



Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

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.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- c) 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 source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). 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 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%.

Measurement Conditions

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

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	38.0 $\pm$ 6 %	1.87 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	250 mW input power	13.6 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.1 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.8 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$55.3 \Omega + 1.3 j\Omega$
Return Loss	- 25.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.157 ns
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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: 22.04.2024

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:919

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.87$ S/m; $\epsilon_r = 38$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.96, 7.96, 7.96) @ 2450 MHz; Calibrated: 03.11.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2024
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 119.3 V/m; Power Drift = 0.03 dB

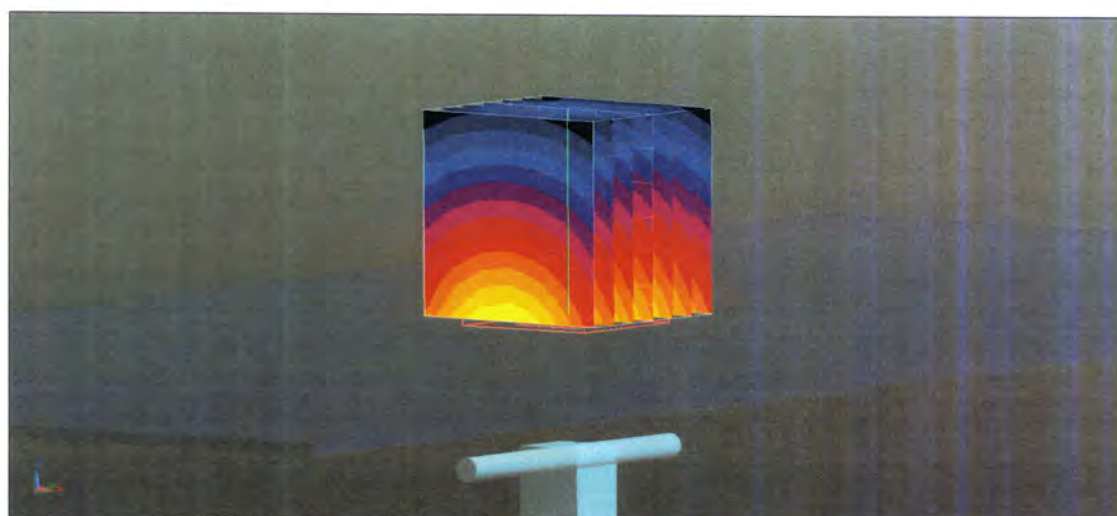
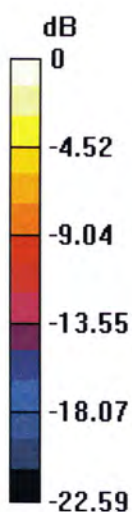
Peak SAR (extrapolated) = 27.2 W/kg

SAR(1 g) = 13.6 W/kg; SAR(10 g) = 6.3 W/kg

Smallest distance from peaks to all points 3 dB below = 9 mm

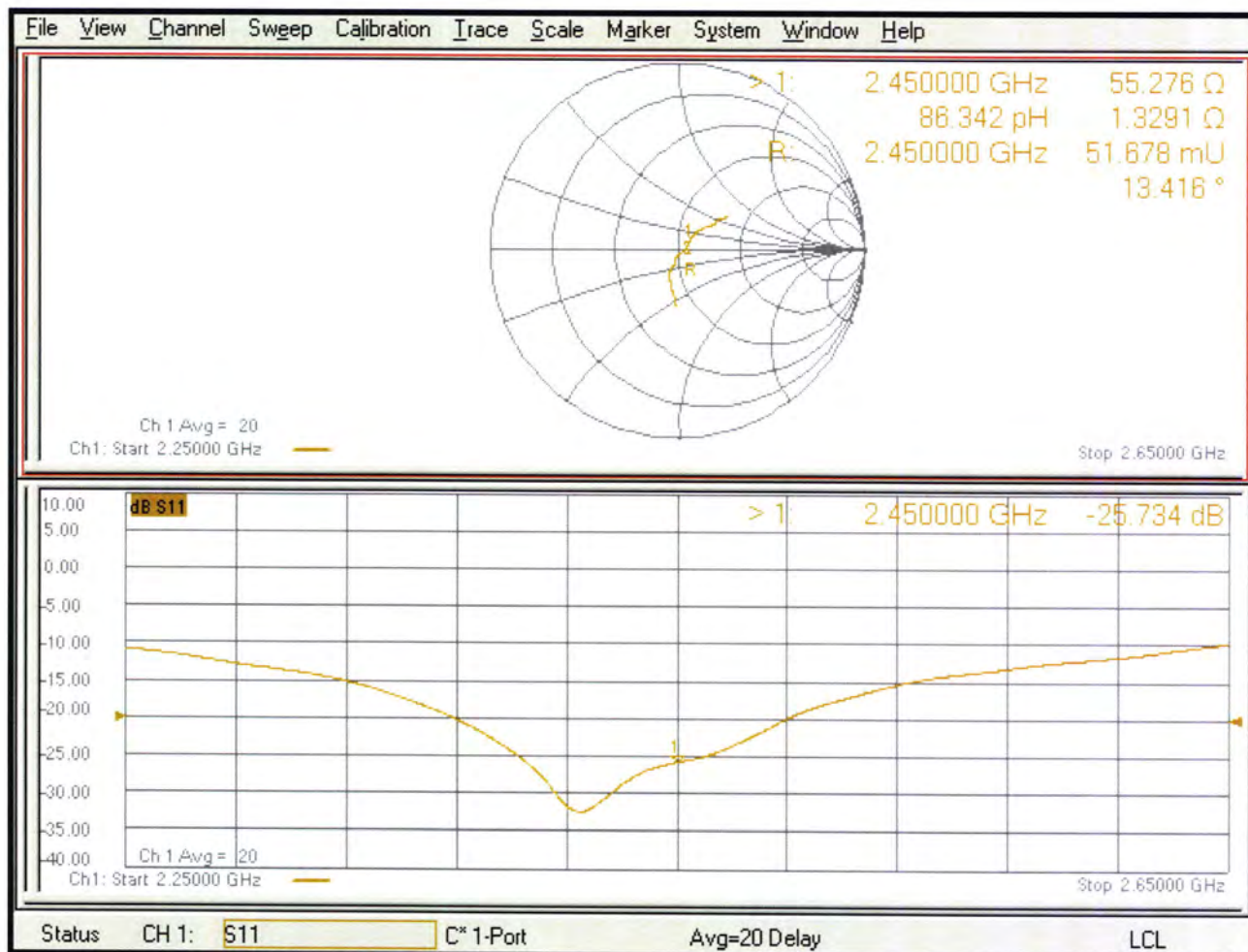
Ratio of SAR at M2 to SAR at M1 = 50.1%

Maximum value of SAR (measured) = 22.4 W/kg



0 dB = 22.4 W/kg = 13.51 dBW/kg

Impedance Measurement Plot for Head TSL





Dipole Internal Calibration Record

Asset No. :	E-434	Model No. :	D2450V2	Serial No. :	919
Environmental	22.5°C, 57 %	Original Cal.Date :	April 22, 2024	Next Cal. Date :	April 22, 2027

Standard List

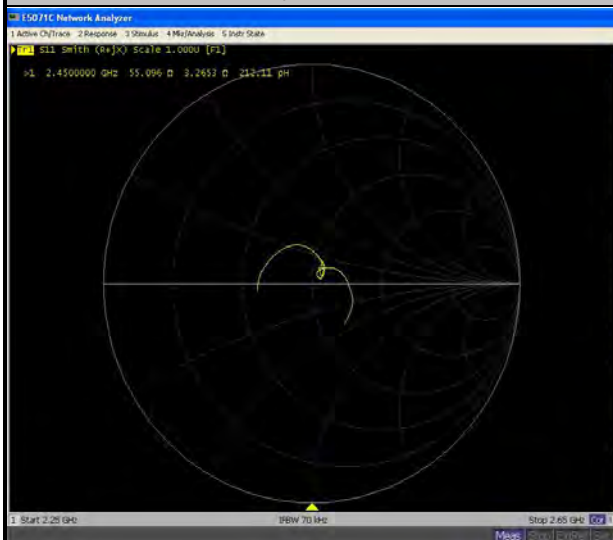
1	IEC/IEEE 62209-1528:2020	Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528:Human Models,Instrumentation And Procedures(Frequency Range of 4 MHz to 10GHz)
2	KDB865664	SAR Measurement Requirements for 100 MHz to 6 GHz

