

Measurement Conditions

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

DASY Version	cDASY6 Module mmWave	V2.0
Phantom	5G Phantom	
Distance Horn Aperture - plane	10 mm	
XY Scan Resolution	dx, dy = 7.5 mm	
Number of measured planes	2 (10mm, 10mm + $\lambda/4$)	
Frequency	10 GHz \pm 10 MHz	

Calibration Parameters, 10 GHz

Distance Horn Aperture to Measured Plane	<i>Prad</i> ¹ (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Avg Power Density n.Re{S}, Re{S} (W/m ²)		Uncertainty (k = 2)
				1 cm ²	4 cm ²	
10 mm	74.8	141	1.27 dB	45.2, 45.4	42.7, 42.9	1.28 dB

¹ Assessed ohmic and mismatch loss: 0.4 dB

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: 1004	-

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

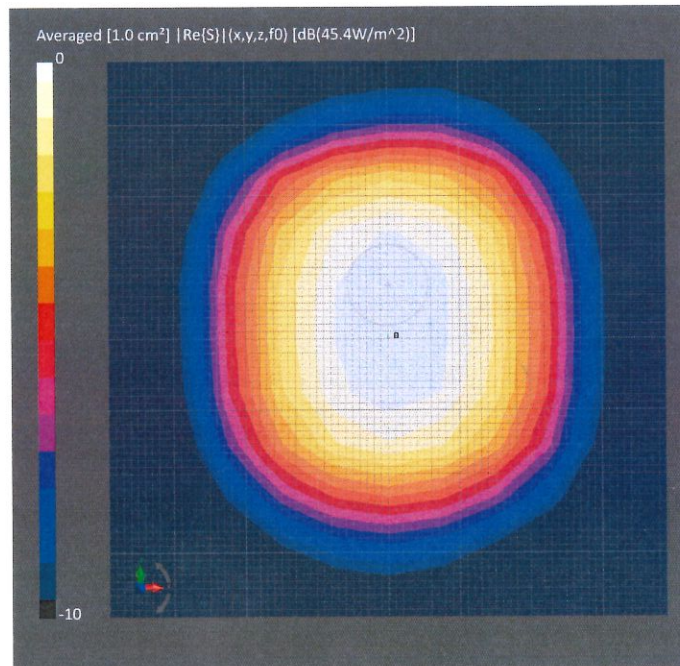
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Air	EUmmWV3 - SN9374_F1-78GHz, 2019-12-31	DAE4ip Sn1602, 2020-08-11

Scan Setup

	5G Scan
Grid Extents [mm]	120.0 x 120.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	10.0
MAIA	MAIA not used

Measurement Results

	5G Scan
Date	2020-08-14, 14:15
Avg. Area [cm ²]	1.00
p _{Stot} avg [W/m ²]	45.4
p _{S_n} avg [W/m ²]	45.2
E _{peak} [V/m]	141
Power Drift [dB]	-0.01



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: 1004	-

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

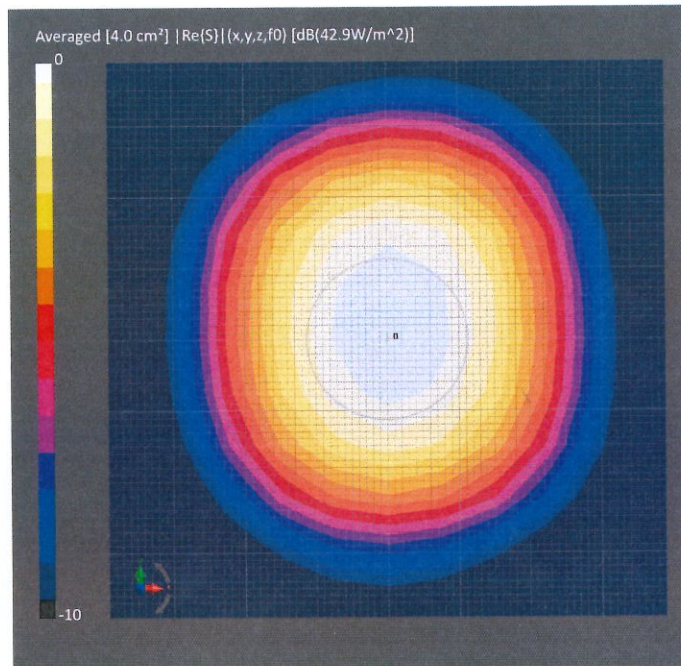
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Air	EUmmWV3 - SN9374_F1-78GHz, 2019-12-31	DAE4ip Sn1602, 2020-08-11

Scan Setup

	5G Scan
Grid Extents [mm]	120.0 x 120.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	10.0
MAIA	MAIA not used

Measurement Results

	5G Scan
Date	2020-08-14, 14:15
Avg. Area [cm ²]	4.00
pS _{tot} avg [W/m ²]	42.9
pS _n avg [W/m ²]	42.7
E _{peak} [V/m]	141
Power Drift [dB]	-0.01





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D6.5GHzV2-1018_Dec20**

CALIBRATION CERTIFICATE

Object **D6.5GHzV2 - SN:1018**

Calibration procedure(s) **QA CAL-22.v5
Calibration Procedure for SAR Validation Sources between 3-10 GHz**

Calibration date: **December 11, 2020**

BNV
12-30-2020

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 (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 7405	29-Jun-20 (No. EX3-7405_Jun20)	Jun-21
DAE4	SN: 908	14-Aug-20 (No. DAE4-908_Aug20)	Aug-21
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor R&S NRP33T	SN: 100967	17-Oct-16 (in house check Dec-18)	In house check: Dec-21
RF generator Anapico APSIN20G	SN: 669	28-Mar-17 (in house check Dec-18)	In house check: Dec-21
Network Analyzer R&S ZVL13	SN: 101093	10-May-12 (in house check Dec-18)	In house check: Dec-21

