

DASY6 Validation Report for Head TSL

Measurement Report for D6.5GHz-1006, UID 0 -, Channel 6500 (6500.0MHz)

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
D6.5GHz	16.0 x 6.0 x 300.0	SN: 1006	-

Exposure Conditions

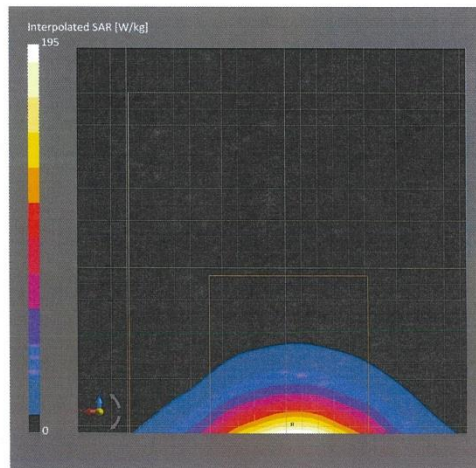
Phantom Section, TSL	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz]	Conversion Factor	TSL Cond. [S/m]	TSL Permittivity
Flat, HSL	5.00	Band	CW,	6500	5.14	6.32	34.9

Hardware Setup

Phantom	TSL	Probe, Calibration Date	DAE, Calibration Date
MFP V8.0 Center - 1182	HBBL600-10000V6	EX3DV4 - SN7405, 2024-07-01	DAE4 Sn908, 2024-03-27

Scan Setup

Zoom Scan		Measurement Results		Zoom Scan	
Grid Extents [mm]	22.0 x 22.0 x 22.0	Date		2024-08-15, 11:31	
Grid Steps [mm]	3.4 x 3.4 x 1.4	psSAR1g [W/Kg]		29.7	
Sensor Surface [mm]	1.4	psSAR8g [W/Kg]		6.63	
Graded Grid	Yes	psSAR10g [W/Kg]		5.43	
Grading Ratio	1.4	Power Drift [dB]		-0.00	
MAIA	N/A	Power Scaling		Disabled	
Surface Detection	VMS + 6p	Scaling Factor [dB]			
Scan Method	Measured	TSL Correction		No correction	
		M2/M1 [%]		49.4	
		Dist 3dB Peak [mm]		4.8	

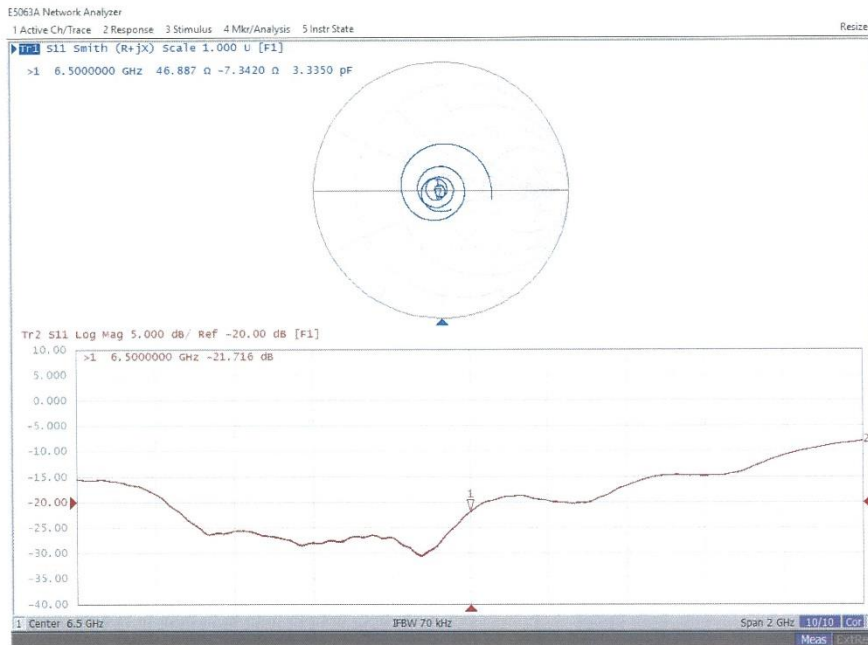


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Impedance Measurement Plot for Head TSL



