

**Meas.12 Body Plane with Open-0° 5mm on 149 Channel in IEEE802.11a mode with Antenna 0**

Date: 2023.08.16

Communication System Band: WLAN(a); Frequency: 5745 MHz; Duty Cycle: 1:1.02

Medium parameters used (interpolated):  $f = 5745$  MHz;  $\sigma = 5.211$  S/m;  $\epsilon_r = 35.726$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Ambient Temperature: 22.4°C Liquid Temperature: 21.4°C

DASY5 Configuration:

- Probe: EX3DV4 - SN7510; ConvF(4.83, 4.83, 4.83); Calibrated: 2023.01.19;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2023.03.20
- Phantom: ELI v4.0 (30deg probe tilt); Type: QDOVA001BB; Serial: TP:1012
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch149/Area Scan (101x101x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.167 W/kg

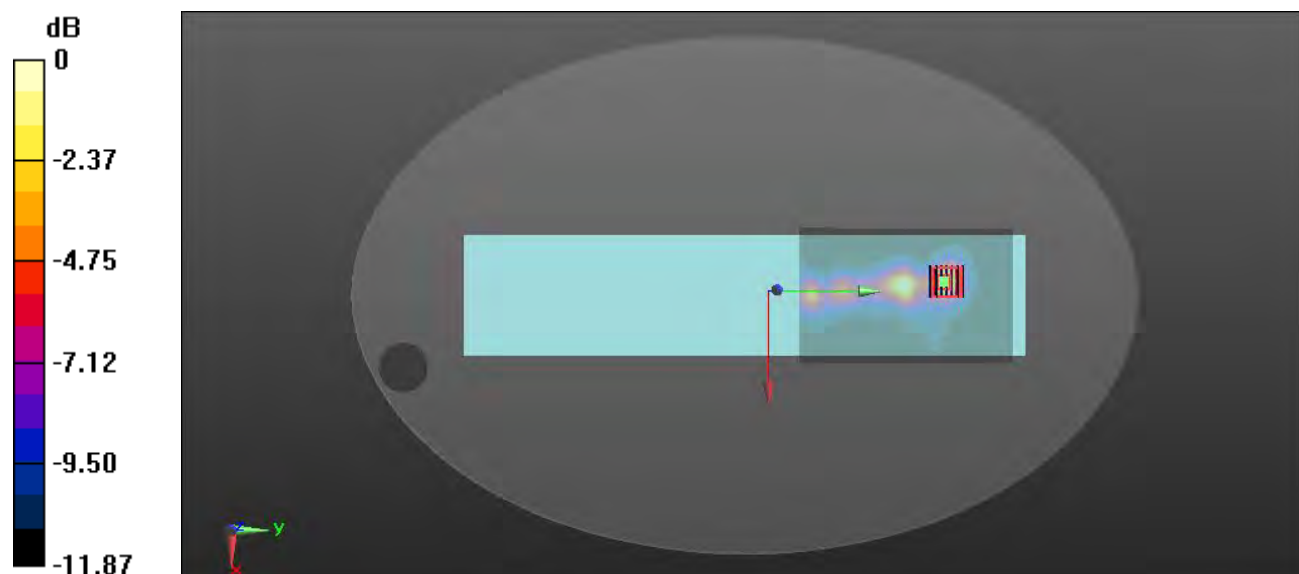
**Ch149/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 1.626 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.691 W/kg

**SAR(1 g) = 0.158 W/kg; SAR(10 g) = 0.043 W/kg**

Maximum value of SAR (measured) = 0.327 W/kg



0 dB = 0.327 W/kg

## ANNEX D EUT EXTERNAL PHOTOS

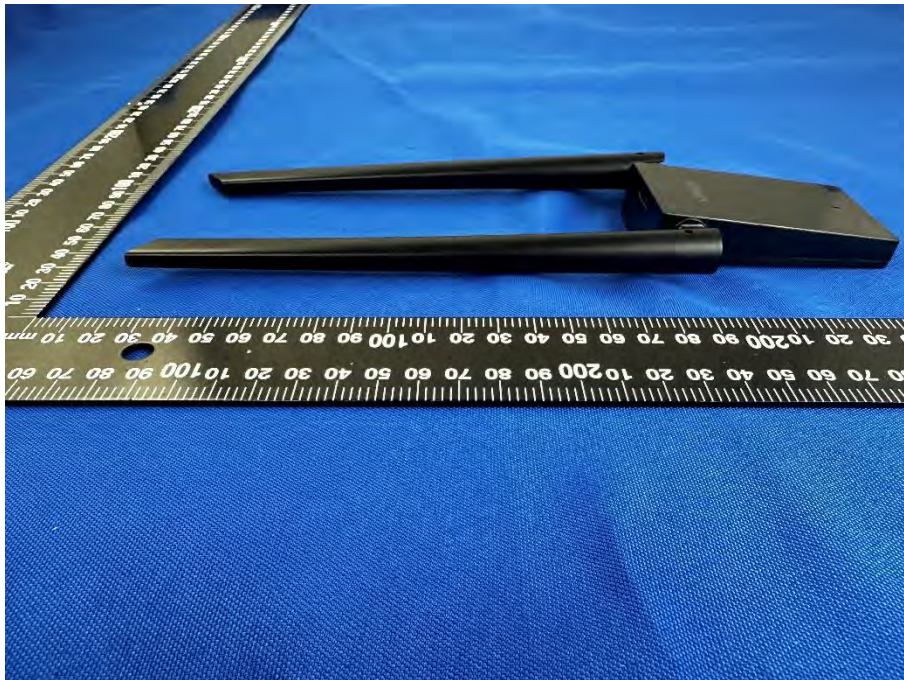
FRONT VIEW OF EUT



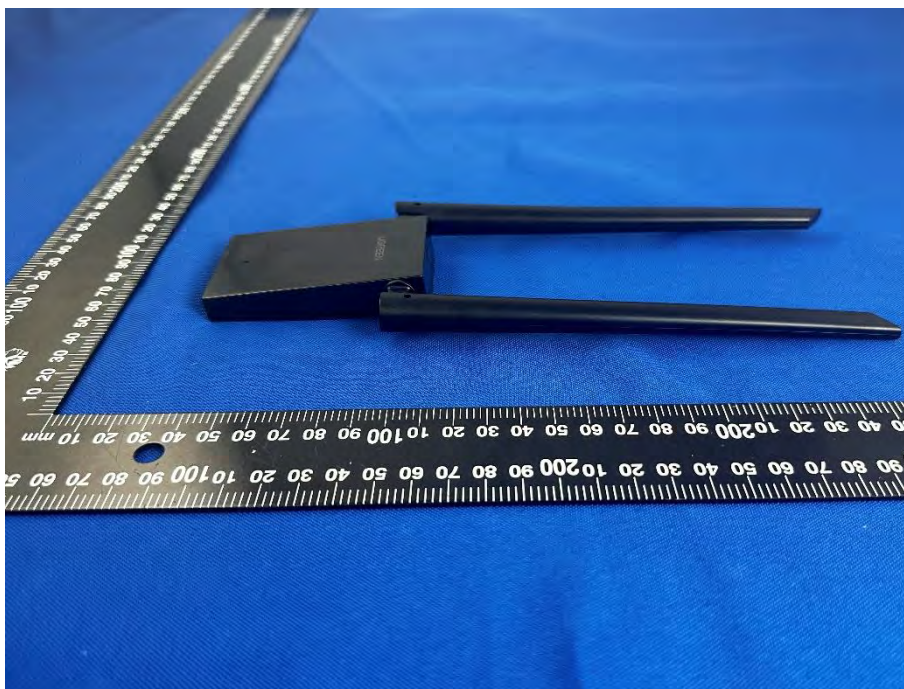
REAR VIEW OF EUT



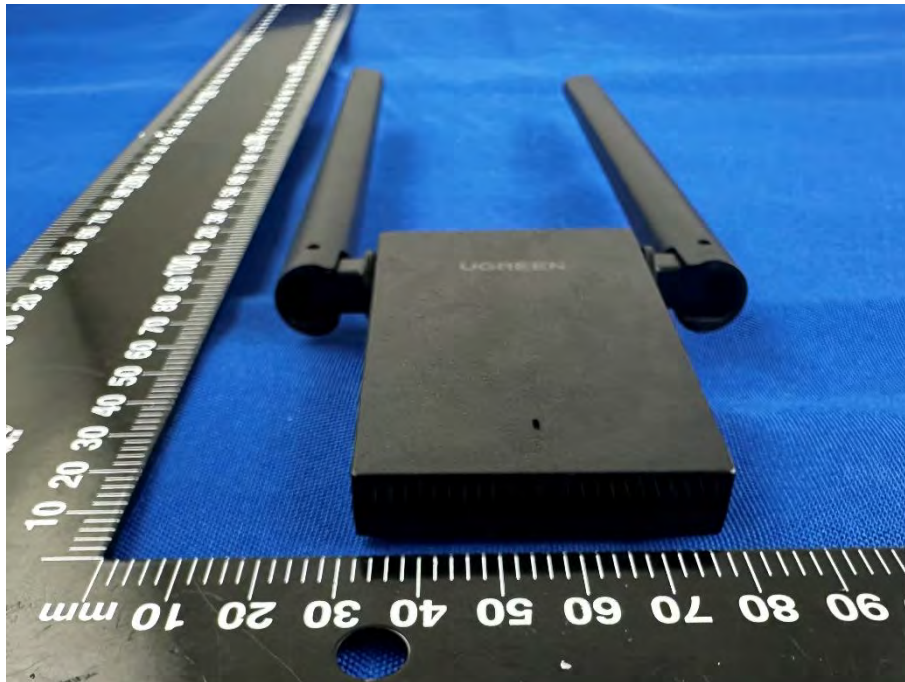
LEFT VIEW OF EUT



RIGHT VIEW OF EUT



TOP VIEW OF EUT



BOTTOM VIEW OF EUT



CLOSE-UP



Accessory-USB Cable



## ANNEX E SAR TEST SETUP PHOTOS

Close-0° (5mm)



Close-180° (5mm)



