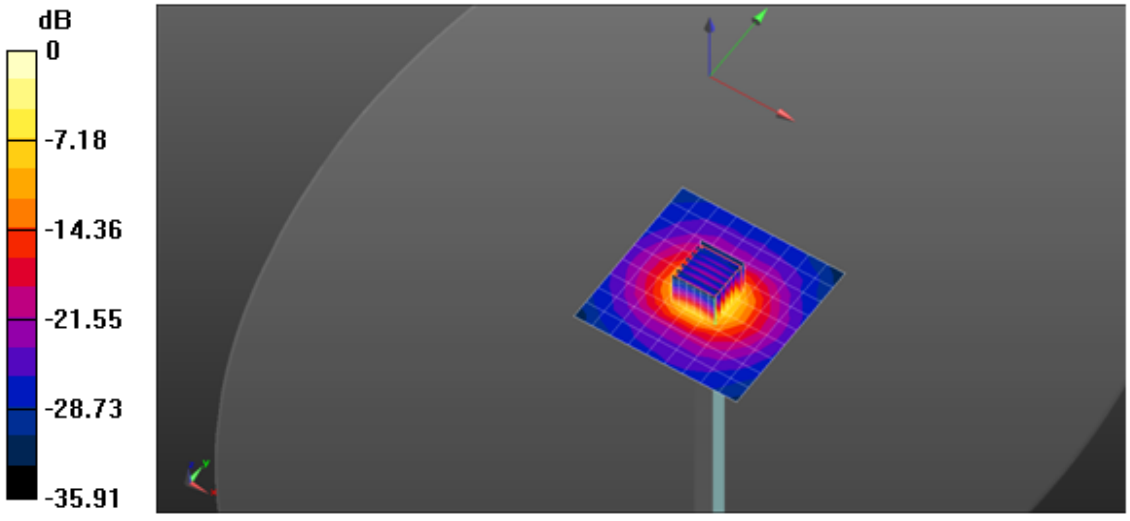
Test Laboratory: BTL Date: 2022/1/24

System Check_H5G

Frequency: 5300 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 23.0°C; Liquid Temperature: 22.0°C
Medium parameters used: f = 5300 MHz; σ = 4.899 S/m; ε_r = 35.252; ρ = 1000 kg/m^3
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 Sn1486; Calibrated: 2021/6/1
- Probe: EX3DV4 - SN7369; ConvF(5, 5, 5) @ 5300 MHz; Calibrated: 2021/6/3
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 AA; Serial: 1240

Configuration/Pin=100mW/Area Scan (10x10x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 12.3 W/kg

Configuration/Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 62.00 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 32.2 W/kg
SAR(1 g) = 8.17 W/kg; SAR(10 g) = 2.35 W/kg
Smallest distance from peaks to all points 3 dB below = 7.5 mm
Ratio of SAR at M2 to SAR at M1 = 55.3%
Maximum value of SAR (measured) = 20.3 W/kg



0 dB = 20.3 W/kg = 13.07 dBW/kg

Test Laboratory: BTL Date: 2022/1/24

System Check_H5G

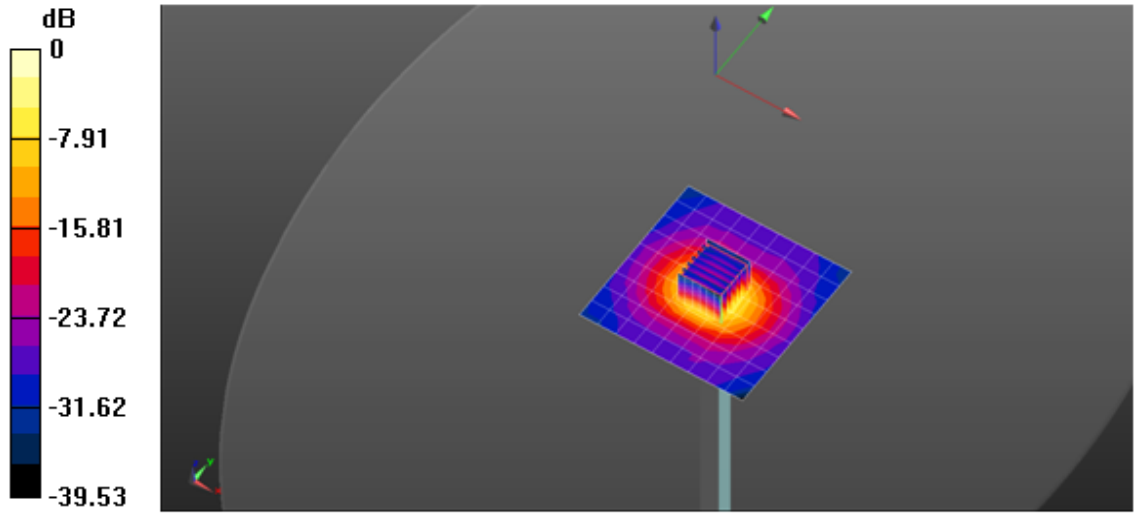
Frequency: 5600 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 23.0°C; Liquid Temperature: 22.0°C
Medium parameters used: f = 5600 MHz; σ = 5.264 S/m; ε_r = 34.496; ρ = 1000 kg/m^3
DASY5 Configuration:
- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1486; Calibrated: 2021/6/1
- Probe: EX3DV4 - SN7369; ConvF(4.66, 4.66, 4.66) @ 5600 MHz; Calibrated: 2021/6/3
- Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 AA; Serial: 1240