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Accreditation No.: SCS 0108

Client **SGS**
Taoyuan City

Certificate No. **D7GHZV2-1007_Aug24**

CALIBRATION CERTIFICATE

Object **D7GHZV2 - SN:1007**

Calibration procedure(s) **QA CAL-22.v7
Calibration Procedure for SAR Validation Sources between 3-10 GHz**

Calibration date: **August 15, 2024**

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 (Certificate No.)	Scheduled Calibration
Power sensor R&S NRP33T	SN: 100967	28-Mar-24 (No. 217-04038)	Mar-25
Reference 20 dB Attenuator	SN: BH9394 (20k)	26-Mar-24 (No. 217-04046)	Mar-25
Mismatch combination	SN: 84224 / 360D	28-Mar-24 (No. 217-04050)	Mar-25
Reference Probe EX3DV4	SN: 7405	01-Jul-24 (No. EX3-7405_Jul24)	Jul-25
DAE4	SN: 908	27-Mar-24 (No. DAE4-908_Mar24)	Mar-25

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator Anapico APSIN20G	SN: 827	18-Dec-18 (in house check Jan-24)	In house check: Jan-25
Power sensor NRP-ZZ3	SN: 100169	10-Jan-19 (in house check Jan-24)	In house check: Jan-25
Power sensor NRP-18T	SN: 100950	28-Sep-22 (in house check Jan-24)	In house check: Jan-25
Network Analyzer Keysight E5063A	SN: MY54504221	31-Oct-19 (in house check Oct-22)	In house check: Oct-25

Calibrated by: **Aldonia Georgiadou** **Laboratory Technician**

Approved by: **Sven Kühn** **Technical Manager**

Issued: August 16, 2024

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Certificate No: D7GHZV2-1007_Aug24

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range Of 4 MHz To 10 GHz)", October 2020.

Additional Documentation:

- b) DASY 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 Return Loss ensures low reflected power. 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 absorbed power density (APD):* The absorbed power density is evaluated according to Samaras T, Christ A, Kuster N, "Compliance assessment of the epithelial or absorbed power density above 6 GHz using SAR measurement systems", Bioelectromagnetics, 2021 (submitted). The additional evaluation uncertainty of 0.55 dB (rectangular distribution) is considered.

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.

DASY Version	DASY6	V16.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	5 mm	with Spacer
Zoom Scan Resolution	dx, dy = 3.0 mm, dz = 1.2 mm	Graded Ratio = 1.2 (Z direction)
Frequency	7000 MHz \pm 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	33.9	6.65 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	34.0 \pm 6 %	6.94 mho/m \pm 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	28.6 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	286 W/kg \pm 24.7 % (k=2)
SAR averaged over 8 cm ³ (8 g) of Head TSL	condition	
SAR measured	100 mW input power	6.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	61.6 W/kg \pm 24.4 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	5.03 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	50.4 W/kg \pm 24.4 % (k=2)

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Appendix (Additional assessments outside the scope of SCS 0108)**Antenna Parameters with Head TSL**

Impedance, transformed to feed point	54.1 Ω - 4.9 j Ω
Return Loss	- 24.3 dB

APD (Absorbed Power Density)

APD averaged over 1 cm ²	Condition	
APD measured	100 mW input power	286 W/m ²
APD measured	normalized to 1W	2860 W/m ² \pm 29.2 % (k=2)

APD averaged over 4 cm ²	condition	
APD measured	100 mW input power	123 W/m ²
APD measured	normalized to 1W	1230 W/m ² \pm 28.9 % (k=2)

* The reported APD values have been derived using the psSAR1g and psSAR8g.