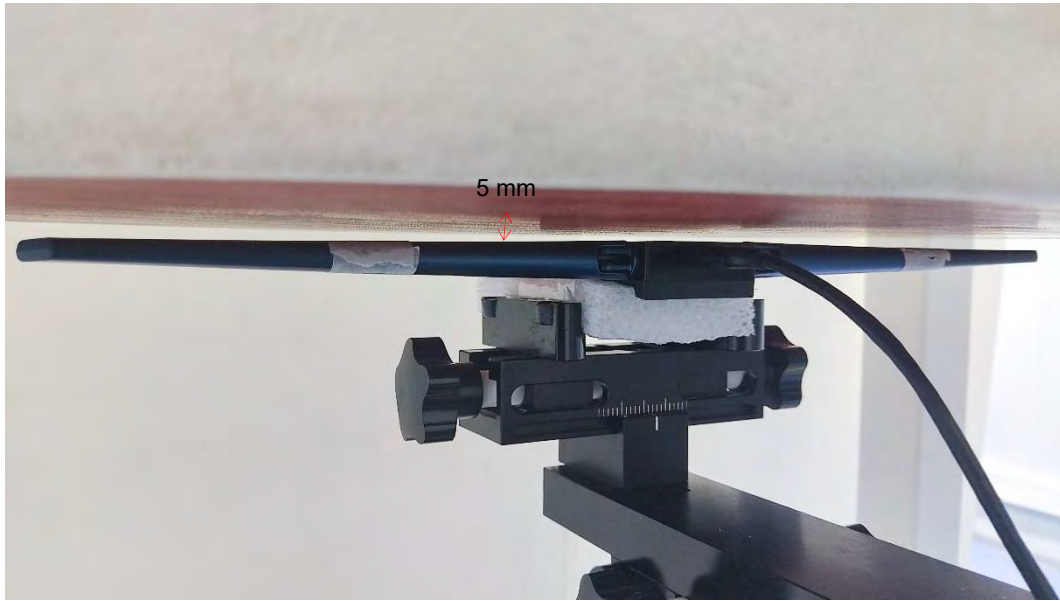
Open-0° (5mm)



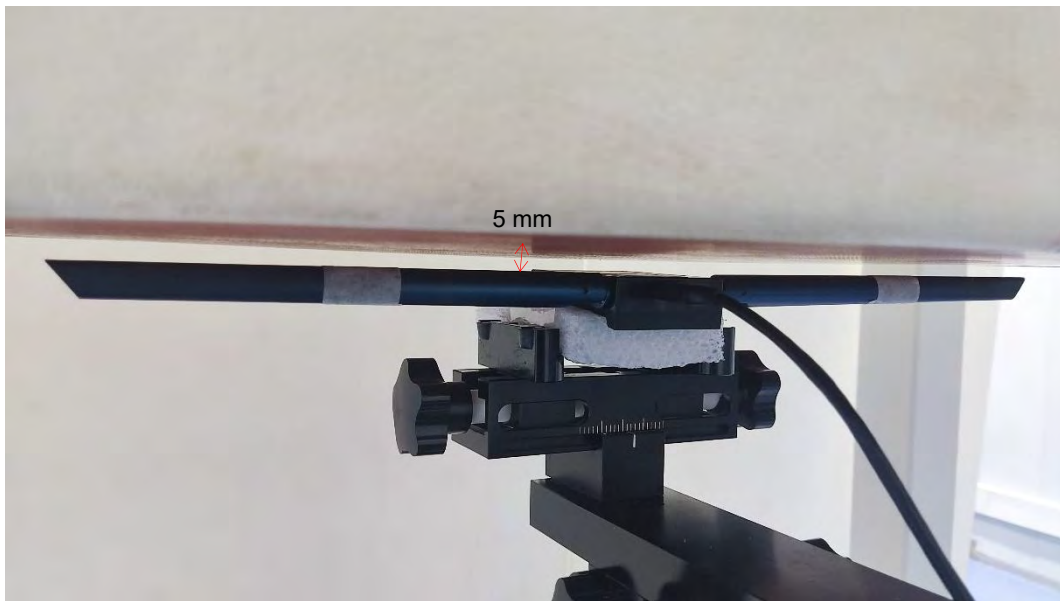
Open-90° (5mm)



Open-180° (5mm)

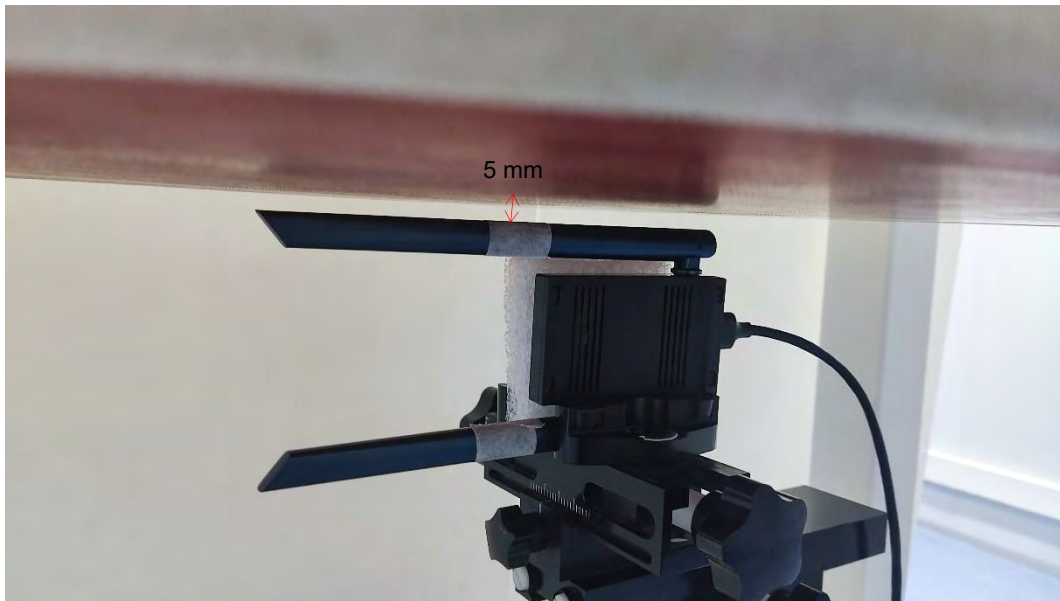


Open-270° (5mm)

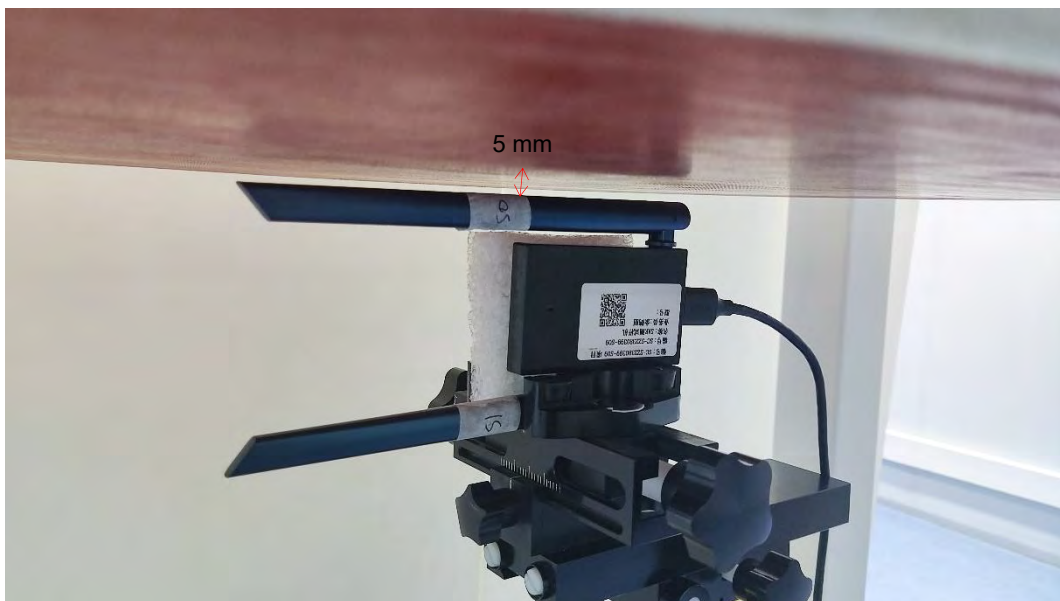




Left Edge (5mm)



Right Edge (5mm)



# ANNEX F CALIBRATION REPORT

## F.1 E-Field Probe(EX3DV4 -SN:7510)

In Collaboration with  
**TTLspeag**  
CALIBRATION LABORATORY

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中国认可  
国际互认  
校准  
CALIBRATION  
CNAS 13070

**Client**      **baluntek**      **Certificate No:**    **Z22-60564**

<b>CALIBRATION CERTIFICATE</b>			
Object	EX3DV4 - SN : 7510		
Calibration Procedure(s)	FF-Z11-004-02 Calibration Procedures for Dosimetric E-field Probes		
Calibration date:	January 19, 2023		
<p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)°C and humidity&lt;70%.</p> <p>Calibration Equipment used (M&amp;TE critical for calibration)</p>			
<b>Primary Standards</b>	<b>ID #</b>	<b>Cal Date(Calibrated by, Certificate No.)</b>	<b>Scheduled Calibration</b>
Power Meter NRP2	101919	14-Jun-22(CTTL, No.J22X04181)	Jun-23
Power sensor NRP-Z91	101547	14-Jun-22(CTTL, No.J22X04181)	Jun-23
Power sensor NRP-Z91	101548	14-Jun-22(CTTL, No.J22X04181)	Jun-23
Reference 10dBAttenuator	18N50W-10dB	20-Jan-21(CTTL, No.J21X00486)	Jan-23
Reference 20dBAttenuator	18N50W-20dB	20-Jan-21(CTTL, No.J21X00485)	Jan-23
Reference Probe EX3DV4	SN 3846	20-May-22(SPEAG, No.EX3-3846_May22)	May-23
DAE4	SN 771	20-Jan-22(SPEAG, No.DAE4-771_Jan22)	Jan-23
<b>Secondary Standards</b>	<b>ID #</b>	<b>Cal Date(Calibrated by, Certificate No.)</b>	<b>Scheduled Calibration</b>
SignalGenerator MG3700A	6201052605	14-Jun-22(CTTL, No.J22X04182)	Jun-23
Network Analyzer E5071C	MY46110673	10-Jan-23(CTTL, No.J23X00104)	Jan-24
	<b>Name</b>	<b>Function</b>	<b>Signature</b>
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	
<p>Issued: January 31, 2023</p> <p>This calibration certificate shall not be reproduced except in full without written approval of the laboratory.</p>			



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#### Glossary:

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

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

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

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

#### Methods Applied and Interpretation of Parameters:

- NORM<sub>x,y,z</sub>:** Assessed for E-field polarization  $\theta=0$  (fs900MHz in TEM-cell;  $f>1800$ MHz: waveguide) NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not effect the  $E^2$ -field uncertainty inside TSL (see below ConvF).
- NORM(f)<sub>x,y,z</sub> = NORM<sub>x,y,z</sub> frequency\_response** (see Frequency Response Chart): This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP<sub>x,y,z</sub>:** DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- PAR:** PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- A<sub>x,y,z</sub>; B<sub>x,y,z</sub>; C<sub>x,y,z</sub>; VR<sub>x,y,z</sub>; A,B,C** are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters:** Assessed in flat phantom using E-field (or Temperature Transfer Standard for fs800MHz) and inside waveguide using analytical field distributions based on power measurements for  $f>800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM<sub>x,y,z</sub> ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from  $\pm 50$ MHz to  $\pm 100$ MHz.
- Spherical isotropy (3D deviation from isotropy):** In a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset:** The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle:** The angle is assessed using the information gained by determining the NORM<sub>x</sub> (no uncertainty required).