Equipment Information

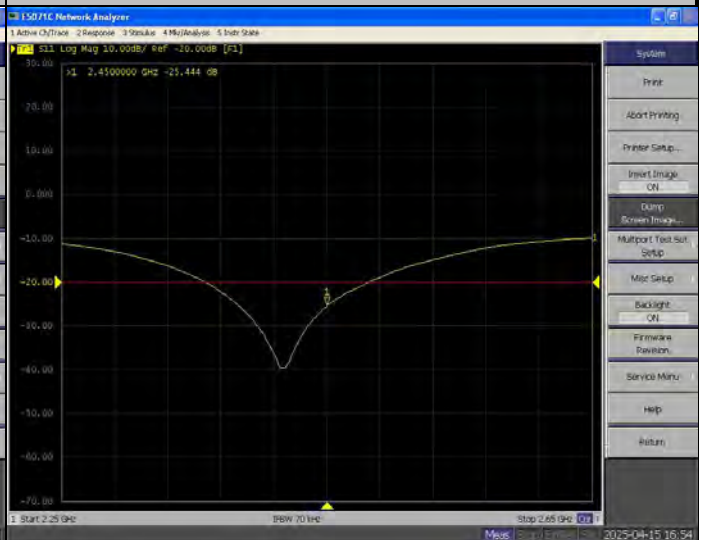
Equipment :	Manufacturer :	Model No. :	Serial No. :	Cal.Organization :	Cal. Date :
Power Amplifier	Mini-Circuits	ZHL-42W+	QA1333003	N/A	June 29, 2024
DC Source metter	Iteck	IT6154	006104126768201001	N/A	June 29, 2024
Vector Network Analyzer	Agilent	E5071C	MY46102965	N/A	January 11, 2025
Signal Generator	Agilent	N5172B	MY53050758	N/A	January 11, 2025
Smart Power Sensor	R&S	NRP18S	101333	N/A	June 1, 2024
Dielectric Assessment	Speag	DAK-3.5	1226	N/A	January 20, 2025
Directional Coupler	Woken	TS-PCC0M-05	0107090019	N/A	January 11, 2025
Coupler	Woken	0110A05601O-10	COM5BNW1A2	N/A	January 12, 2025
Liquid Thermometer	Nscing Es	YZ6021S	/	N/A	November 24, 2024

Model No	For Head Tissue				
	Item	Original Cal. Result	Verified on 2025/4/15	Deviation	Result
D2450V2	Impedance, transformed to feed point	55.3Ω+1.3jΩ	55.09Ω+3.27Ω	<5Ω	Pass
	Return Loss(dB)	-25.7	-25.444	-1.0%	Pass
	SAR Value for 1g(mW/g)	13.6	12.7	-6.6%	Pass
	SAR Value for 10g(mW/g)	6.3	5.97	-5.2%	Pass

Impedance Test-Head



Return Loss-Head



Test Laboratory: BTL Inc.

Date: 2025/4/15

System Check_H2450_0415**DUT: Dipole 2450 MHz D2450V2;SN:919;**

Communication System: UID 0, CW (0); Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.836$ S/m; $\epsilon_r = 39.639$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.5°C; Liquid Temperature: 22.1°C

DASY Configuration:

- Probe: EX3DV4 - SN3809; ConvF(7.59, 6.97, 6.79)@2450 MHz; Calibrated: 2025/1/24
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 1.0, 31.0$
- Electronics: DAE4 Sn1390; Calibrated: 2024/11/14
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax; Serial: 1222
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Area Scan (6x7x1): Measurement grid: $dx=15$ mm, $dy=15$ mm

Maximum value of SAR (measured) = 15.6 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8$ mm, $dy=8$ mm, $dz=5$ mm

Reference Value = 111.4 V/m; Power Drift = -0.04 dB

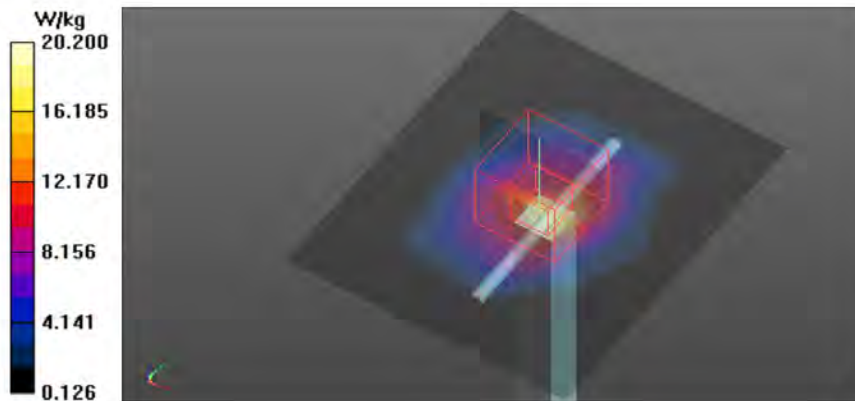
Peak SAR (extrapolated) = 23.9 W/kg

SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.97 W/kg

Smallest distance from peaks to all points 3 dB below = 10.7 mm

Ratio of SAR at M2 to SAR at M1 = 53.1%

Maximum value of SAR (measured) = 20.2 W/kg



Calibrator:

Justin Huang

Approver:

Herbert Lin



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Multilateral Agreement for the recognition of calibration certificates

Client **BTL Inc.**
Guangdong

Certificate No. **D5GHzV2-1160_Apr24/2**

CALIBRATION CERTIFICATE (Replacement of No: D5GHzV2-1160_Apr24)

Object **D5GHzV2 - SN:1160**

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

Calibration date: **April 25, 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 $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

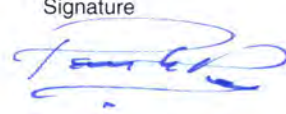
Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP2	SN: 104778	26-Mar-24 (No. 217-04036/04037)	Mar-25
Power sensor NRP-Z91	SN: 103244	26-Mar-24 (No. 217-04036)	Mar-25
Power sensor NRP-Z91	SN: 103245	26-Mar-24 (No. 217-04037)	Mar-25
Reference 20 dB Attenuator	SN: BH9394 (20k)	26-Mar-24 (No. 217-04046)	Mar-25
Type-N mismatch combination	SN: 310982 / 06327	26-Mar-24 (No. 217-04047)	Mar-25
Reference Probe EX3DV4	SN: 3503	07-Mar-24 (No. EX3-3503_Mar24)	Mar-25
DAE4	SN: 601	30-Jan-24 (No. DAE4-601_Jan24)	Jan-25

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-22)	In house check: Oct-24
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24

Calibrated by: **Paulo Pina** Name: **Paulo Pina** Function: **Laboratory Technician**

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

Signature



Issued: May 21, 2024

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



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Multilateral Agreement for the recognition of calibration certificates

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.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- c) 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 source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). 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 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%.

Measurement Conditions

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

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz $\pm$ 1 MHz 5600 MHz $\pm$ 1 MHz 5750 MHz $\pm$ 1 MHz 5850 MHz $\pm$ 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	36.7 $\pm$ 6 %	4.58 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.84 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.7 W/kg $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.7 W/kg $\pm$ 19.5 % (k=2)

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	36.1 ± 6 %	4.97 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.5 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.8 ± 6 %	5.14 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm³ (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	78.7 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.4 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5850 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.2	5.32 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.8 ± 6 %	5.24 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5850 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.6 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.0 W/kg ± 19.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	49.2 Ω - 3.5 jΩ
Return Loss	- 28.8 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	55.0 Ω - 0.3 jΩ
Return Loss	- 26.4 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	54.8 Ω - 0.7 jΩ
Return Loss	- 26.7 dB

Antenna Parameters with Head TSL at 5850 MHz

Impedance, transformed to feed point	56.3 Ω - 3.9 jΩ
Return Loss	- 23.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.198 ns
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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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Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1160

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz, Frequency: 5850 MHz

Medium parameters used: $f = 5250$ MHz; $\sigma = 4.58$ S/m; $\epsilon_r = 36.7$; $\rho = 1000$ kg/m³

Medium parameters used: $f = 5600$ MHz; $\sigma = 4.97$ S/m; $\epsilon_r = 36.1$; $\rho = 1000$ kg/m³

Medium parameters used: $f = 5750$ MHz; $\sigma = 5.14$ S/m; $\epsilon_r = 35.8$; $\rho = 1000$ kg/m³

Medium parameters used: $f = 5850$ MHz; $\sigma = 5.24$ S/m; $\epsilon_r = 35.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.39, 5.39, 5.39) @ 5250 MHz, ConvF(5, 5, 5) @ 5600 MHz, ConvF(4.98, 4.98, 4.98) @ 5750 MHz, ConvF(4.89, 4.89, 4.89) @ 5850 MHz; Calibrated: 07.03.2024
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2024
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 72.71 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 26.2 W/kg