Calibrated by:	Name Jeton Kastrati	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature

Issued: December 15, 2020

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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 ED1, "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)", draft 2019

Additional Documentation:

- b) DASY6 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.
- *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	V6.14
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 ± 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 ± 0.2) °C	34.8 ± 6 %	6.30 mho/m ± 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	29.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	292 W/kg ± 24.7 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	5.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.8 W/kg ± 24.4 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.5 Ω - 4.4 j Ω
Return Loss	- 26.5 dB

APD (Absorber Power Density)

APD averaged over 1 cm ²	Condition	
APD measured	100 mW input power	292 W/m ²
APD measured	normalized to 1W	2925 W/ m² \pm 29.2 % (k=2)

APD averaged over 4 cm ²	condition	
APD measured	100 mW input power	135 W/m ²
APD measured	normalized to 1W	1350 W/ m² \pm 28.9 % (k=2)

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-1018, 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: 1018	-

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	5.75	6.30	34.8

Hardware Setup

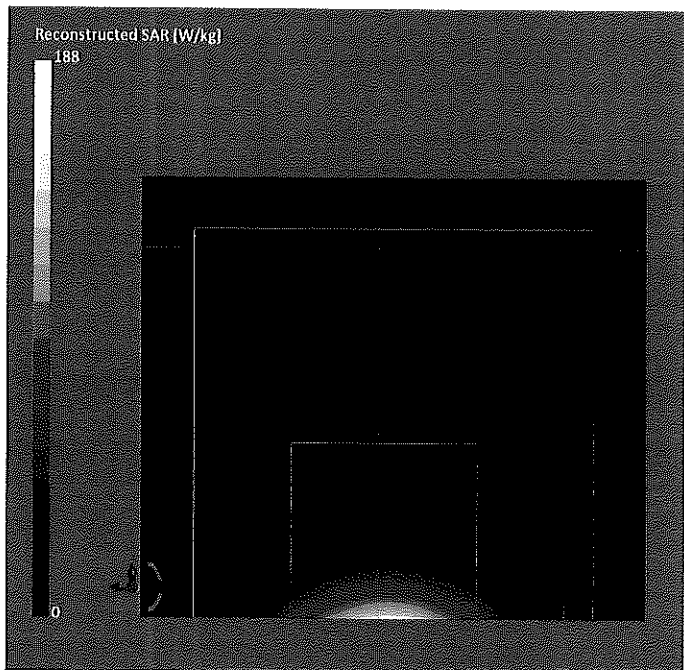
Phantom	TSL	Probe, Calibration Date	DAE, Calibration Date
MFP V8.0 Center - 1182	HBBL600-10000V6	EX3DV4 - SN7405, 2020-06-29	DAE4 Sn908, 2020-08-14

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	2020-12-11, 09:27
psSAR1g [W/Kg]	29.2
psSAR10g [W/Kg]	5.37
Power Drift [dB]	-0.01
Power Scaling	Disabled
Scaling Factor [dB]	
TSL Correction	Enabled
M2/M1 [%]	49.7
Dist 3dB Peak [mm]	4.8

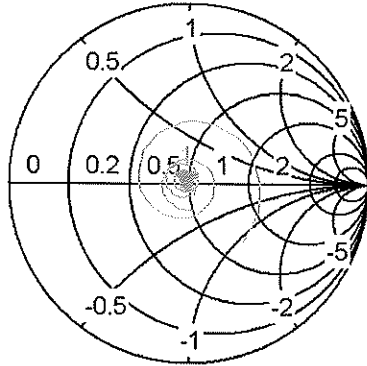


Impedance Measurement Plot for Head TSL



Trc1 S11 Smith Ref 1 U Cal

S11



1	6.500000 GHz	48.485	Ω
		j4.423	Ω
		5.536	pF

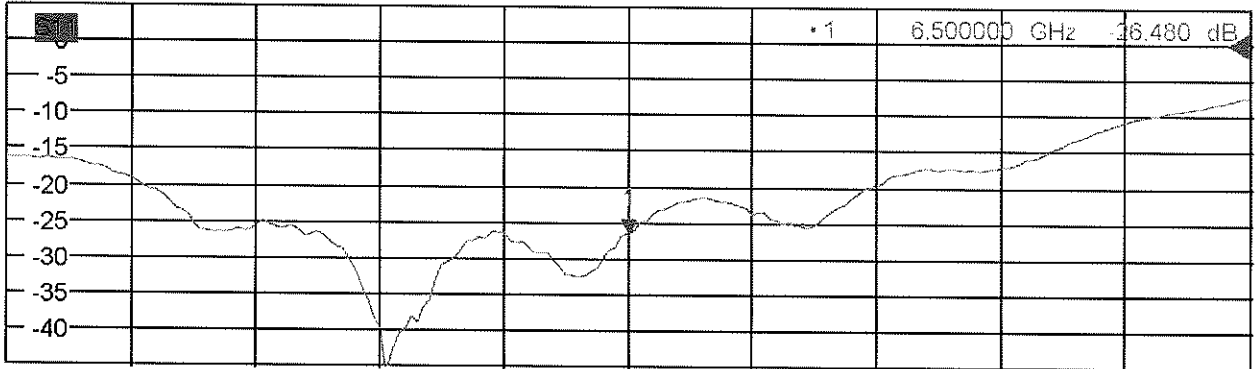
Ch1 Center 6.5 GHz

Pwr 0 dBm

Span 2 GHz

Trc2 S11 dB Mag 5 dB/ Ref 0 dB Cal

2



Ch1 Center 6.5 GHz

Pwr 0 dBm

Span 2 GHz