Certificate No:Z22-60564

Page 1 of 9



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## DASY/EASY – Parameters of Probe: EX3DV4 – SN:7510

### Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm( $\mu\text{V}/(\text{V}/\text{m})^2$ ) <sup>A</sup>	0.64	0.55	0.42	±10.0%
DCP(mV) <sup>B</sup>	95.9	95.5	97.2	

### Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB· $\mu\text{V}$	C	D dB	VR mV	Unc <sup>E</sup> (k=2)
0	CW	X	0.0	0.0	1.0	0.00	192.1	±2.5%
		Y	0.0	0.0	1.0		177.1	
		Z	0.0	0.0	1.0		147.7	

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%.

<sup>A</sup> The uncertainties of Norm X, Y, Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Page 5)

<sup>B</sup> Numerical linearization parameter: uncertainty not required.

<sup>E</sup> Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.



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## DASY/EASY – Parameters of Probe: EX3DV4 – SN:7510

### Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz] <sup>C</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) <sup>F</sup>	ConvF X	ConvF Y	ConvF Z	Alpha <sup>G</sup>	Depth <sup>G</sup> (mm)	Unct. (k=2)
750	41.0	0.89	10.40	10.40	10.40	0.12	1.36	±12.7%
835	41.5	0.90	9.97	9.97	9.97	0.09	1.82	±12.7%
1750	40.1	1.37	8.65	8.65	8.65	0.18	1.19	±12.7%
1900	40.0	1.40	8.21	8.21	8.21	0.25	0.98	±12.7%
2100	39.8	1.49	8.40	8.40	8.40	0.21	1.08	±12.7%
2300	39.5	1.67	8.05	8.05	8.05	0.43	0.73	±12.7%
2450	39.2	1.80	7.78	7.78	7.78	0.45	0.74	±12.7%
2600	39.0	1.96	7.60	7.60	7.60	0.51	0.71	±12.7%
3300	38.2	2.71	7.35	7.35	7.35	0.30	1.03	±13.9%
3500	37.9	2.91	7.15	7.15	7.15	0.34	1.01	±13.9%
3700	37.7	3.12	6.90	6.90	6.90	0.30	1.09	±13.9%
3900	37.5	3.32	6.75	6.75	6.75	0.30	1.45	±13.9%
4100	37.2	3.53	6.73	6.73	6.73	0.30	1.40	±13.9%
4400	36.9	3.84	6.50	6.50	6.50	0.30	1.50	±13.9%
4600	36.7	4.04	6.42	6.42	6.42	0.40	1.30	±13.9%
4800	36.4	4.25	6.32	6.32	6.32	0.40	1.35	±13.9%
4950	36.3	4.40	6.07	6.07	6.07	0.35	1.50	±13.9%
5200	36.0	4.66	5.67	5.67	5.67	0.45	1.30	±13.9%
5300	35.9	4.76	5.37	5.37	5.37	0.40	1.45	±13.9%
5500	35.6	4.96	4.98	4.98	4.98	0.45	1.35	±13.9%
5600	35.5	5.07	4.88	4.88	4.88	0.45	1.40	±13.9%
5800	35.3	5.27	4.83	4.83	4.83	0.45	1.38	±13.9%

<sup>C</sup> Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

<sup>F</sup> At frequency up to 6 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

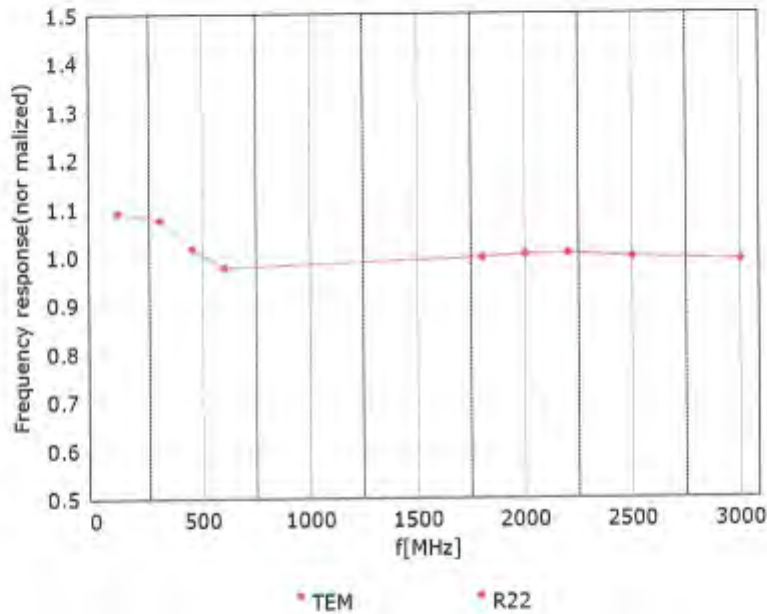
<sup>G</sup> Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.



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### Frequency Response of E-Field (TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field:  $\pm 7.4\%$  ( $k=2$ )



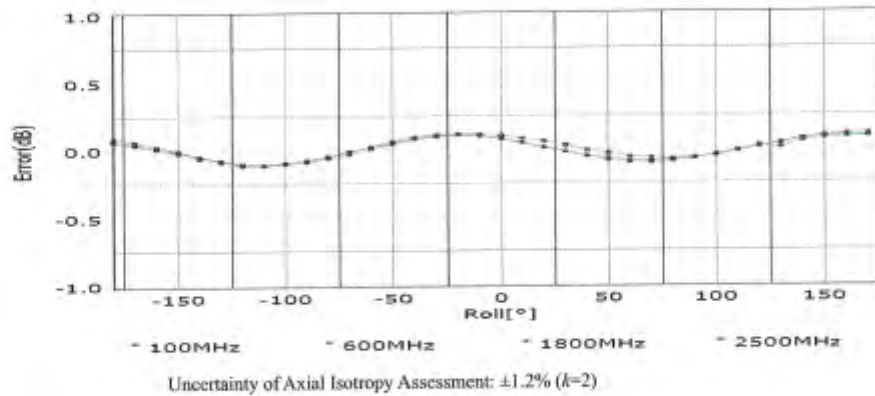
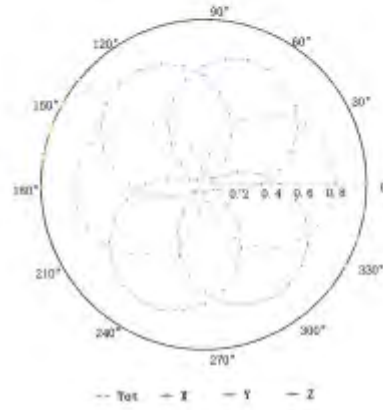
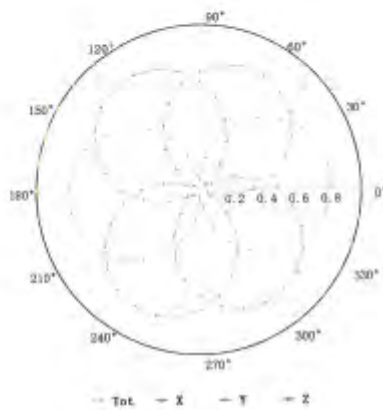
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### Receiving Pattern ( $\Phi$ ), $\theta=0^\circ$

**f=600 MHz, TEM**

**f=1800 MHz, R22**

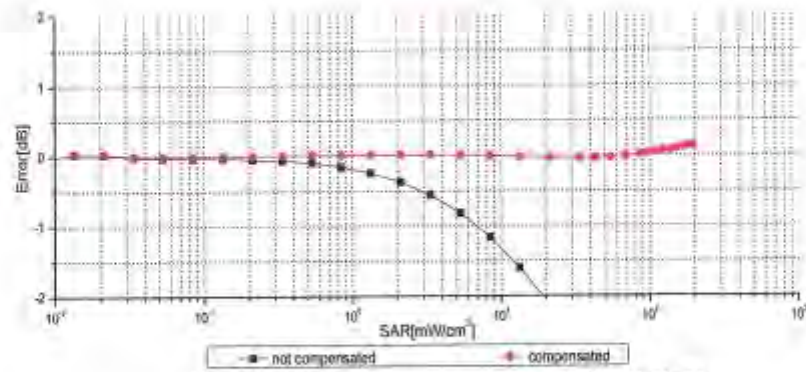
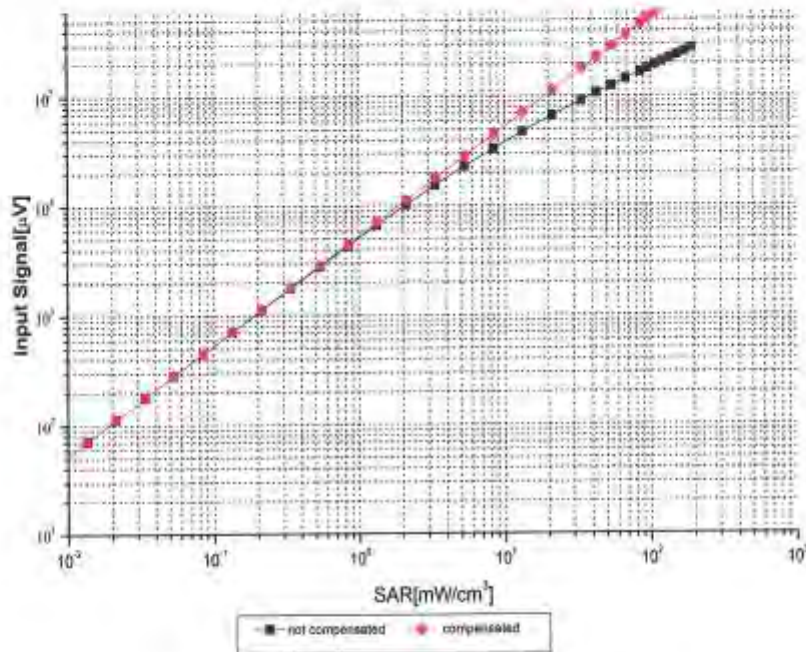