SAR(1 g) = 7.84 W/kg; SAR(10 g) = 2.26 W/kg

Smallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 71.3%

Maximum value of SAR (measured) = 17.5 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 = 72.07 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 29.5 W/kg

SAR(1 g) = 8.16 W/kg; SAR(10 g) = 2.34 W/kg

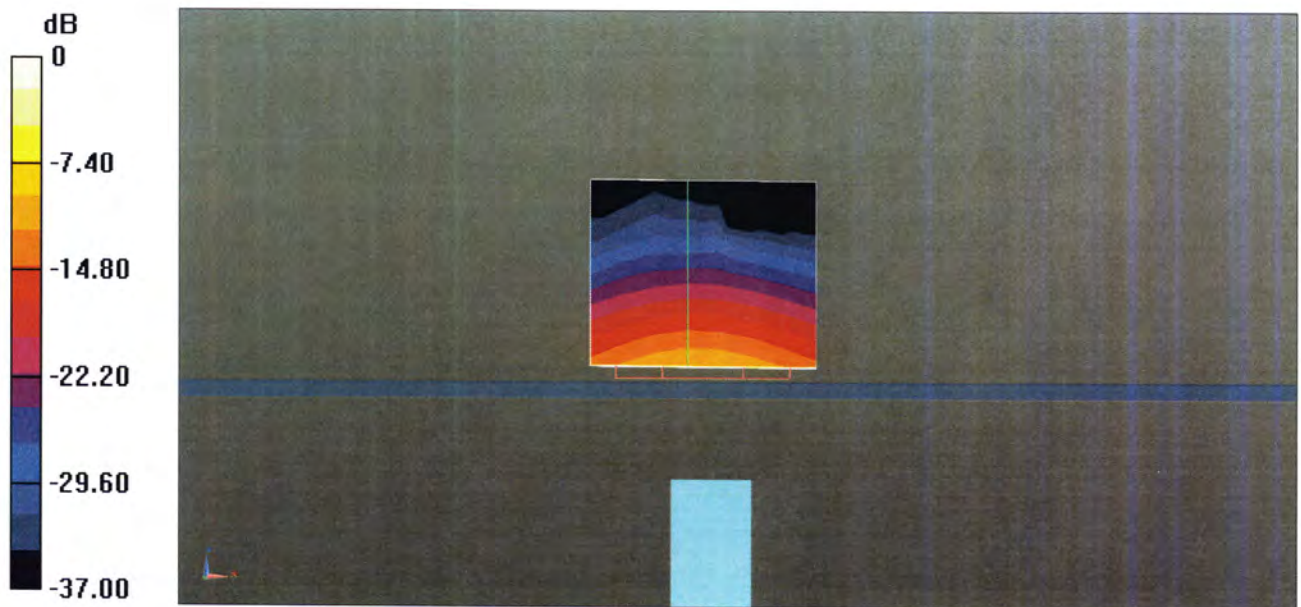
Smallest distance from peaks to all points 3 dB below = 7.4 mm

Ratio of SAR at M2 to SAR at M1 = 68.7%

Maximum value of SAR (measured) = 18.7 W/kg

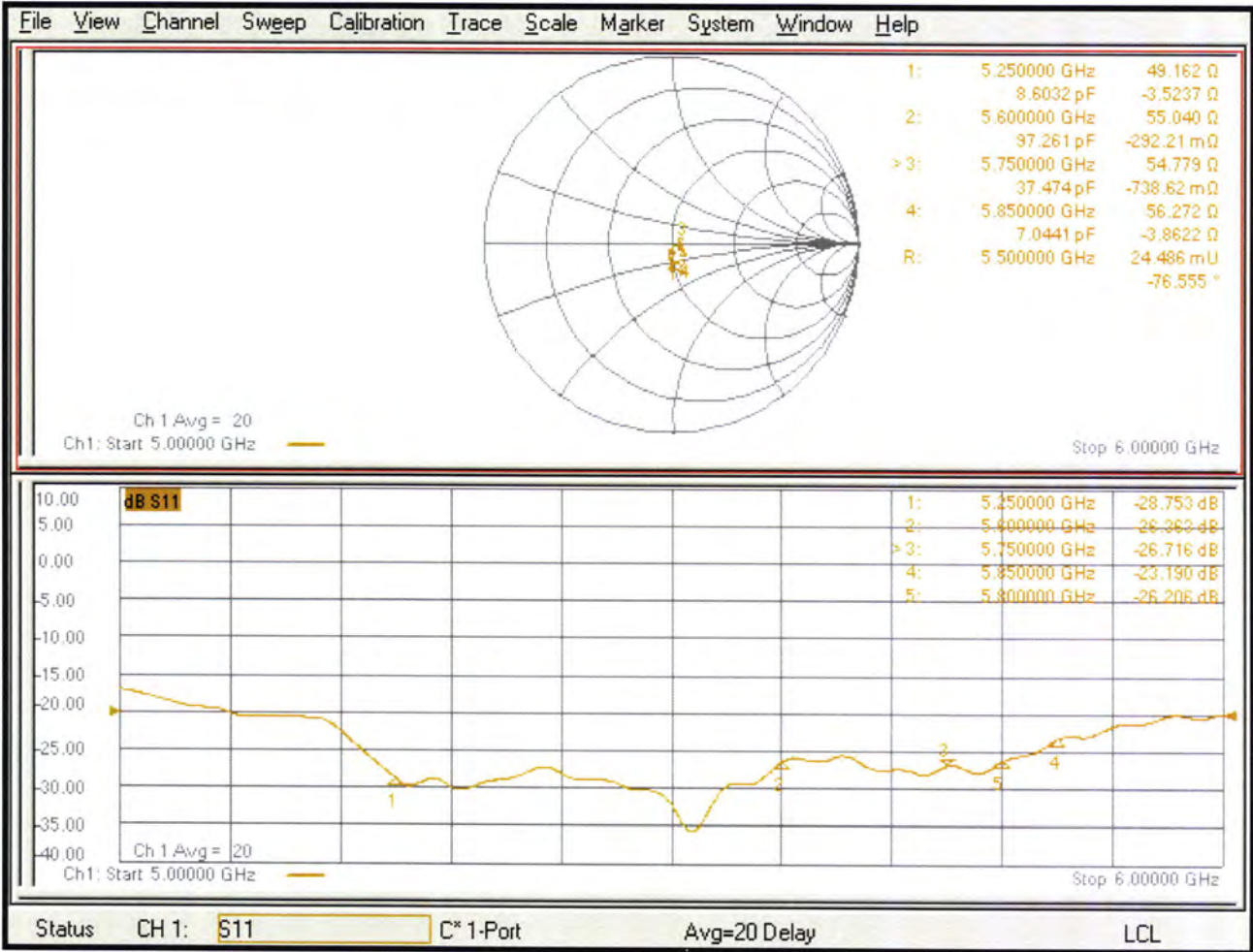
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 69.69 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 30.0 W/kg
SAR(1 g) = 7.85 W/kg; SAR(10 g) = 2.23 W/kg
Smallest distance from peaks to all points 3 dB below = 7.2 mm
Ratio of SAR at M2 to SAR at M1 = 67%
Maximum value of SAR (measured) = 18.6 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5850 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 69.55 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 31.4 W/kg
SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.29 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%
Maximum value of SAR (measured) = 18.9 W/kg



0 dB = 18.9 W/kg = 12.76 dBW/kg

Impedance Measurement Plot for Head TSL





Dipole Internal Calibration Record

Asset No. :	E-436	Model No. :	D5GHzV2	Serial No. :	1160
Environmental	22.5°C, 54%	Original Cal. Date :	April 25, 2024	Next Cal. Date :	April 25, 2027

Standard List

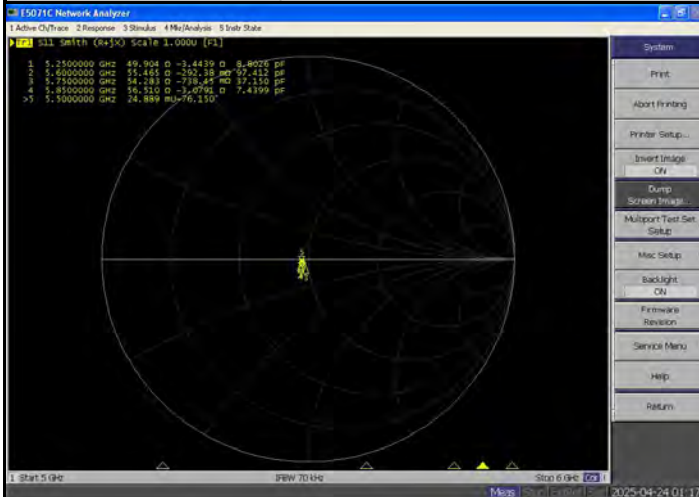
1	IEC/IEEE 62209-1528:2020	Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528:Human Models,Instrumentation And Procedures(Frequency Range of 4 MHz to 10GHz)
2	KDB865664	SAR Measurement Requirements for 100 MHz to 6 GHz