General Antenna Parameters and Design

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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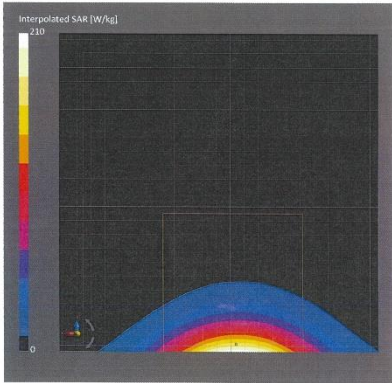
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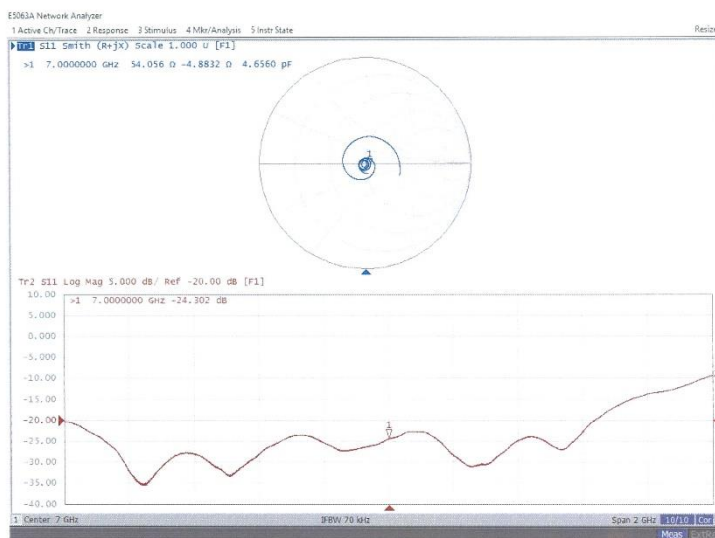
DASY6 Validation Report for Head TSL

Measurement Report for D7GHz-1007, UID 0 -, Channel 7000 (7000.0MHz)

Device under Test Properties				DUT Type			
Name, Manufacturer	Dimensions [mm]	IMEI					
D7GHz	14.0 x 6.0 x 297.0	SN: 1007					
Exposure Conditions							
Phantom	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz]	Conversion Factor	TSL Cond. [S/m]	TSL Permittivity
Flat, HSL	5.00	Band	CW,	7000	5.80	6.94	34.0
Hardware Setup				Measurement Results			
Phantom	TSL	Probe, Calibration Date	DAE, Calibration Date				
MFP V8.0 Center - 1182	HBBL600-10000V6	EX3DV4 - SN7405, 2024-07-01	DAE4 Sn908, 2024-03-27				
Scan Setup		Zoom Scan		Measurement Results		Zoom Scan	
Grid Extents [mm]	22.0 x 22.0 x 22.0	Date	2024-08-15, 12:48	psSAR1g [W/Kg]	28.6		
Grid Steps [mm]	3.0 x 3.0 x 1.2	psSAR8g [W/Kg]	6.16	psSAR10g [W/Kg]	5.03		
Sensor Surface [mm]	1.4	Power Drift [dB]	0.07	Power Scaling	Disabled		
Graded Grid	Yes	Scaling Factor [dB]		TSL Correction	No correction		
Grading Ratio	1.2	M2/M1 [%]	46.1	Dist 3dB Peak [mm]	4.3		
MAIA	N/A						
Surface Detection	VMS + 6p						
Scan Method	Measured						



Impedance Measurement Plot for Head TSL



Certificate No: D7GHzV2-1007_Aug24

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Accreditation No.: SCS 0108

Client **SGS**
Taoyuan City

Certificate No. **5G-Veri10-1021_Jan24**

CALIBRATION CERTIFICATE

Object **5G Verification Source 10 GHz - SN: 1021**

Calibration procedure(s) **QA CAL-45.v4**
Calibration procedure for sources in air above 6 GHz

Calibration date: **January 17, 2024**

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 (Certificate No.)	Scheduled Calibration
Reference Probe EUMMWV3	SN: 9374	04-Dec-23 (No. EUMMWV3-Dec23)	Dec-24
DAE4	SN: 1215	29-Jun-23 (No. DAE4-1215_Jun23)	Jun-24

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMF100A	SN: 100184	29-Nov-23 (in house check Nov-23)	In house check: Nov-24
Power sensor R&S NRP18S-10	SN: 101258	29-Nov-23 (in house check Nov-23)	In house check: Nov-24
Network Analyzer Keysight E5063A	SN: MY54504221	31-Oct-19 (in house check Oct-22)	In house check: Oct-25