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### Dynamic Range f(SAR<sub>head</sub>) (TEM cell, f = 900 MHz)



Uncertainty of Linearity Assessment: ±0.9% (k=2)



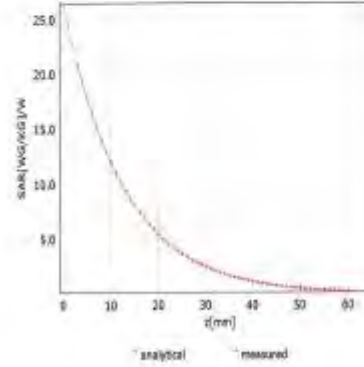
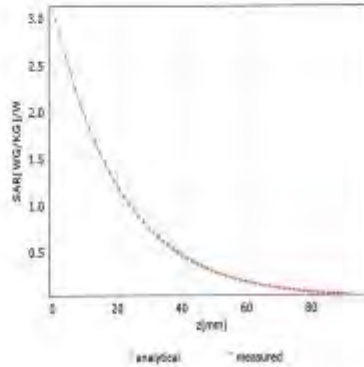


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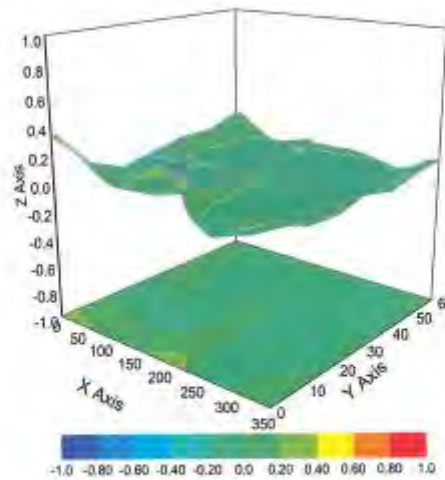
### Conversion Factor Assessment

f=750 MHz,WGLS R9(H\_convF)

f=1750 MHz,WGLS R22(H\_convF)



### Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment:  $\pm 3.2\%$  ( $k=2$ )



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## DASY/EASY – Parameters of Probe: EX3DV4 – SN:7510

### Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	36.7
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm

F.2 Data Acquisition Electronics (DAE4 - SN:1454)

**Calibration Laboratory of  
Schmid & Partner  
Engineering AG**  
Zeughausstrasse 43, 8004 Zurich, Switzerland



**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
**S** Servizio svizzero di taratura  
**S** Swiss Calibration Service

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

Accreditation No.: **SCS 0108**

Client **Balun-SZ**  
Shenzhen, China

Certificate No: **DAE4-1454\_Mar23**

CALIBRATION CERTIFICATE																							
Object	DAE4 - SD 000 D04 BM - SN: 1454																						
Calibration procedure(s)	QA CAL-06.v30 Calibration procedure for the data acquisition electronics (DAE)																						
Calibration date:	March 20, 2023																						
<p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity &lt; 70%.</p> <p>Calibration Equipment used (M&amp;TE critical for calibration)</p> <table border="1"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Keithley Multimeter Type 2001</td> <td>SN: 0810278</td> <td>29-Aug-22 (No:34389)</td> <td>Aug-23</td> </tr> <tr> <th>Secondary Standards</th> <th>ID #</th> <th>Check Date (in house)</th> <th>Scheduled Check</th> </tr> <tr> <td>Auto DAE Calibration Unit</td> <td>SE UWS 053 AA 1001</td> <td>27-Jan-23 (in house check)</td> <td>In house check: Jan-24</td> </tr> <tr> <td>Calibrator Box V2.1</td> <td>SE UMS 006 AA 1002</td> <td>27-Jan-23 (in house check)</td> <td>In house check: Jan-24</td> </tr> </tbody> </table>				Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration	Keithley Multimeter Type 2001	SN: 0810278	29-Aug-22 (No:34389)	Aug-23	Secondary Standards	ID #	Check Date (in house)	Scheduled Check	Auto DAE Calibration Unit	SE UWS 053 AA 1001	27-Jan-23 (in house check)	In house check: Jan-24	Calibrator Box V2.1	SE UMS 006 AA 1002	27-Jan-23 (in house check)	In house check: Jan-24
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Calibrated by:	Name Dominique Steffen	Function Laboratory Technician	Signature 																				
Approved by:	Sven Kühn	Technical Manager																					
			Issued: March 20, 2023																				
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**Calibration Laboratory of  
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

## Glossary

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

## Methods Applied and Interpretation of Parameters

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

**DC Voltage Measurement**

A/D - Converter Resolution nominal

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

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

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

Calibration Factors	X	Y	Z
High Range	404.187 $\pm$ 0.02% (k=2)	403.680 $\pm$ 0.02% (k=2)	403.750 $\pm$ 0.02% (k=2)
Low Range	4.01310 $\pm$ 1.50% (k=2)	3.99119 $\pm$ 1.50% (k=2)	4.00106 $\pm$ 1.50% (k=2)

**Connector Angle**

Connector Angle to be used in DASY system	23.0 <sup>o</sup> $\pm$ 1 <sup>o</sup>
---	--

## Appendix (Additional assessments outside the scope of SCS0108)

### 1. DC Voltage Linearity

High Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	199993.53	-0.16	-0.00
Channel X + Input	20000.37	-1.52	-0.01
Channel X - Input	-19999.85	2.00	-0.01
Channel Y + Input	199992.61	-1.01	-0.00
Channel Y + Input	19996.38	-5.29	-0.03
Channel Y - Input	-20002.70	-0.67	0.00
Channel Z + Input	199993.15	-0.43	-0.00
Channel Z + Input	19998.47	-3.23	-0.02
Channel Z - Input	-20002.38	-0.20	0.00

Low Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	2001.24	0.12	0.01
Channel X + Input	201.71	0.37	0.18
Channel X - Input	-197.46	1.13	-0.57
Channel Y + Input	2000.95	-0.02	-0.00
Channel Y + Input	200.51	-0.63	-0.31
Channel Y - Input	-199.24	-0.64	0.32
Channel Z + Input	2001.05	0.27	0.01
Channel Z + Input	200.02	-1.14	-0.56
Channel Z - Input	-199.76	-1.03	0.52

### 2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading ( $\mu\text{V}$ )	Low Range Average Reading ( $\mu\text{V}$ )
Channel X	200	-14.84	-16.14
	-200	17.57	16.14
Channel Y	200	-22.27	-23.07
	-200	22.28	21.89
Channel Z	200	-12.61	-12.43
	-200	10.08	10.17

### 3. Channel separation

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

	Input Voltage (mV)	Channel X ( $\mu\text{V}$ )	Channel Y ( $\mu\text{V}$ )	Channel Z ( $\mu\text{V}$ )
Channel X	200	-	-2.54	-1.12
Channel Y	200	3.48	-	-1.60
Channel Z	200	10.43	2.06	-

#### 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	16118	16673
Channel Y	16296	16437
Channel Z	16044	14637

#### 5. Input Offset Measurement

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

Input 10M $\Omega$

	Average ( $\mu$ V)	min. Offset ( $\mu$ V)	max. Offset ( $\mu$ V)	Std. Deviation ( $\mu$ V)
Channel X	0.42	-0.45	1.19	0.37
Channel Y	-0.56	-1.57	0.44	0.44
Channel Z	-0.66	-1.58	0.32	0.35

#### 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

F.3 2450 MHz Dipole



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Client **baluntek**

Certificate No: **Z21-60171**

CALIBRATION CERTIFICATE			
Object	D2450V2 - SN: 952		
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits		
Calibration date:	May 19, 2021		
<p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (22±3)°C and humidity&lt;70%.</p> <p>Calibration Equipment used (M&amp;TE critical for calibration)</p>			
Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	23-Sep-20 (CTTL, No.J20X08336)	Sep-21
Power sensor NRP8S	104291	23-Sep-20 (CTTL, No.J20X08336)	Sep-21
ReferenceProbe EX3DV4	SN 3846	26-Apr-21(CTTL-SPEAG,No.Z21-60084)	Apr-22
DAE4	SN 777	08-Jan-21(CTTL-SPEAG,No.Z21-60003)	Jan-22
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	25-Feb-20 (CTTL, No.J20X00516)	Feb-21
NetworkAnalyzer E5071C	MY46110673	10-Feb-20 (CTTL, No.J20X00515)	Feb-21
Calibrated by:	Name Zhao Jing	Function SAR Test Engineer	Signature 
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	
Issued: May 24, 2021			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			





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#### Glossary:

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

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

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

#### Additional Documentation:

- DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

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

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



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### Measurement Conditions

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

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
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	39.4 $\pm$ 6 %	1.79 mho/m $\pm$ 6 %
Head TSL temperature change during test	<1.0 °C	----	----

### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>53.0 W/kg <math>\pm</math> 18.8 % (k=2)</b>
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.00 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>24.1 W/kg <math>\pm</math> 18.7 % (k=2)</b>

### Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.2 $\pm$ 6 %	1.96 mho/m $\pm$ 6 %
Body TSL temperature change during test	<1.0 °C	----	----

### SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>52.5 W/kg <math>\pm</math> 18.8 % (k=2)</b>
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	6.06 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>24.2 W/kg <math>\pm</math> 18.7 % (k=2)</b>



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

**Antenna Parameters with Head TSL**

Impedance, transformed to feed point	54.1Ω+ 2.20 jΩ
Return Loss	- 27.0dB

**Antenna Parameters with Body TSL**

Impedance, transformed to feed point	49.0Ω+ 3.93 jΩ
Return Loss	- 27.8dB

**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.068 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

**Additional EUT Data**

Manufactured by	SPEAG
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**DASY5 Validation Report for Head TSL**