Equipment Information

Equipment :	Manufacturer :	Model No. :	Serial No. :	Cal.Organization :	Cal. Date :
Power Amplifier	Mini-Circuits	ZVE-8G+	520701341	N/A	January 12, 2025
DC Source metter	Iteck	IT6154	006104126768201001	N/A	June 29, 2024
Vector Network Analyzer	Agilent	E5071C	MY46102965	N/A	January 11, 2025
Signal Generator	Agilent	N5172B	MY53050758	N/A	January 11, 2025
Smart Power Sensor	R&S	NRP18S	101333	N/A	June 1, 2024
Dielectric Assessment	Speag	DAK-3.5	1226	N/A	January 20, 2025
Directional Coupler	Woken	TS-PCC0M-05	0107090019	N/A	January 11, 2025
Coupler	Woken	0110A05601O-10	COM5BNW1A2	N/A	January 12, 2025
Liquid Thermometer	Nscing Es	YZ6021S	/	N/A	November 24, 2024

Model No	For Head Tissue				
	Item	Originak Cal. Result	Verified on 2025/4/24	Deviation	Result
D5GHzV2(5250MHz)	Impedance, transformed to feed point	49.2Ω-3.5jΩ	49.9Ω-3.4Ω	<5Ω	Pass
	Return Loss(dB)	-28.8	-28.835	0.1%	Pass
	SAR Value for 1g(mW/g)	7.84	7.88	0.5%	Pass
	SAR Value for	2.26	2.25	-0.4%	Pass
D5GHzV2(5600MHz)	Impedance, transformed to feed point	55.0Ω-0.3jΩ	55.5Ω-0.3Ω	<5Ω	Pass
	Return Loss(dB)	-26.4	-26.09	-1.2%	Pass
	SAR Value for 1g(mW/g)	8.16	7.99	-2.1%	Pass
	SAR Value for	2.34	2.27	-3.0%	Pass
D5GHzV2(5750MHz)	Impedance, transformed to feed point	54.8Ω-0.7jΩ	54.3Ω-0.7Ω	<5Ω	Pass
	Return Loss(dB)	-26.7	-26.15	-2.1%	Pass
	SAR Value for 1g(mW/g)	7.85	7.55	-3.8%	Pass
	SAR Value for	2.23	2.15	-3.6%	Pass
D5GHzV2(5850MHz)	Impedance, transformed to feed point	56.3Ω-3.9jΩ	56.5Ω-3.1Ω	<5Ω	Pass
	Return Loss(dB)	-23.2	-23.431	1.0%	Pass
	SAR Value for 1g(mW/g)	8.04	8	-0.5%	Pass
	SAR Value for	2.29	2.29	0.0%	Pass

Impedance Test-Head



Return Loss-Head



Validation Report for Head TSL of 5.25GHz

Test Laboratory: BTL Inc.

Date: 2025/4/24

System Check_H5250_0424

DUT: Dipole D5GHzV2;SN:1160;

Communication System: UID 0, CW (0); Frequency: 5250 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 5250$ MHz; $\sigma = 4.589$ S/m; $\epsilon_r = 35.391$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.5°C; Liquid Temperature: 22.2°C

DASY Configuration:

- Probe: EX3DV4 - SN3809; ConvF(6.23, 5.73, 5.57)@5250 MHz; Calibrated:2025/1/24
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 1.0, 23.0$
- Electronics: DAE4 Sn1390; Calibrated: 2024/11/14
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax; Serial: 1222
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Area Scan (6x6x1): Measurement grid: $dx=10$ mm, $dy=10$ mm

Maximum value of SAR (measured) = 16.0 W/kg

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

Reference Value = 66.73 V/m; Power Drift = -0.04 dB

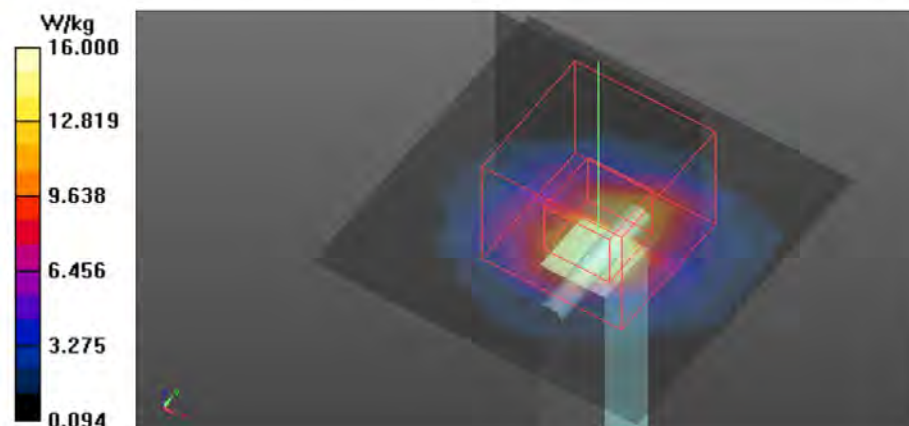
Peak SAR (extrapolated) = 37.7 W/kg

SAR(1 g) = 7.88 W/kg; SAR(10 g) = 2.25 W/kg

Smallest distance from peaks to all points 3 dB below = 8 mm

Ratio of SAR at M2 to SAR at M1 = 19.3%

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



Validation Report for Head TSL of 5.6GHz

Test Laboratory: BTL Inc.

Date: 2025/4/24

System Check_H5600_0424

DUT: Dipole D5GHzV2;SN:1160;

Communication System: UID 0, CW (0); Frequency: 5600 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5600$ MHz; $\sigma = 5.051$ S/m; $\epsilon_r = 34.576$; $\rho = 1000$ kg/m³
Ambient Temperature: 22.5°C; Liquid Temperature: 22.2°C

DASY Configuration:

- Probe: EX3DV4 - SN3809; ConvF(5.54, 5.1, 4.96) @5600 MHz; Calibrated: 2025/1/24
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 1.0, 23.0$
- Electronics: DAE4 Sn1390; Calibrated: 2024/11/14
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax; Serial: 1222
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Area Scan (6x6x1): Measurement grid: $dx=10$ mm, $dy=10$ mm

Maximum value of SAR (measured) = 17.7 W/kg

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

Reference Value = 64.05 V/m; Power Drift = -0.03 dB

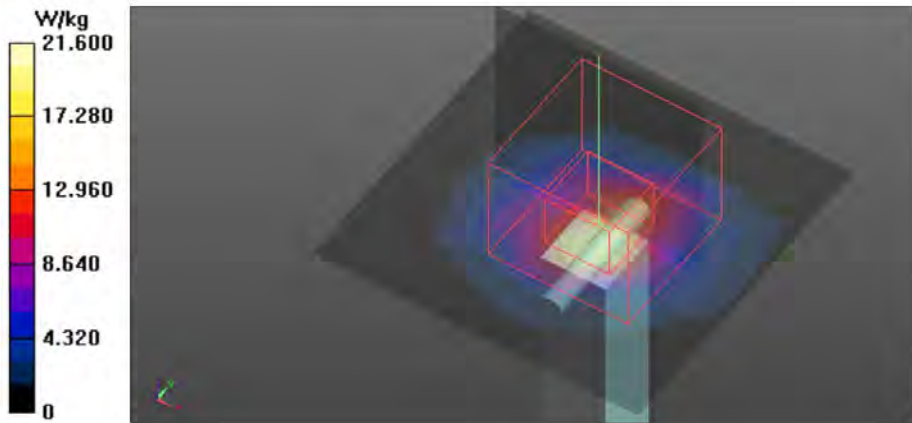
Peak SAR (extrapolated) = 44.4 W/kg

SAR(1 g) = 7.99 W/kg; SAR(10 g) = 2.27 W/kg

Smallest distance from peaks to all points 3 dB below = 8 mm

Ratio of SAR at M2 to SAR at M1 = 15.7%

Maximum value of SAR (measured) = 21.6 W/kg



Validation Report for Head TSL of 5.75GHz

Test Laboratory: BTL Inc.