Configuration/Pin=100mW/Area Scan (10x10x1): Measurement grid:

dx=10mm, dy=10mm
Maximum value of SAR (measured) = 13.0 W/kg

Configuration/Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 60.64 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 34.9 W/kg
SAR(1 g) = 8.27 W/kg; SAR(10 g) = 2.37 W/kg
Smallest distance from peaks to all points 3 dB below = 7.6 mm
Ratio of SAR at M2 to SAR at M1 = 52.8%
Maximum value of SAR (measured) = 21.0 W/kg



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

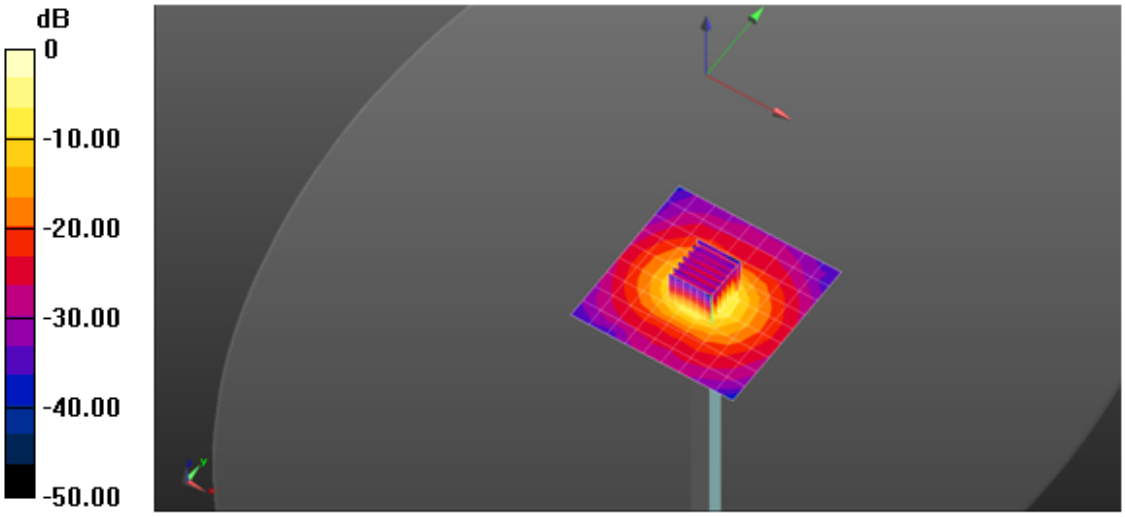
Test Laboratory: BTL Date: 2022/1/24

System Check_H5G

Frequency: 5800 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 23.0°C; Liquid Temperature: 22.0°C
Medium parameters used: f = 5800 MHz; σ = 5.503 S/m; ε_r = 34.001; ρ = 1000 kg/m^3
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 Sn1486; Calibrated: 2021/6/1
- Probe: EX3DV4 - SN7369; ConvF(4.61, 4.61, 4.61) @ 5800 MHz; Calibrated: 2021/6/3
- Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 AA; Serial: 1240

Configuration/Pin=100mW/Area Scan (10x10x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 12.9 W/kg

Configuration/Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 58.58 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 36.1 W/kg
SAR(1 g) = 8.01 W/kg; SAR(10 g) = 2.27 W/kg
Smallest distance from peaks to all points 3 dB below = 7.5 mm
Ratio of SAR at M2 to SAR at M1 = 50.6%
Maximum value of SAR (measured) = 21.0 W/kg



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

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	16078	13925
Channel Y	16429	12079
Channel Z	15999	15718

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.45	-0.32	1.60	0.31
Channel Y	0.25	-0.35	1.64	0.33
Channel Z	0.32	-0.56	1.39	0.36

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