Date: 05.19.2021

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 952**

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.788$  S/m;  $\epsilon_r = 39.43$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3846; ConvF(7.45, 7.45, 7.45) @ 2450 MHz; Calibrated: 2021-04-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 2021-01-08
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm,**

**dy=5mm, dz=5mm**

Reference Value = 107.4 V/m; Power Drift = -0.04 dB

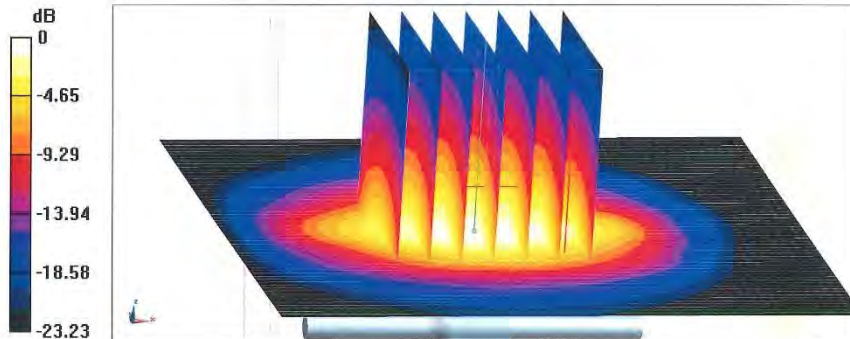
Peak SAR (extrapolated) = 28.2 W/kg

**SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6 W/kg**

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

Ratio of SAR at M2 to SAR at M1 = 46.4%

Maximum value of SAR (measured) = 22.5 W/kg



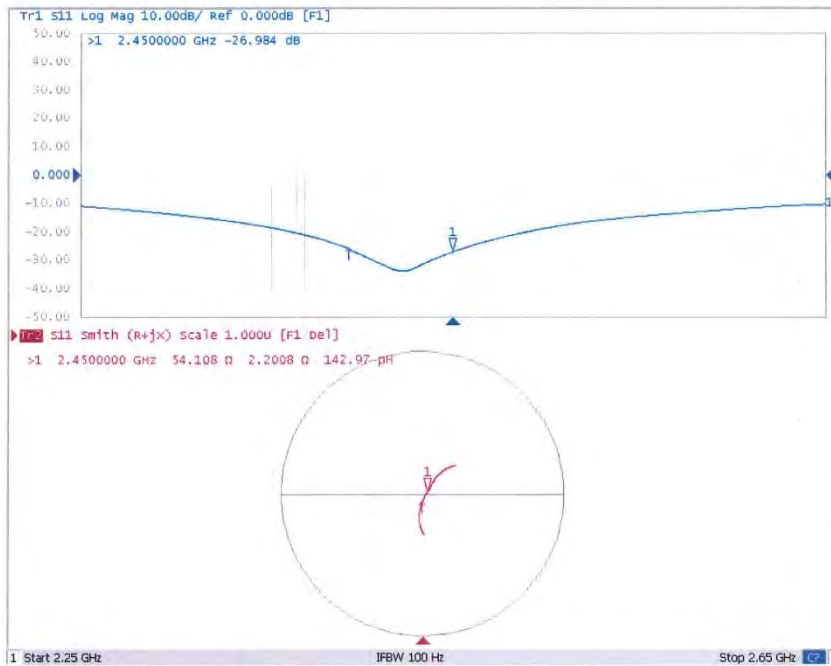
0 dB = 22.5 W/kg = 13.52 dBW/kg

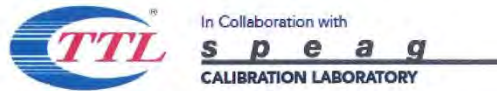


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**Impedance Measurement Plot for Head TSL**





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**DASY5 Validation Report for Body TSL**

Date: 05.19.2021

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 952**

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.96$  S/m;  $\epsilon_r = 52.15$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3846; ConvF(7.37, 7.37, 7.37) @ 2450 MHz; Calibrated: 2021-04-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 2021-01-08
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 101.3 V/m; Power Drift = 0.04 dB

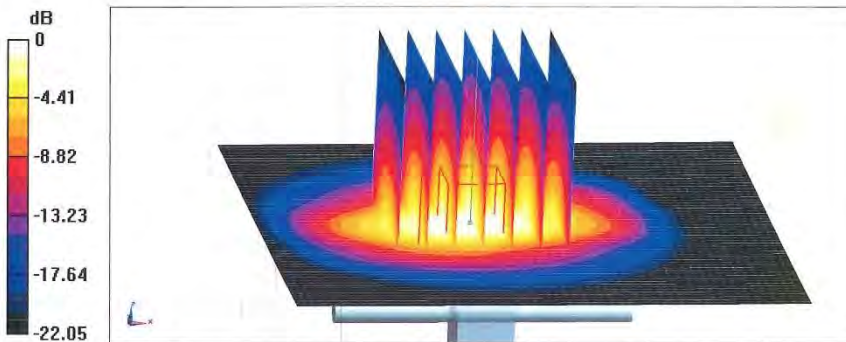
Peak SAR (extrapolated) = 26.9 W/kg

**SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.06 W/kg**

Smallest distance from peaks to all points 3 dB below = 8.5 mm

Ratio of SAR at M2 to SAR at M1 = 49.7%

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



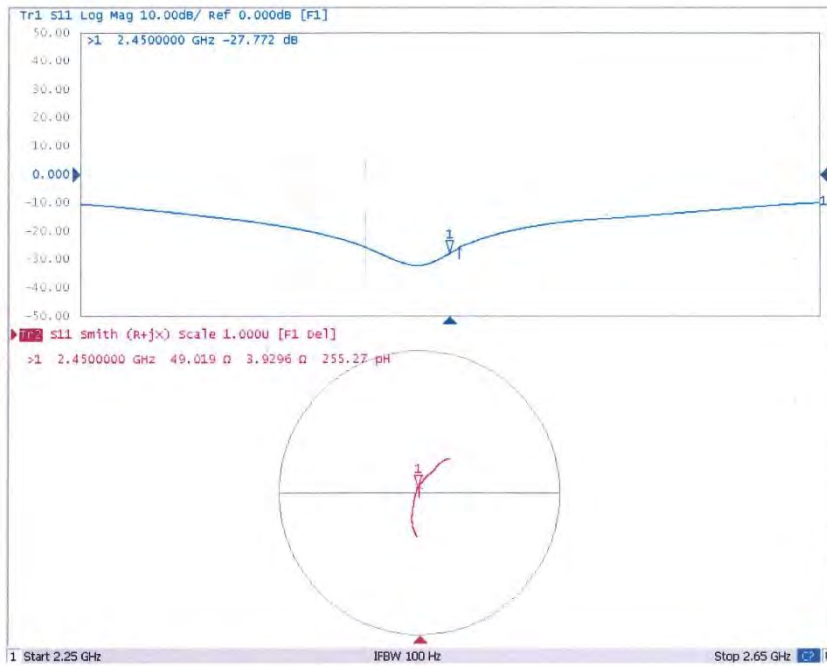
0 dB = 22.1 W/kg = 13.44 dBW/kg



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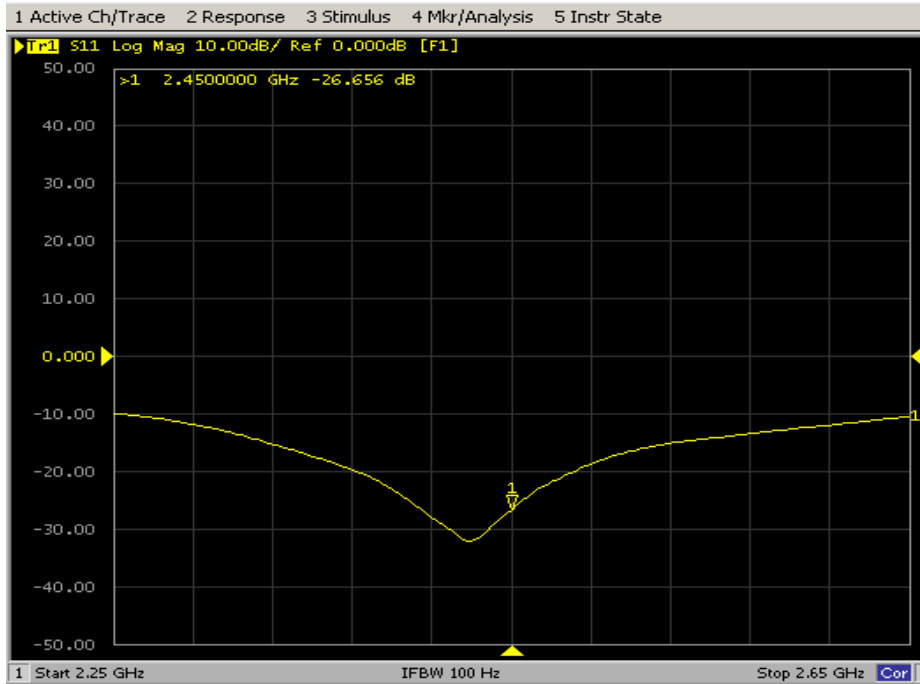
### Impedance Measurement Plot for Body TSL



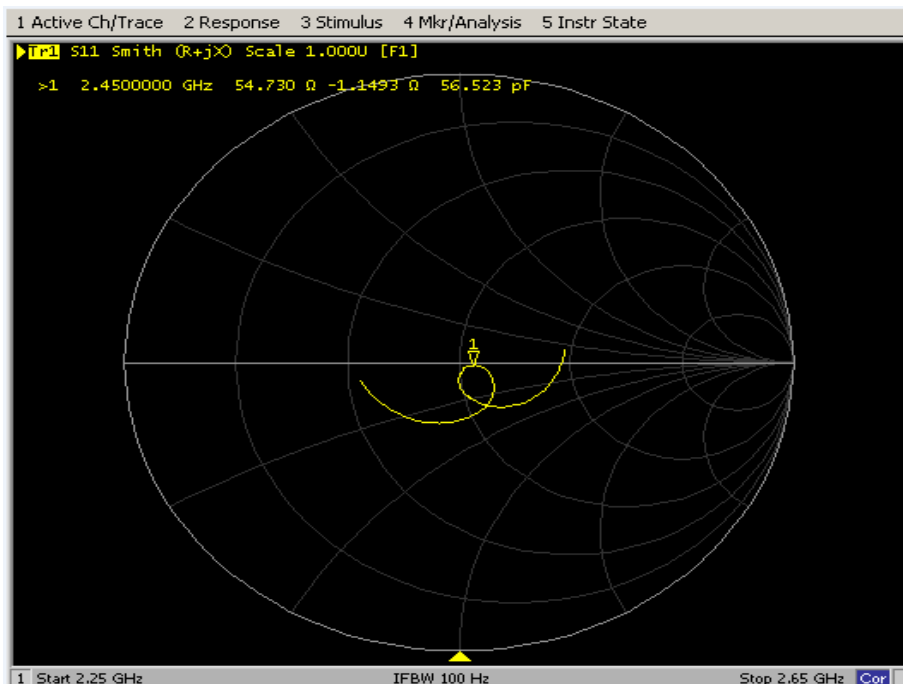
D2450V2 Dipole impedance and return loss Validation