Calibrated by: **Joanna Lleshaj** **Laboratory Technician**

Approved by: **Sven Kühn** **Technical Manager**

Signature

Issued: January 19, 2024

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Certificate No: 5G-Veri10-1021_Jan24

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CW Continuous wave

Calibration is Performed According to the Following Standards

- Internal procedure QA CAL-45, Calibration procedure for sources in air above 6 GHz.
- IEC/IEEE 63195-1, "Assessment of power density of human exposure to radio frequency fields from wireless devices in close proximity to the head and body (frequency range of 6 GHz to 300 GHz)", May 2022

Methods Applied and Interpretation of Parameters

- Coordinate System:** z-axis in the waveguide horn boresight, x-axis is in the direction of the E-field, y-axis normal to the others in the field scanning plane parallel to the horn flare and horn flange.
- Measurement Conditions:** (1) 10 GHz: The radiated power is the forward power to the horn antenna minus ohmic and mismatch loss. The forward power is measured prior and after the measurement with a power sensor. During the measurements, the horn is directly connected to the cable and the antenna ohmic and mismatch losses are determined by far-field measurements. (2) 30, 45, 60 and 90 GHz: The verification sources are switched on for at least 30 minutes. Absorbers are used around the probe cub and at the ceiling to minimize reflections.
- Horn Positioning:** The waveguide horn is mounted vertically on the flange of the waveguide source to allow vertical positioning of the EUmmW probe during the scan. The plane is parallel to the phantom surface. Probe distance is verified using mechanical gauges positioned on the flare of the horn.
- E- field distribution:** E field is measured in two x-y-plane (10mm, 10mm + $\lambda/4$) with a vectorial E-field probe. The E-field value stated as calibration value represents the E-field-maxima and the averaged (1cm² and 4cm²) power density values at 10mm in front of the horn.
- Field polarization:** Above the open horn, linear polarization of the field is expected. This is verified graphically in the field representation.

Calibrated Quantity

- Local peak E-field (V/m) and average of peak spatial components of the poynting vector (W/m²) averaged over the surface area of 1 cm² and 4cm² at the nominal operational frequency of the verification source. Both square and circular averaging results are listed.

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.

DASY Version	DASY8 Module mmWave	V3.2
Phantom	5G Phantom	
Distance Horn Aperture - plane	10 mm	
Number of measured planes	2 (10mm, 10mm + $\lambda/4$)	
Frequency	10 GHz \pm 10 MHz	

Calibration Parameters, 10 GHz**Circular Averaging**

Distance Horn Aperture to Measured Plane	<i>Prad'</i> (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Avg Power Density Avg (psPDn+, psPDtot+, psPDmod+) (W/m ²)		Uncertainty (k = 2)
				1 cm ²	4 cm ²	
10 mm	93.3	154	1.27 dB	60.6	56.2	1.28 dB

Distance Horn Aperture to Measured Plane	<i>Prad'</i> (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Power Density psPDn+, psPDtot+, psPDmod+ (W/m ²)		Uncertainty (k = 2)
				1 cm ²	4 cm ²	
10 mm	93.3	154	1.27 dB	60.4, 60.6, 60.8	55.9, 56.2, 56.5	1.28 dB

Square Averaging

Distance Horn Aperture to Measured Plane	<i>Prad'</i> (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Avg Power Density Avg (psPDn+, psPDtot+, psPDmod+) (W/m ²)		Uncertainty (k = 2)
				1 cm ²	4 cm ²	
10 mm	93.3	154	1.27 dB	60.6	56.1	1.28 dB

Distance Horn Aperture to Measured Plane	<i>Prad'</i> (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Power Density psPDn+, psPDtot+, psPDmod+ (W/m ²)		Uncertainty (k = 2)
				1 cm ²	4 cm ²	
10 mm	93.3	154	1.27 dB	60.4, 60.6, 60.8	55.8, 56.1, 56.4	1.28 dB

Max Power Density

Distance Horn Aperture to Measured Plane	<i>Prad'</i> (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Max Power Density Sn, Stot, Stot (W/m ²)	Uncertainty (k = 2)
10 mm	93.3	154	1.27 dB	62.1, 62.2, 62.4	1.28 dB