Date: 2025/4/24

System Check_H5750_0424

DUT: Dipole D5GHzV2;SN:1160;

Communication System: UID 0, CW (0); Frequency: 5750 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 5750$ MHz; $\sigma = 5.168$ S/m; $\epsilon_r = 34.173$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.5°C; Liquid Temperature: 22.2°C

DASY Configuration:

- Probe: EX3DV4 - SN3809 ConvF(5.51, 5.06, 4.93)@5750 MHz; Calibrated: 2025/1/24
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 1.0, 23.0$
- Electronics: DAE4 Sn1390; Calibrated: 2024/11/14
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax; Serial: 1222
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Area Scan (6x6x1): Measurement grid: $dx=10$ mm, $dy=10$ mm

Maximum value of SAR (measured) = 15.9 W/kg

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

Reference Value = 60.96 V/m; Power Drift = -0.09 dB

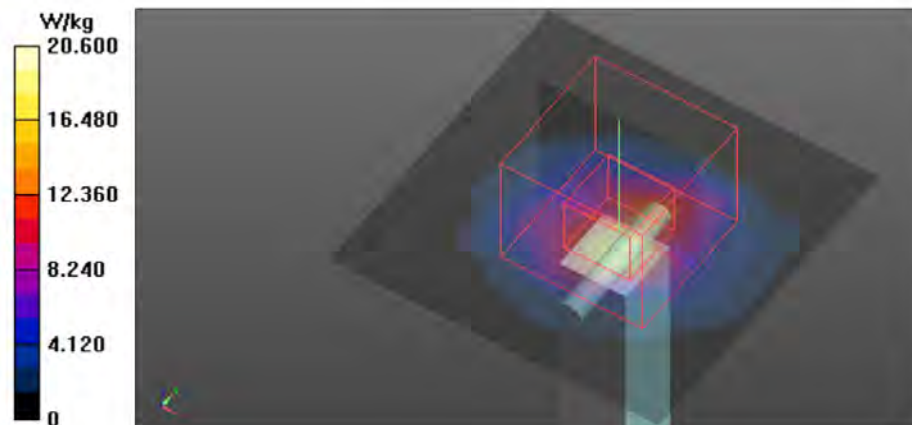
Peak SAR (extrapolated) = 39.4 W/kg

SAR(1 g) = 7.55 W/kg; SAR(10 g) = 2.15 W/kg

Smallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 45.4%

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



Validation Report for Head TSL of 5.85GHz

Test Laboratory: BTL Inc.

Date: 2025/4/24

System Check_H5850_0424

DUT: Dipole D5GHzV2;SN:1160;

Communication System: UID 0, CW (0); Frequency: 5850 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 5850$ MHz; $\sigma = 5.252$ S/m; $\epsilon_r = 33.712$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.5°C; Liquid Temperature: 22.2°C

DASY Configuration:

- Probe: EX3DV4 - SN3809; ConvF(5.51, 5.06, 4.93)@5850 MHz; Calibrated: 2025/1/24
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 1.0, 23.0$
- Electronics: DAE4 Sn1390; Calibrated: 2024/11/14
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax; Serial: 1222
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Area Scan (6x6x1): Measurement grid: $dx=10$ mm, $dy=10$ mm

Maximum value of SAR (measured) = 13.7 W/kg

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

Reference Value = 67.76 V/m; Power Drift = -0.09 dB

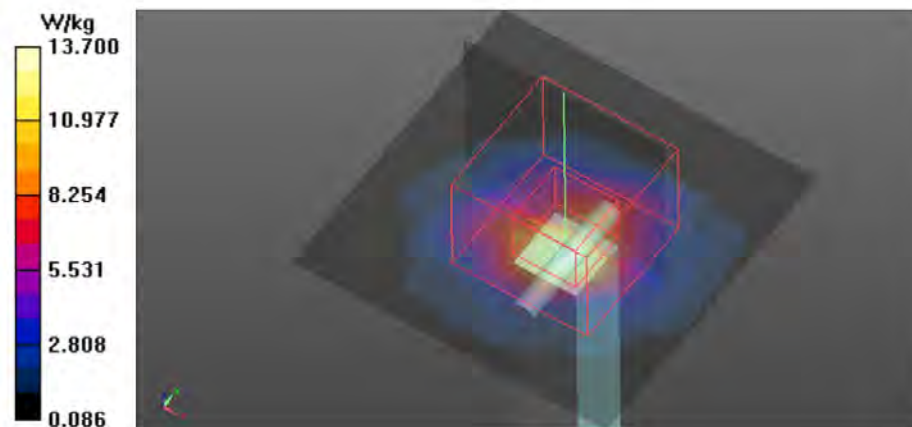
Peak SAR (extrapolated) = 43.1 W/kg

SAR(1 g) = 8 W/kg; SAR(10 g) = 2.29 W/kg

Smallest distance from peaks to all points 3 dB below = 7.9 mm

Ratio of SAR at M2 to SAR at M1 = 44.2%

Maximum value of SAR (measured) = 22.1 W/kg



Calibrator:

Justin Huang

Approver:

Herbert Lin



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Client **BTL Inc.**
Guangdong

Certificate No. **D6.5GHzV2-1052_Nov24**

CALIBRATION CERTIFICATE

Object **D6.5GHzV2 - SN:1052**

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

Calibration date: **November 13, 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 $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
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-Z23	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 Sep-24)	In house check: Sep-26

Calibrated by: **Krešimir Franjić** Name
Laboratory Technician Function

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

Signature

Issued: November 13, 2024

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



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Multilateral Agreement for the recognition of calibration certificates

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%.

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 = 3.4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	6500 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	34.5	6.07 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	34.6 $\pm$ 6 %	6.21 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	29.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	291 W/kg $\pm$ 24.7 % (k=2)

SAR averaged over 8 cm³ (8 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.58 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	65.8 W/kg $\pm$ 24.4 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	5.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	54.0 W/kg $\pm$ 24.4 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.7 Ω - 3.7 j Ω
Return Loss	- 28.6 dB

APD (Absorbed Power Density)

APD averaged over 1 cm²	Condition	
APD measured	100 mW input power	291 W/m ²
APD measured	normalized to 1W	2910 W/m² $\pm$ 29.2 % (k=2)

APD averaged over 4 cm²	condition	
APD measured	100 mW input power	132 W/m ²
APD measured	normalized to 1W	1320 W/m² $\pm$ 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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DASY6 Validation Report for Head TSL

Measurement Report for D6.5GHz-1052, 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: 1052	-

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	6.21	34.6

Hardware Setup

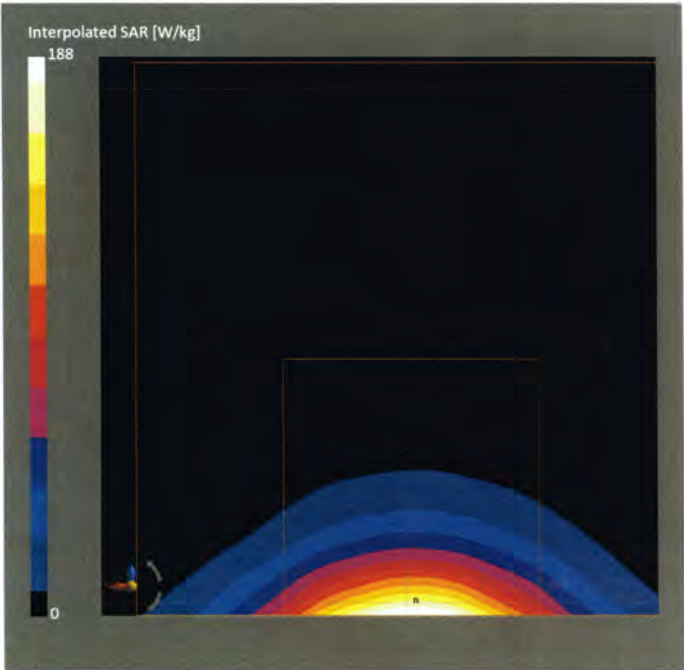
Phantom	TSL	Probe, Calibration Date	DAE, Calibration Date
MFP V8.0 Center - 1182	HBBL600-10000V6	EX3DV4 - SN7405, 2024-07-01	DAE4 Sn908, 2024-03-27