Meas. Results	Current Meas.	Previous Meas.	Max. Deviation
Meas. Data	2023.05.17	2022.05.18	/
Return Loss(dB)	-26.656	-26.401	0.97%
Impedance	54.73 Ω -1.149 jΩ	54.102 Ω +2.830 jΩ	-3.979Ω (Imaginary part)

Return Loss for Head TSL



Impedance for Head TSL





F.4 5GHz Dipole



Client **baluntek** Certificate No: **Z21-60173**

CALIBRATION CERTIFICATE			
Object	D5GHzV2 - SN: 1200		
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits		
Calibration date:	May 18, 2021		
<p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (22±3)°C and humidity&lt;70%.</p> <p>Calibration Equipment used (M&amp;TE critical for calibration)</p>			
Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	23-Sep-20 (CTTL, No.J20X08336)	Sep-21
Power sensor NRP8S	104291	23-Sep-20 (CTTL, No.J20X08336)	Sep-21
ReferenceProbe EX3DV4	SN 3846	26-Apr-21(CTTL-SPEAG,No.Z21-60084)	Apr-22
DAE4	SN 777	08-Jan-21(CTTL-SPEAG,No.Z21-60003)	Jan-22
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	25-Feb-20 (CTTL, No.J20X00516)	Feb-21
NetworkAnalyzerE5071C	MY46110673	10-Feb-20 (CTTL, No.J20X00515)	Feb-21
Calibrated by:	Name Zhao Jing	Function SAR Test Engineer	Signature 
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	
Issued: May 24, 2021			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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#### Glossary:

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

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

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

#### Additional Documentation:

- DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

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

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



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### Measurement Conditions

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

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4 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	

### 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	35.5 $\pm$ 6 %	4.67 mho/m $\pm$ 6 %
Head TSL temperature change during test	<1.0 °C	----	----

### SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.80 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>77.8 W/kg <math>\pm</math> 24.4 % (k=2)</b>
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.22 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>22.1 W/kg <math>\pm</math> 24.2 % (k=2)</b>



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#### Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.9 ± 6 %	5.05 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

#### SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.15 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>81.2 W/kg ± 24.4 % (k=2)</b>
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>23.1 W/kg ± 24.2 % (k=2)</b>

#### 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	34.7 ± 6 %	5.21 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

#### SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.75 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>77.2 W/kg ± 24.4 % (k=2)</b>
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>21.7 W/kg ± 24.2 % (k=2)</b>



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**Body TSL parameters at 5250 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.36 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	49.1 ± 6 %	5.34 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

**SAR result with Body TSL at 5250 MHz**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.33 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	73.4 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.05 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.5 W/kg ± 24.2 % (k=2)

**Body TSL parameters at 5600 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.4 ± 6 %	5.82 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

**SAR result with Body TSL at 5600 MHz**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.72 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	77.2 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.6 W/kg ± 24.2 % (k=2)



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**Body TSL parameters at 5750 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.3	5.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.1 ± 6 %	6.05 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

**SAR result with Body TSL at 5750 MHz**

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b>	Condition	
SAR measured	100 mW input power	7.34 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>73.4 W/kg ± 24.4 % (k=2)</b>
<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b>	Condition	
SAR measured	100 mW input power	2.03 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>20.3 W/kg ± 24.2 % (k=2)</b>



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

##### Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	45.1Ω + 1.25jΩ
Return Loss	- 25.5dB

##### Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	49.7Ω + 7.81jΩ
Return Loss	- 22.1dB

##### Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	45.9Ω + 4.85jΩ
Return Loss	- 23.5dB

##### Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	43.9Ω + 2.08jΩ
Return Loss	- 23.3dB

##### Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	50.3Ω + 8.89jΩ
Return Loss	- 21.1dB

##### Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	46.6Ω + 5.63jΩ
Return Loss	- 23.3dB



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**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.096 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

**Additional EUT Data**

Manufactured by	SPEAG
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**DASY5 Validation Report for Head TSL**

Date: 05.18.2021

Test Laboratory: CCTL, Beijing, China

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1200**

Communication System: CW; Frequency: 5250 MHz, Frequency: 5600 MHz,  
 Frequency: 5750 MHz,

Medium parameters used:  $f = 5250$  MHz;  $\sigma = 4.668$  S/m;  $\epsilon_r = 35.48$ ;  $\rho = 1000$  kg/m<sup>3</sup>,  
 Medium parameters used:  $f = 5600$  MHz;  $\sigma = 5.045$  S/m;  $\epsilon_r = 34.88$ ;  $\rho = 1000$  kg/m<sup>3</sup>,  
 Medium parameters used:  $f = 5750$  MHz;  $\sigma = 5.208$  S/m;  $\epsilon_r = 34.67$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Phantom section: Center Section

## DASY5 Configuration:

- Probe: EX3DV4 - SN3846; ConvF(5.43, 5.43, 5.43) @ 5250 MHz; ConvF(4.69, 4.69, 4.69) @ 5600 MHz; ConvF(4.9, 4.9, 4.9) @ 5750 MHz; Calibrated: 2021-04-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 2021-01-08
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

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

Reference Value = 69.22 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 32.9 W/kg

**SAR(1 g) = 7.8 W/kg; SAR(10 g) = 2.22 W/kg**

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

Ratio of SAR at M2 to SAR at M1 = 63.3%

Maximum value of SAR (measured) = 18.9 W/kg

**Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan,****dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 70.18 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 35.5 W/kg

**SAR(1 g) = 8.15 W/kg; SAR(10 g) = 2.32 W/kg**

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

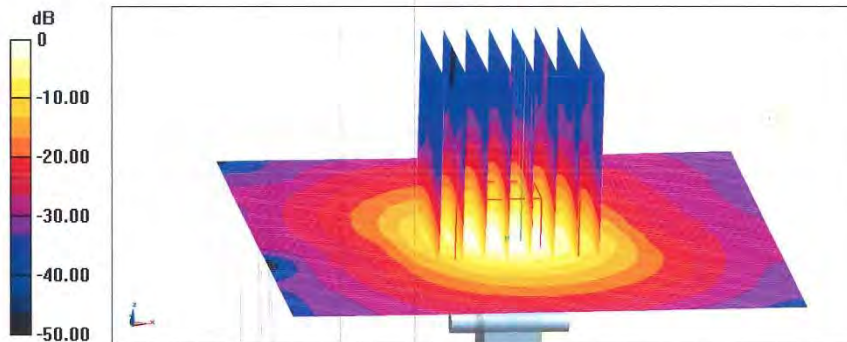
Ratio of SAR at M2 to SAR at M1 = 62.9%

Maximum value of SAR (measured) = 19.8 W/kg



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**Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan,**  
**dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm**  
Reference Value = 68.06 V/m; Power Drift = -0.09 dB  
Peak SAR (extrapolated) = 34.6 W/kg  
**SAR(1 g) = 7.75 W/kg; SAR(10 g) = 2.18 W/kg**  
Smallest distance from peaks to all points 3 dB below = 7.4 mm  
Ratio of SAR at M2 to SAR at M1 = 62.1%  
Maximum value of SAR (measured) = 19.0 W/kg

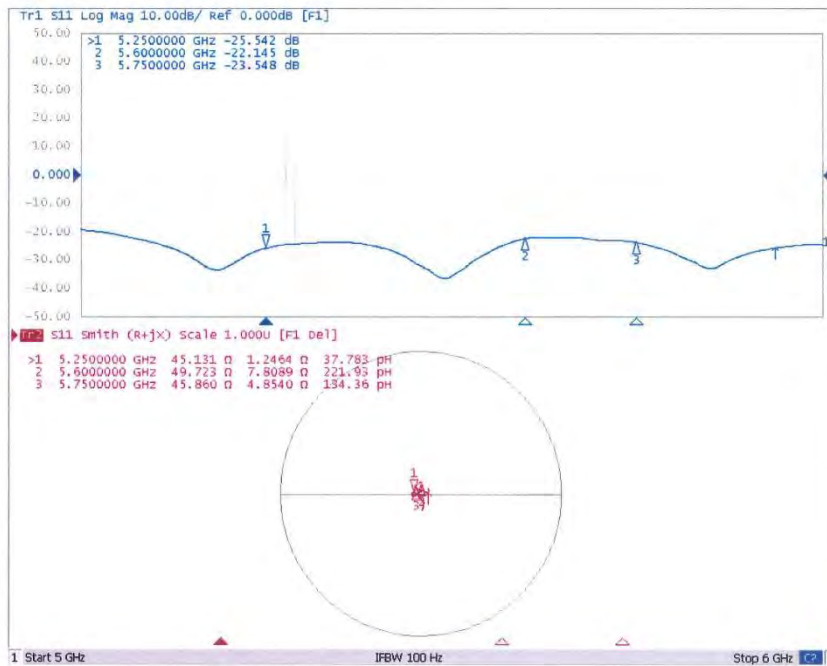


0 dB = 19.0 W/kg = 12.79 dBW/kg



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**Impedance Measurement Plot for Head TSL**





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### DASY5 Validation Report for Body TSL

Date: 05.18.2021

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1200

Communication System: CW; Frequency: 5250 MHz, Frequency: 5600 MHz,  
 Frequency: 5750 MHz,