¹ Assessed ohmic and mismatch loss plus numerical offset: 0.30 dB

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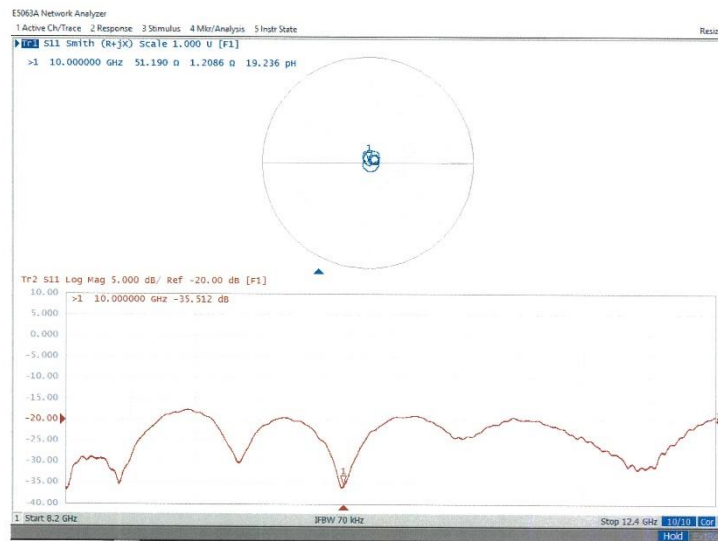
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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters

Impedance, transformed to feed point	51.2 Ω + 1.2 j Ω
Return Loss	- 35.5 dB

Impedance Measurement Plot



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DASY Report

Measurement Report for 5G Verification Source 10 GHz, UID 0 -, Channel 10000 (10000.0MHz)

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
5G Verification Source 10 GHz	100.0 x 100.0 x 172.0	SN: 1021	-

Exposure Conditions

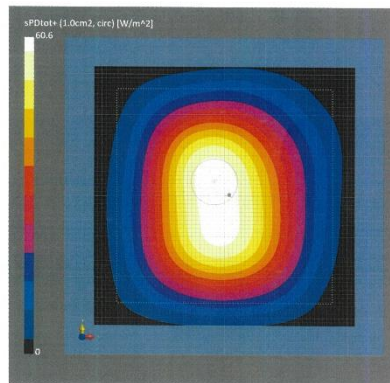
Phantom Section	Position, Test Distance [mm]	Band	Group,	Frequency [MHz], Channel Number	Conversion Factor
5G -	10.0 mm	Validation band	CW	10000.0, 10000	1.0

Hardware Setup

Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Air	E UmmWV3 - SN9374_F1-55GHz, 2023-12-04	DAE4 Sn1215, 2023-06-29

Scan Setup

Sensor Surface [mm]	5G Scan	Measurement Results	5G Scan
MAIA	10.0	Date	2024-01-17, 15:16
	MAIA not used	Avg. Area [cm ²]	1.00
		Avg. Type	Circular Averaging
		psPDn+ [W/m ²]	60.4
		psPDtot+ [W/m ²]	60.6
		psPDmod+ [W/m ²]	60.8
		Max(Sn) [W/m ²]	62.1
		Max(Stot) [W/m ²]	62.2
		E _{max} [V/m]	154
		Power Drift [dB]	0.00



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DASY Report

Measurement Report for 5G Verification Source 10 GHz, UID 0 -, Channel 10000 (10000.0MHz)

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
5G Verification Source 10 GHz	100.0 x 100.0 x 172.0	SN: 1021	-

Exposure Conditions

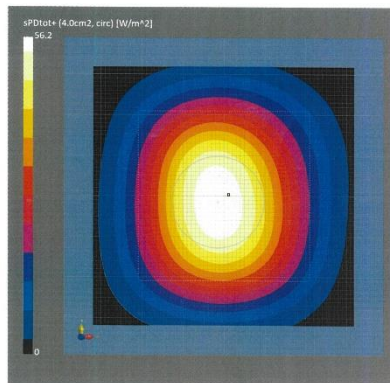
Phantom Section	Position, Test Distance [mm]	Band	Group,	Frequency [MHz], Channel Number	Conversion Factor
5G -	10.0 mm	Validation band	CW	10000.0, 10000	1.0