Scan Setup

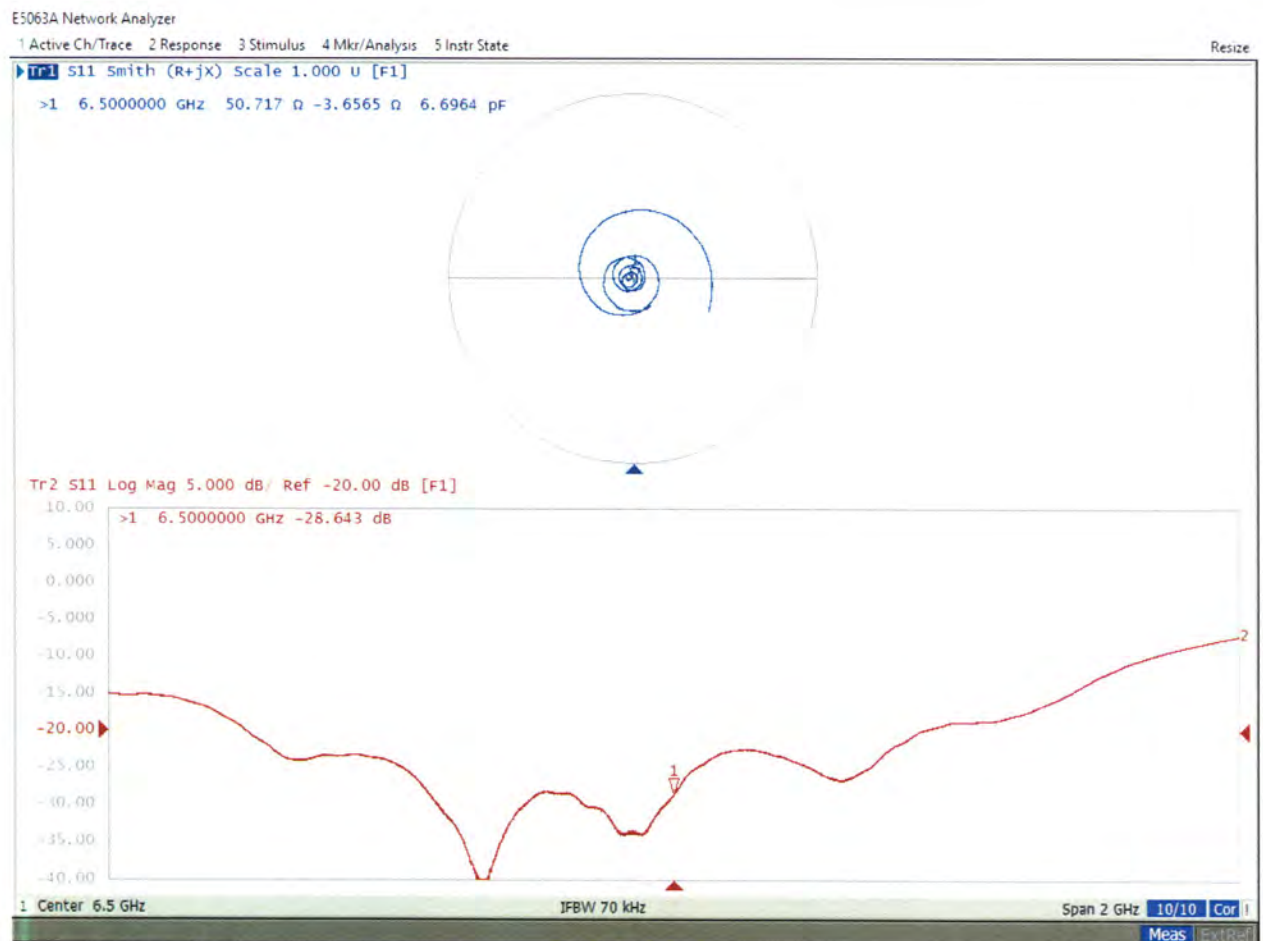
	Zoom Scan
Grid Extents [mm]	22.0 x 22.0 x 22.0
Grid Steps [mm]	3.4 x 3.4 x 1.4
Sensor Surface [mm]	1.4
Graded Grid	Yes
Grading Ratio	1.4
MAIA	N/A
Surface Detection	VMS + 6p
Scan Method	Measured

Measurement Results

	Zoom Scan
Date	2024-11-13, 11:13
psSAR1g [W/Kg]	29.1
psSAR8g [W/Kg]	6.58
psSAR10g [W/Kg]	5.40
Power Drift [dB]	-0.01
Power Scaling	Disabled
Scaling Factor [dB]	
TSL Correction	No correction
M2/M1 [%]	49.2
Dist 3dB Peak [mm]	4.8



Impedance Measurement Plot for Head TSL





Dipole Internal Calibration Record

Asset No. :	E-1132	Model No. :	D6.5GHzV2	Serial No. :	1052
Environmental	22.8°C, 55%	Original Cal. Date :	November 13, 2024	Next Cal. Date :	November 13, 2027

Standard List

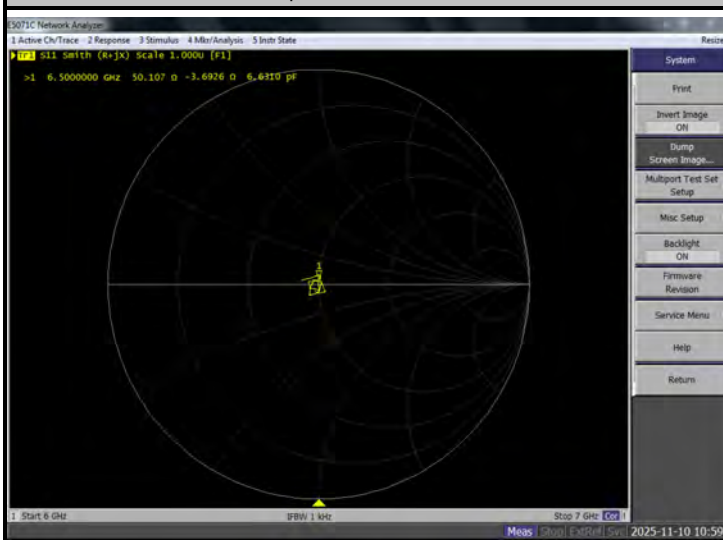
1	IEC/IEEE 62209-1528:2020	Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528:Human Models,Instrumentation And Procedures(Frequency Range of 4 MHz to 10GHz)
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Equipment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

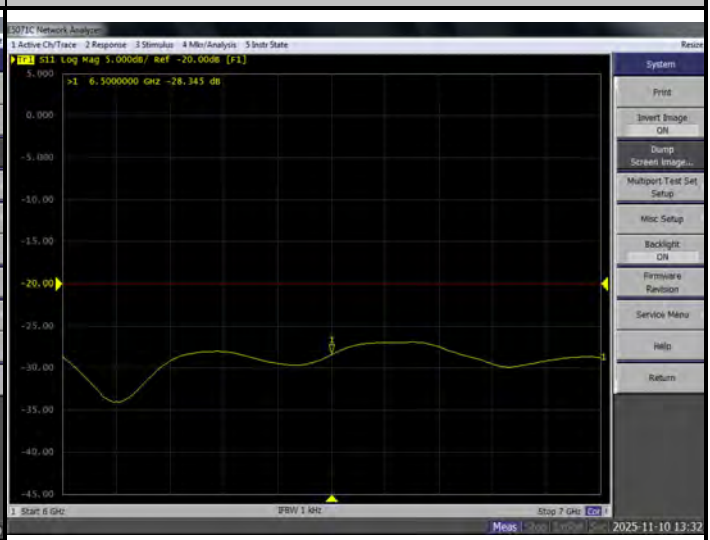
Equipment :	Manufacturer :	Model No. :	Serial No. :	Cal.Organization :	Cal. Date :
Power Amplifier	Mini-Circuits	ZVE-8G+	520701341	N/A	January 12, 2025
DC Source metter	Iteck	IT6154	006104126768201001	N/A	May 29, 2025
Vector Network Analyzer	Agilent	E5071C	MY46102965	N/A	January 11, 2025
Signal Generator	Agilent	N5173B	MY59101420	N/A	January 11, 2025
Smart Power Sensor	R&S	NRP18S	101333	N/A	May 29, 2025
Dielectric Assessment	Speag	DAK-3.5	1226	N/A	January 20, 2025
Directional Coupler	Talent Microwave	TC-05180-20S	210628013	N/A	January 11, 2025
Coupler	Woken	0110A05601O-10	COM5BNW1A2	N/A	January 12, 2025
Liquid Thermometer	Nscing Es	YZ6021S	/	N/A	November 24, 2024

Model No	For Head Tissue				
	Item	Originak Cal. Result	Verified on 2025/11/10	Deviation	Result
D6.5GHzV2(6500MHz)	Impedance, transformed to feed point	50.7 Ω -3.7j Ω	50.1 Ω -3.69 Ω	<5 Ω	Pass
	Return Loss(dB)	-28.6	-28.35	-0.9%	Pass
	SAR Value for 1g(mW/g)	29.1	29.9	2.7%	Pass
	SAR Value for 10g(mW/g)	5.4	5.62	4.1%	Pass

Impedance Test-Head



Return Loss-Head



Validation Report for Head TSL of 6.5GHz

Measurement Report for System Check (6500.000MHz)