Medium parameters used:  $f = 5250$  MHz;  $\sigma = 5.34$  S/m;  $\epsilon_r = 49.12$ ;  $\rho = 1000$  kg/m<sup>3</sup>,  
 Medium parameters used:  $f = 5600$  MHz;  $\sigma = 5.815$  S/m;  $\epsilon_r = 48.44$ ;  $\rho = 1000$   
 kg/m<sup>3</sup>, Medium parameters used:  $f = 5750$  MHz;  $\sigma = 6.045$  S/m;  $\epsilon_r = 48.11$ ;  $\rho =$   
 1000 kg/m<sup>3</sup>,

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3846; ConvF(4.95, 4.95, 4.95) @ 5250 MHz; ConvF(4.32, 4.32, 4.32) @ 5600 MHz; ConvF(4.38, 4.38, 4.38) @ 5750 MHz; Calibrated: 2021-04-26,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 2021-01-08
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

#### Dipole Calibration /Pin=100mW, d=10mm, f=5250 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 65.86 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 29.6 W/kg

**SAR(1 g) = 7.33 W/kg; SAR(10 g) = 2.05 W/kg**

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

Ratio of SAR at M2 to SAR at M1 = 65.3%

Maximum value of SAR (measured) = 17.2 W/kg

#### Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 66.06 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 33.1 W/kg

**SAR(1 g) = 7.72 W/kg; SAR(10 g) = 2.16 W/kg**

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

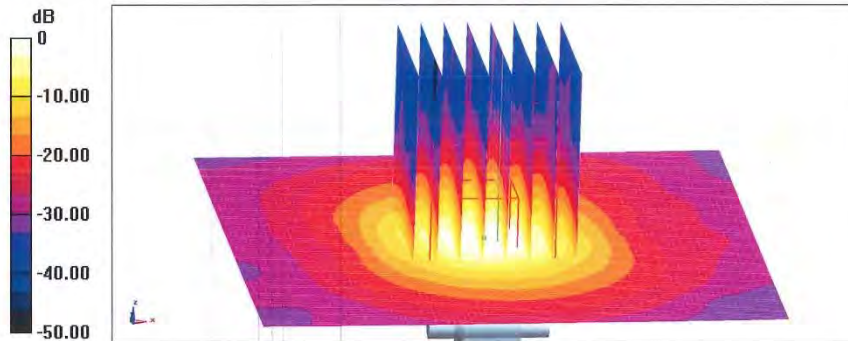
Ratio of SAR at M2 to SAR at M1 = 63.1%

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



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**Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan,**  
**dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm**  
Reference Value = 64.58 V/m; Power Drift = -0.04 dB  
Peak SAR (extrapolated) = 32.8 W/kg  
**SAR(1 g) = 7.34 W/kg; SAR(10 g) = 2.03 W/kg**  
Smallest distance from peaks to all points 3 dB below = 7.2 mm  
Ratio of SAR at M2 to SAR at M1 = 62%  
Maximum value of SAR (measured) = 18.1 W/kg

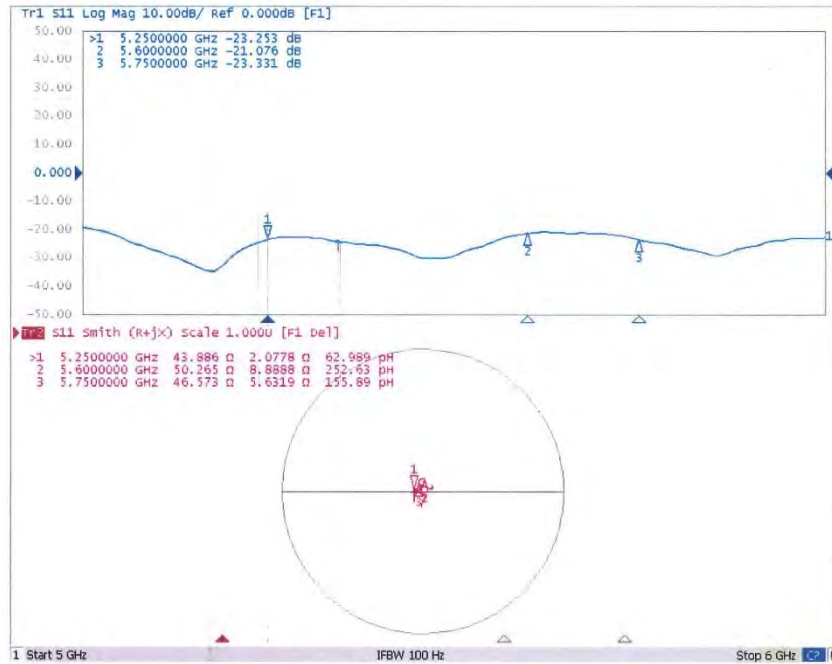


0 dB = 18.1 W/kg = 12.58 dBW/kg



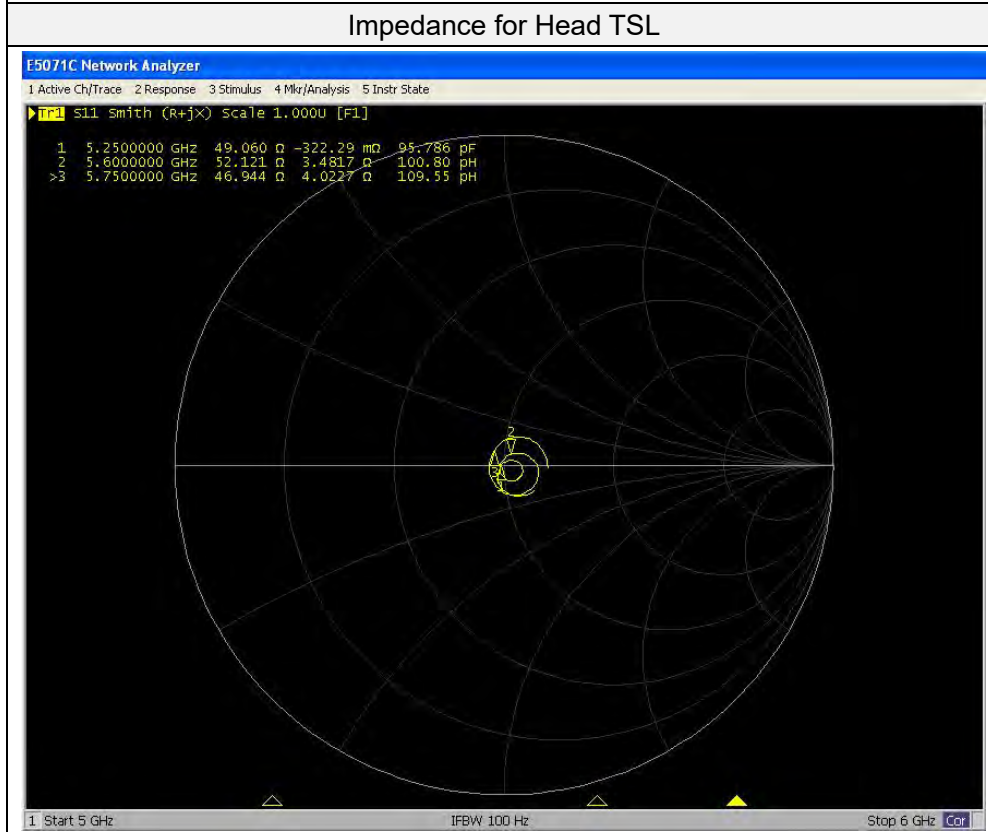
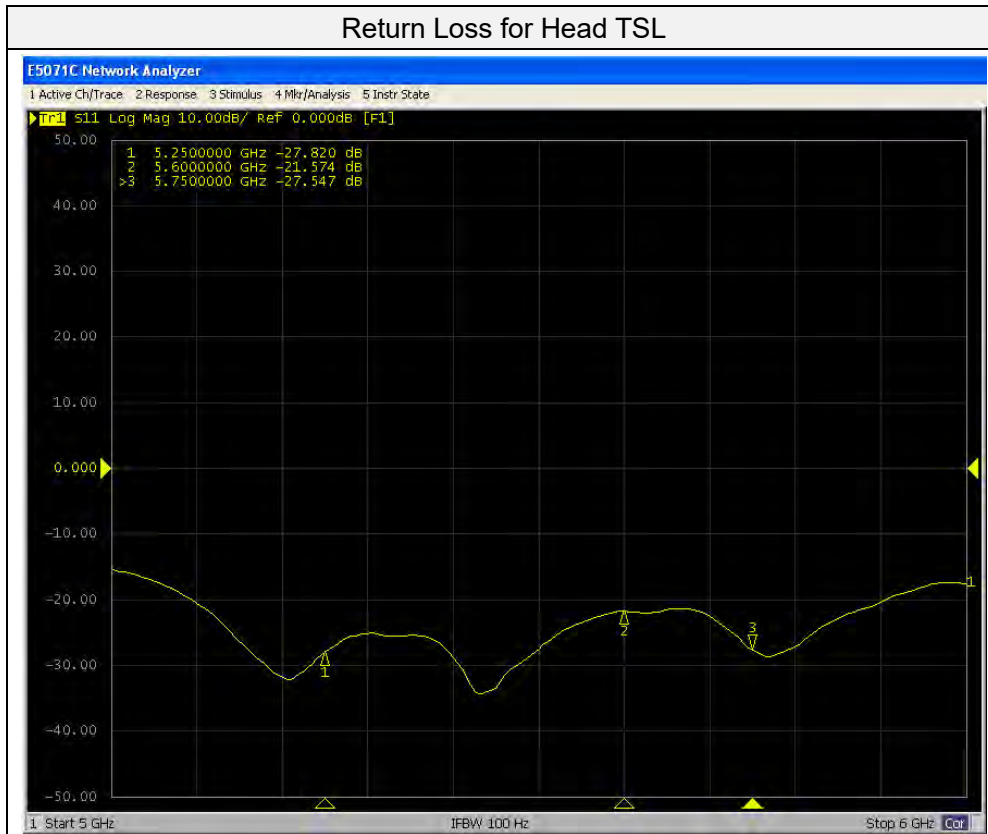
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**Impedance Measurement Plot for Body TSL**