Hardware Setup

Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Air	EUMmWV3 - SN9374_F1-55GHz, 2023-12-04	DAE4 Sn1215, 2023-06-29

Scan Setup

Sensor Surface [mm]	5G Scan	Date	5G Scan
MAIA	10.0	2024-01-17, 15:16	
	MAIA not used	Avg. Area [cm ²]	4.00
		Avg. Type	Circular Averaging
		psPDn+ [W/m ²]	55.9
		psPDtot+ [W/m ²]	56.2
		psPDmod+ [W/m ²]	56.5
		Max(Sn) [W/m ²]	62.1
		Max(Stot) [W/m ²]	62.2
		Max(Stot) [W/m ²]	62.4
		E _{max} [V/m]	154
		Power Drift [dB]	0.00



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DASY Report

Measurement Report for 5G Verification Source 10 GHz, UID 0 -, Channel 10000 (10000.0MHz)

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
5G Verification Source 10 GHz	100.0 x 100.0 x 172.0	SN: 1021	-

Exposure Conditions

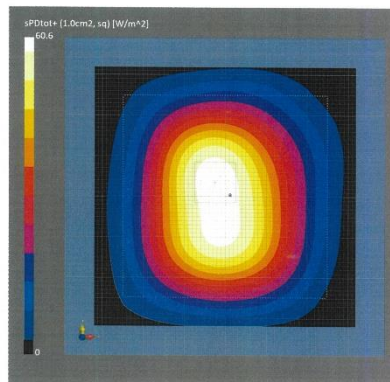
Phantom Section	Position, Test Distance [mm]	Band	Group,	Frequency [MHz], Channel Number	Conversion Factor
5G -	10.0 mm	Validation band	CW	10000.0, 10000	1.0

Hardware Setup

Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Air	EUMmWV3 - SN9374_F1-55GHz, 2023-12-04	DAE4 Sn1215, 2023-06-29

Scan Setup

Sensor Surface [mm]	5G Scan	Date	5G Scan
MAIA	10.0	2024-01-17, 15:16	2024-01-17, 15:16
	MAIA not used	Avg. Area [cm ²]	1.00
		Avg. Type	Square Averaging
		psPDn+ [W/m ²]	60.4
		psPDtot+ [W/m ²]	60.6
		psPDmod+ [W/m ²]	60.8
		Max(Sn) [W/m ²]	62.1
		Max(Stot) [W/m ²]	62.2
		Max(Stot) [W/m ²]	62.4
		E _{max} [V/m]	154
		Power Drift [dB]	0.00



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DASY Report

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Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
5G Verification Source 10 GHz	100.0 x 100.0 x 172.0	SN: 1021	-

Exposure Conditions

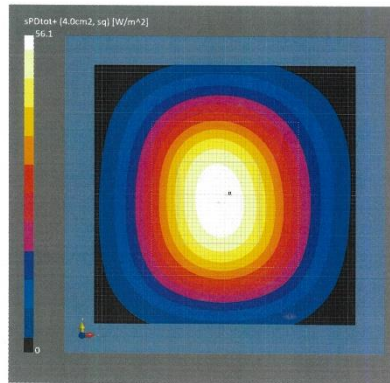
Phantom Section	Position, Test Distance [mm]	Band	Group,	Frequency [MHz], Channel Number	Conversion Factor
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Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
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Scan Setup

Sensor Surface [mm]	5G Scan	Date	5G Scan
MAIA	10.0	2024-01-17, 15:16	2024-01-17, 15:16
	MAIA not used	Avg. Area [cm ²]	4.00
		Avg. Type	Square Averaging
		psPDn+ [W/m ²]	55.8
		psPDn+ [W/m ²]	56.1
		psPDmod+ [W/m ²]	56.4
		Max(Sn) [W/m ²]	62.1
		Max(Stot) [W/m ²]	62.2
		Max(Stot) [W/m ²]	62.4
		E _{max} [V/m]	154
		Power Drift [dB]	0.00

**- End of report -**

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