Device under Test Properties

Model, Manufacturer	Dimensions [mm]	IMEI	DUT Type
D6.5GHz,	16.0 x 6.0 x 300.0	SN:1052	Dipole 6.5GHzV2

Exposure Conditions

Phantom Section, TSL	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor	TSL Conductivity [S/m]	TSL Permittivity
Flat, Head Simulating Liquid	5, 00		CW,	6500.000,	5,6	5.55	34.2

Hardware Setup

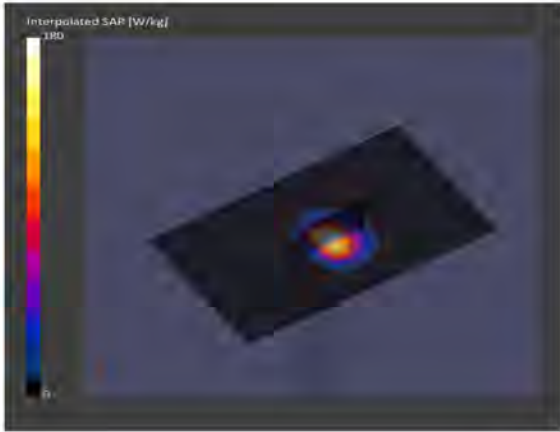
Phantom	TSL, Measured Date	Probe, Calibration Date	DAE, Calibration Date
ELI V5.0 (20deg probe tilt) - 1128	4500-6000	EX3DV4 - SN7693, 2024-11-20	DAE4 Sn420, 2025-04-08

Scan Setup

	Area Scan	Zoom Scan
Grid Extents [mm]	51.0 x 85.0	22.0 x 22.0 x 22.0
Grid Steps [mm]	8.5 x 8.5	3.4 x3.4 x1.4
Sensor Surface [mm]	1.4	1.4
Graded Grid	N/A	Yes
Grading Ratio	N/A	1.4
MAIA	N/A	N/A
Surface Detection	All points	All points
Scan Method	Measured	Measured

Measurement Results

	Area Scan	Zoom Scan
Date	2025-11-10	2025-11-10
psSAR1g [W/kg]	22.7	29.9
psSAR10g [W/kg]	5.03	5.62
Power Drift [dB]	-0.12	0.01
Power Scaling	Disabled	Disabled
Scaling Factor [dB]		
TSL Correction	No correction	No correction
M2/M1 [%]		49.8
Dist 3dB Peak [mm]		5.0



Calibrator:

Justin Huang

Approver:

Herbert Lin



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Multilateral Agreement for the recognition of calibration certificates**

Accreditation No.: SCS 0108

Client

BTL Inc.
Guangdong

Certificate No.

5G-Veri10-1041_May25

CALIBRATION CERTIFICATE

Object

5G Verification Source 10 GHz - SN: 1041

Calibration procedure(s)

QA CAL-45.v5
Calibration procedure for sources in air > 6 GHz

Calibration date

May 27, 2025

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 Cal
Reference Probe SPEAG EUmmWV3	SN: 9374	28-Aug-24 (No. Eumm_9374_Aug24)	Aug-25
DAE4ip	SN: 1602	06-Nov-24 (No. DAE4ip-1602_Nov24)	Nov-25

Secondary Standards	ID	Check Date (in house)	Scheduled Check
Signal Generator R&S SMF100A	SN: 100184	26-Nov-24 (No. 5G-Source-Cal-IHC-202411)	Nov-25
Power Sensor R&S NRP18S-10	SN: 101258	26-Nov-24 (No. 5G-Source-Cal-IHC-202411)	Nov-25
Network Analyzer Keysight E5063A	SN: MY54504221	30-Sept-24 (No. 675-CAL18-S4489-Sep24)	Sep-26

	Name	Function	Signature
Calibrated by	Joanna Lleshaj	Laboratory Technician	
Approved by	Sven Kühn	Technical Manager	
Issued: May 27, 2025			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

Calibration Laboratory of

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary

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*: The E-field is measured in two x-y-planes (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%.

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	10.0 GHz $\pm$ 10 MHz	

Calibration Parameters, 10 GHz

Circular Averaging

Distance Horn Aperture to Measurement Plane	Prad ¹ (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Avg Power Density Avg (psPDn+, psPDtot+, psPDmod+) (W/m ²)		Uncertainty (k = 2)
				1cm ²	4cm ²	
10 mm	93.3	154	1.27 dB	60.8	57.5	1.28 dB

Distance Horn Aperture to Measurement Plane	Prad ¹ (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Power Density psPDn+, psPDtot+, psPDmod+ (W/m ²)		Uncertainty (k = 2)
				1cm ²	4cm ²	
10 mm	93.3	154	1.27 dB	60.5, 60.9, 61.0	57.1, 57.5, 57.8	1.28 dB

Square Averaging

Distance Horn Aperture to Measurement Plane	Prad ¹ (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Avg Power Density Avg (psPDn+, psPDtot+, psPDmod+) (W/m ²)		Uncertainty (k = 2)
				1cm ²	4cm ²	
10 mm	93.3	154	1.27 dB	60.8	57.4	1.28 dB

Distance Horn Aperture to Measurement Plane	Prad ¹ (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Power Density psPDn+, psPDtot+, psPDmod+ (W/m ²)		Uncertainty (k = 2)
				1cm ²	4cm ²	
10 mm	93.3	154	1.27 dB	60.5, 60.9, 61.0	57.0, 57.4, 57.7	1.28 dB

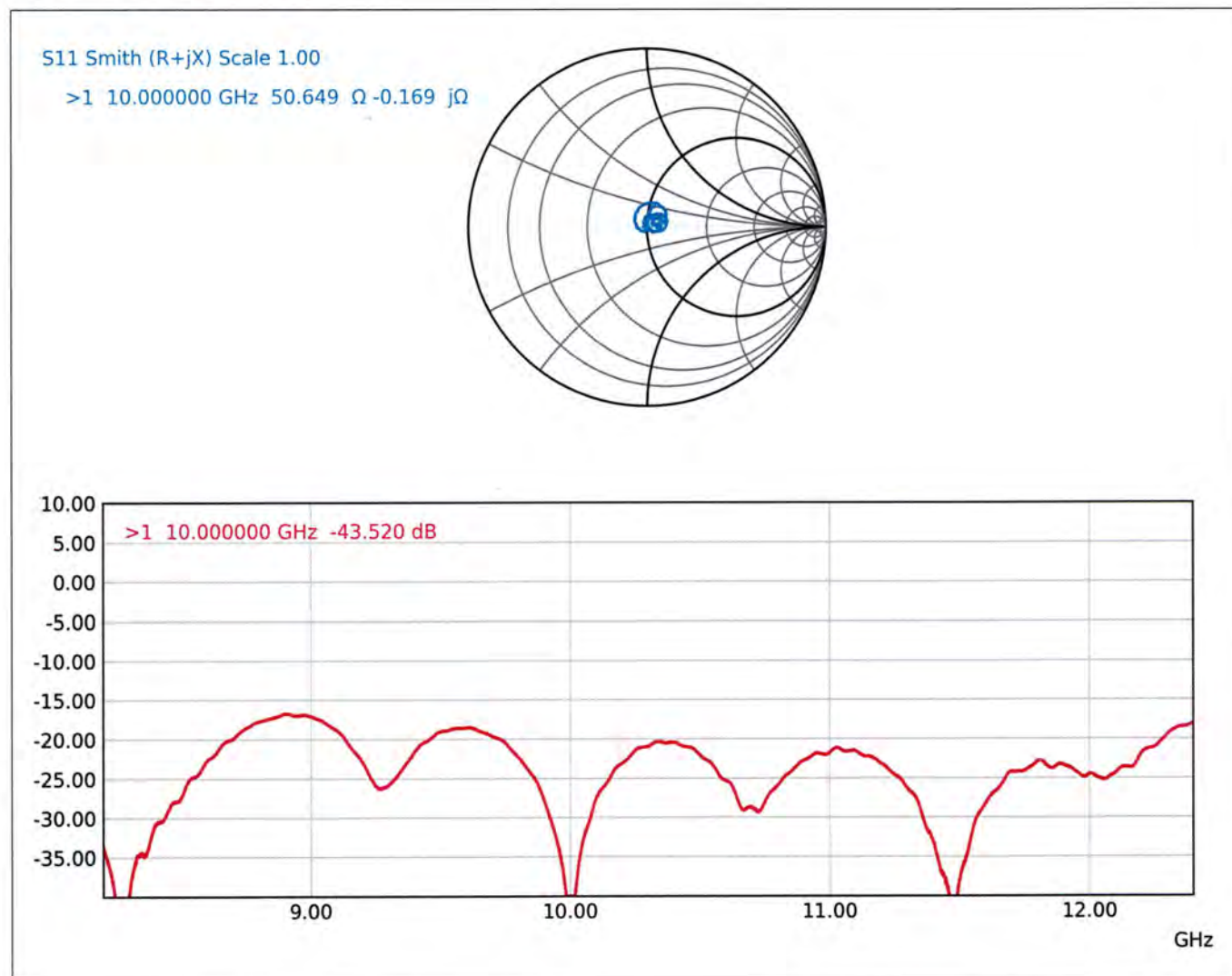
Max Power Density

Distance Horn Aperture to Measurement Plane	Prad ¹ (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	61.8, 62.4, 62.4	1.28 dB