## D5GHzV2 Dipole impedance and return loss Validation

Meas. Results	Current Meas.	Previous Meas.	Max. Deviation
Meas. Data	2023.05.16	2022.05.17	/
5.25GHz Return Loss(dB)	-27.820	-29.961	-7.15%
5.25GHz Impedance	49.06 $\Omega$ -0.322 j $\Omega$	48.925 $\Omega$ +1.802 j $\Omega$	-2.124 $\Omega$ (Imaginary part)
5.6GHz Return Loss(dB)	-21.574	-25.244	-14.54%
5.6GHz Impedance	52.121 $\Omega$ +3.482 j $\Omega$	47.163 $\Omega$ +3.417 j $\Omega$	4.958 $\Omega$ (Real part)
5.75GHz Return Loss(dB)	-27.547	-27.284	0.96%
5.75GHz Impedance	46.944 $\Omega$ +4.023 j $\Omega$	50.693 $\Omega$ +8.724 j $\Omega$	-4.701 $\Omega$ (Imaginary part)





## ANNEX G TUNE-UP PROCEDURE

Normal Mode RF Power Range (2.4G WLAN-Antenna 0)

Band (GHz)	Mode	Channel	Freq. (MHz)	Range (dBm)
2.4 (2.4~2.4835)	802.11b	1	2412	[11.50, 13.50]
		6	2437	[11.50, 13.50]
		11	2462	[11.50, 13.50]
	802.11g	1	2412	[11.50, 13.50]
		6	2437	[11.50, 13.50]
		11	2462	[11.50, 13.50]
	802.11n(HT20)	1	2412	[8.50, 10.50]
		6	2437	[8.50, 10.50]
		11	2462	[8.50, 10.50]
	802.11n(HT40)	3	2422	[8.50, 10.50]
		6	2437	[8.50, 10.50]
		9	2452	[8.50, 10.50]
	802.11ax(HE20)	1	2412	[8.50, 10.50]
		6	2437	[8.50, 10.50]
		11	2462	[8.50, 10.50]
802.11ax(HE40)	3	2422	[8.50, 10.50]	
	6	2437	[8.50, 10.50]	
	9	2452	[8.50, 10.50]	

## Normal Mode RF Power Range (2.4G WLAN-Antenna 1)

Band (GHz)	Mode	Channel	Freq. (MHz)	Range (dBm)
2.4 (2.4~2.4835)	802.11b	1	2412	[11.50, 13.50]
		6	2437	[11.50, 13.50]
		11	2462	[11.50, 13.50]
	802.11g	1	2412	[11.50, 13.50]
		6	2437	[11.50, 13.50]
		11	2462	[11.50, 13.50]
	802.11n(HT20)	1	2412	[8.50, 10.50]
		6	2437	[8.50, 10.50]
		11	2462	[8.50, 10.50]
	802.11n(HT40)	3	2422	[8.50, 10.50]
		6	2437	[8.50, 10.50]
		9	2452	[8.50, 10.50]
	802.11ax(HE20)	1	2412	[8.50, 10.50]
		6	2437	[8.50, 10.50]
		11	2462	[8.50, 10.50]
802.11ax(HE40)	3	2422	[8.50, 10.50]	
	6	2437	[8.50, 10.50]	
	9	2452	[8.50, 10.50]	

## Normal Mode RF Power Range (2.4G WLAN-MIMO)

Band (GHz)	Mode	Channel	Freq. (MHz)	Range (dBm)
2.4 (2.4~2.4835)	802.11n(HT20)	1	2412	[11.50, 13.50]
		6	2437	[11.50, 13.50]
		11	2462	[11.50, 13.50]
	802.11n(HT40)	3	2422	[11.50, 13.50]
		6	2437	[11.50, 13.50]
		9	2452	[11.50, 13.50]
	802.11ax(HE20)	1	2412	[11.50, 13.50]
		6	2437	[11.50, 13.50]
		11	2462	[11.50, 13.50]
	802.11ax(HE40)	3	2422	[11.50, 13.50]
		6	2437	[11.50, 13.50]
		9	2452	[11.50, 13.50]

## Normal Mode RF Power Range (5G WLAN-Antenna 0)

Band (GHz)	Mode	Channel	Freq. (MHz)	Range (dBm)
5.2 (5.15~5.25)	802.11a	36	5180	[11.50, 13.50]
		44	5220	[11.50, 13.50]
		48	5240	[11.50, 13.50]
	802.11n(HT20)	36	5180	[11.50, 13.50]
		44	5220	[11.50, 13.50]
		48	5240	[11.50, 13.50]
	802.11n(HT40)	38	5190	[11.50, 13.50]
		46	5230	[11.50, 13.50]
	802.11ac(VHT20)	36	5180	[11.50, 13.50]
		44	5220	[11.50, 13.50]
		48	5240	[11.50, 13.50]
	802.11ac(VHT40)	38	5190	[11.50, 13.50]
		46	5230	[11.50, 13.50]
	802.11ac(VHT80)	42	5210	[11.50, 13.50]
	802.11ax(HE20)	36	5180	[11.50, 13.50]
		44	5220	[11.50, 13.50]
		48	5240	[11.50, 13.50]
	802.11ax(HE40)	38	5190	[11.50, 13.50]
46		5230	[11.50, 13.50]	
802.11ax(HE80)	42	5210	[11.50, 13.50]	
5.8 (5.725~5.850)	802.11a	149	5745	[14.50, 16.50]
		157	5785	[14.50, 16.50]
		165	5825	[14.50, 16.50]
	802.11n(HT20)	149	5745	[11.50, 13.50]
		157	5785	[11.50, 13.50]
		165	5825	[11.50, 13.50]
	802.11n(HT40)	151	5755	[11.50, 13.50]
		159	5795	[11.50, 13.50]
	802.11ac(VHT20)	149	5745	[11.50, 13.50]
		157	5785	[11.50, 13.50]
		165	5825	[11.50, 13.50]
	802.11ac(VHT40)	151	5755	[11.50, 13.50]
		159	5795	[11.50, 13.50]
	802.11ac(VHT80)	155	5775	[11.50, 13.50]
	802.11ax(HE20)	149	5745	[11.50, 13.50]
		157	5785	[11.50, 13.50]
		165	5825	[11.50, 13.50]
	802.11ax(HE40)	151	5755	[11.50, 13.50]
159		5795	[11.50, 13.50]	
802.11ax(HE80)	155	5775	[11.50, 13.50]	

## Normal Mode RF Power Range (5G WLAN-Antenna 1)

Band (GHz)	Mode	Channel	Freq. (MHz)	Range (dBm)
5.2 (5.15~5.25)	802.11a	36	5180	[11.50, 13.50]
		44	5220	[11.50, 13.50]
		48	5240	[11.50, 13.50]
	802.11n(HT20)	36	5180	[11.50, 13.50]
		44	5220	[11.50, 13.50]
		48	5240	[11.50, 13.50]
	802.11n(HT40)	38	5190	[11.50, 13.50]
		46	5230	[11.50, 13.50]
	802.11ac(VHT20)	36	5180	[11.50, 13.50]
		44	5220	[11.50, 13.50]
		48	5240	[11.50, 13.50]
	802.11ac(VHT40)	38	5190	[11.50, 13.50]
		46	5230	[11.50, 13.50]
	802.11ac(VHT80)	42	5210	[11.50, 13.50]
	802.11ax(HE20)	36	5180	[11.50, 13.50]
		44	5220	[11.50, 13.50]
		48	5240	[11.50, 13.50]
	802.11ax(HE40)	38	5190	[11.50, 13.50]
46		5230	[11.50, 13.50]	
802.11ax(HE80)	42	5210	[11.50, 13.50]	
5.8 (5.725~5.850)	802.11a	149	5745	[14.50, 16.50]
		157	5785	[14.50, 16.50]
		165	5825	[14.50, 16.50]
	802.11n(HT20)	149	5745	[11.50, 13.50]
		157	5785	[11.50, 13.50]
		165	5825	[11.50, 13.50]
	802.11n(HT40)	151	5755	[11.50, 13.50]
		159	5795	[11.50, 13.50]
	802.11ac(VHT20)	149	5745	[11.50, 13.50]
		157	5785	[11.50, 13.50]
		165	5825	[11.50, 13.50]
	802.11ac(VHT40)	151	5755	[11.50, 13.50]
		159	5795	[11.50, 13.50]
	802.11ac(VHT80)	155	5775	[11.50, 13.50]
	802.11ax(HE20)	149	5745	[11.50, 13.50]
		157	5785	[11.50, 13.50]
		165	5825	[11.50, 13.50]
	802.11ax(HE40)	151	5755	[11.50, 13.50]
159		5795	[11.50, 13.50]	
802.11ax(HE80)	155	5775	[11.50, 13.50]	

## Normal Mode RF Power Range (5G WLAN-MIMO)

Band (GHz)	Mode	Channel	Freq. (MHz)	Range (dBm)
5.2 (5.15~5.25)	802.11n(HT20)	36	5180	[14.50, 16.50]
		44	5220	[14.50, 16.50]
		48	5240	[14.50, 16.50]
	802.11n(HT40)	38	5190	[14.50, 16.50]
		46	5230	[14.50, 16.50]
	802.11ac(VHT20)	36	5180	[14.50, 16.50]
		44	5220	[14.50, 16.50]
		48	5240	[14.50, 16.50]
	802.11ac(VHT40)	38	5190	[14.50, 16.50]
		46	5230	[14.50, 16.50]
	802.11ac(VHT80)	42	5210	[14.50, 16.50]
	802.11ax(HE20)	36	5180	[14.50, 16.50]
		44	5220	[14.50, 16.50]
		48	5240	[14.50, 16.50]
	802.11ax(HE40)	38	5190	[14.50, 16.50]
46		5230	[14.50, 16.50]	
802.11ax(HE80)	42	5210	[14.50, 16.50]	
5.8 (5.725~5.850)	802.11n(HT20)	149	5745	[14.50, 16.50]
		157	5785	[14.50, 16.50]
		165	5825	[14.50, 16.50]
	802.11n(HT40)	151	5755	[14.50, 16.50]
		159	5795	[14.50, 16.50]
	802.11ac(VHT20)	149	5745	[14.50, 16.50]
		157	5785	[14.50, 16.50]
		165	5825	[14.50, 16.50]
	802.11ac(VHT40)	151	5755	[14.50, 16.50]
		159	5795	[14.50, 16.50]
	802.11ac(VHT80)	155	5775	[14.50, 16.50]
	802.11ax(HE20)	149	5745	[14.50, 16.50]
		157	5785	[14.50, 16.50]
		165	5825	[14.50, 16.50]
	802.11ax(HE40)	151	5755	[14.50, 16.50]
159		5795	[14.50, 16.50]	
802.11ax(HE80)	155	5775	[14.50, 16.50]	

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