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

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

Impedance, transformed to feed point	50.6 Ω - 0.2 j Ω
Return Loss	-43.5 dB

Impedance Measurement Plot

DASY Report

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

Device Under Test Properties

Model, Manufacturer	Dimensions [mm]	IMEI	DUT Type
5G Verification Source 10 GHz	100.0 x 100.0 x 172.0	SN: 1041	—

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G --	10.0 mm	Validation band	CW, 0--	10000.0,10000	1.0

Hardware Setup

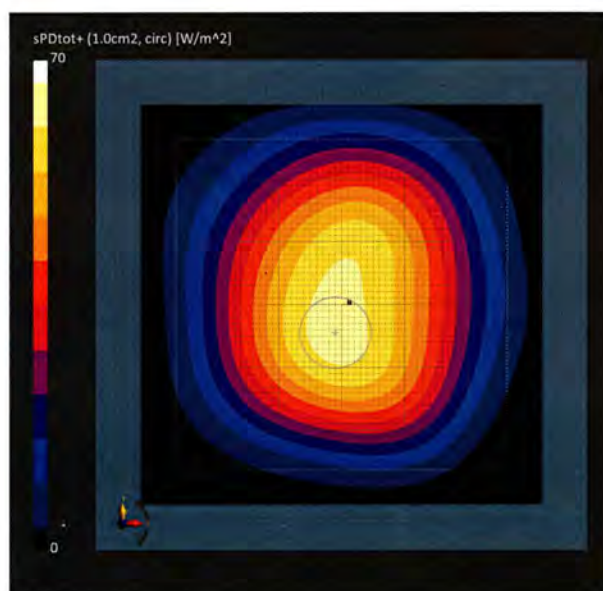
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom --	Air --	EUmmWV3 -- SN9374_F1--55GHz, 2024-08-28	DAE4ip -- SN1602, 2024-11-06

Scans Setup

Sensor Surface [mm]	10.0
MAIA	MAIA not used

Measurement Results

Scan Type	5G Scan
Date	2025-05-27
Avg. Area [cm ²]	1.00
Avg. Type	Circular Averaging
psPDn+ [W/m ²]	60.5
psPDtot+ [W/m ²]	60.9
psPDmod+ [W/m ²]	61.0
Max(Sn) [W/m ²]	61.8
Max(Stot) [W/m ²]	62.4
Max(Stot) [W/m ²]	62.4
E _{max} [V/m]	154
Power Drift [dB]	0.01



DASY Report

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

Device Under Test Properties

Model, Manufacturer	Dimensions [mm]	IMEI	DUT Type
5G Verification Source 10 GHz	100.0 x 100.0 x 172.0	SN: 1041	--

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G --	10.0 mm	Validation band	CW, 0--	10000.0,10000	1.0

Hardware Setup

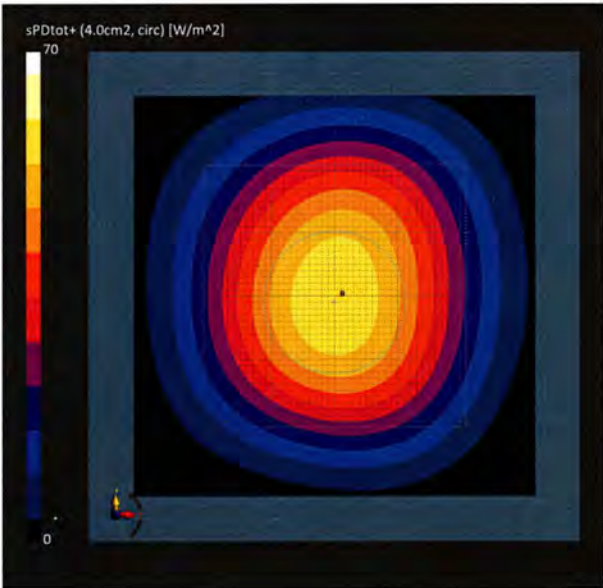
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom --	Air --	EUmmWV3 -- SN9374_F1--55GHz, 2024-08-28	DAE4ip -- SN1602, 2024-11-06

Scans Setup

Sensor Surface [mm]	10.0
MAIA	MAIA not used

Measurement Results

Scan Type	5G Scan
Date	2025-05-27
Avg. Area [cm ²]	4.00
Avg. Type	Circular Averaging
psPDn+ [W/m ²]	57.1
psPDtot+ [W/m ²]	57.5
psPDmod+ [W/m ²]	57.8
Max(Sn) [W/m ²]	61.8
Max(Stot) [W/m ²]	62.4
Max(Stot) [W/m ²]	62.4
E _{max} [V/m]	154
Power Drift [dB]	0.01



DASY Report

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

Device Under Test Properties

Model, Manufacturer	Dimensions [mm]	IMEI	DUT Type
5G Verification Source 10 GHz	100.0 x 100.0 x 172.0	SN: 1041	-

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G --	10.0 mm	Validation band	CW, 0--	10000.0,10000	1.0

Hardware Setup

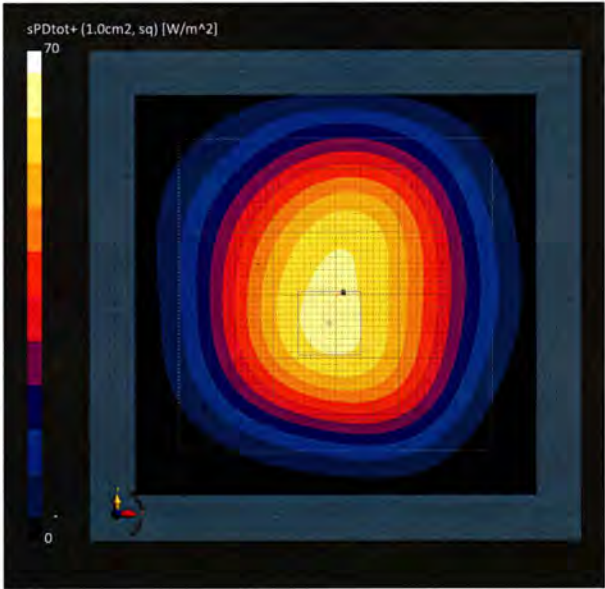
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom --	Air --	EUmmWV3 -- SN9374_F1--55GHz, 2024-08-28	DAE4ip -- SN1602, 2024-11-06

Scans Setup

Sensor Surface [mm]	10.0
MAIA	MAIA not used

Measurement Results

Scan Type	5G Scan
Date	2025-05-27
Avg. Area [cm ²]	1.00
Avg. Type	Square Averaging
psPDn+ [W/m ²]	60.5
psPDtot+ [W/m ²]	60.9
psPDmod+ [W/m ²]	61.0
Max(Sn) [W/m ²]	61.8
Max(Stot) [W/m ²]	62.4
Max(Stot) [W/m ²]	62.4
E _{max} [V/m]	154
Power Drift [dB]	0.01



DASY Report

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

Device Under Test Properties

Model, Manufacturer	Dimensions [mm]	IMEI	DUT Type
5G Verification Source 10 GHz	100.0 x 100.0 x 172.0	SN: 1041	-

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G --	10.0 mm	Validation band	CW, 0--	10000.0,10000	1.0

Hardware Setup

Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom --	Air --	EUmmWV3 -- SN9374_F1--55GHz, 2024-08-28	DAE4ip -- SN1602, 2024-11-06

Scans Setup

Sensor Surface [mm]	10.0
MAIA	MAIA not used

Measurement Results

Scan Type	5G Scan
Date	2025-05-27
Avg. Area [cm ²]	4.00
Avg. Type	Square Averaging
psPDn+ [W/m ²]	57.0
psPDtot+ [W/m ²]	57.4
psPDmod+ [W/m ²]	57.7
Max(Sn) [W/m ²]	61.8
Max(Stot) [W/m ²]	62.4
Max(Stot) [W/m ²]	62.4
E _{max} [V/m]	154
Power Drift [dB]	0.01

