

**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

Accreditation No.: **SCS 0108**

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:

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

#### Additional Documentation:

- 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	2600 MHz $\pm$ 1 MHz	

**Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	37.4 $\pm$ 6 %	1.97 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °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	14.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>56.0 W/kg <math>\pm</math> 17.0 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>25.3 W/kg <math>\pm</math> 16.5 % (k=2)</b>

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

Impedance, transformed to feed point	48.1 $\Omega$ + 1.3 j $\Omega$
Return Loss	- 32.7 dB

**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.143 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: 27.03.2023

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1206**

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 1.97$  S/m;  $\epsilon_r = 37.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.68, 7.68, 7.68) @ 2600 MHz; Calibrated: 10.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 19.12.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; 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 = 118.2 V/m; Power Drift = -0.00 dB

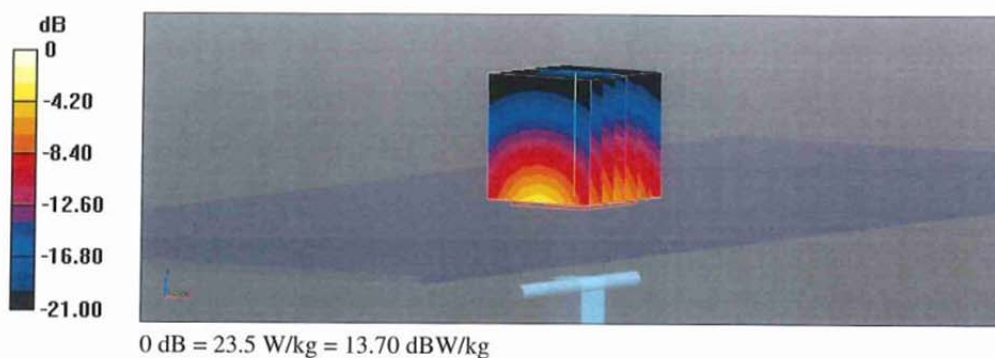
Peak SAR (extrapolated) = 27.7 W/kg

**SAR(1 g) = 14.2 W/kg; SAR(10 g) = 6.36 W/kg**

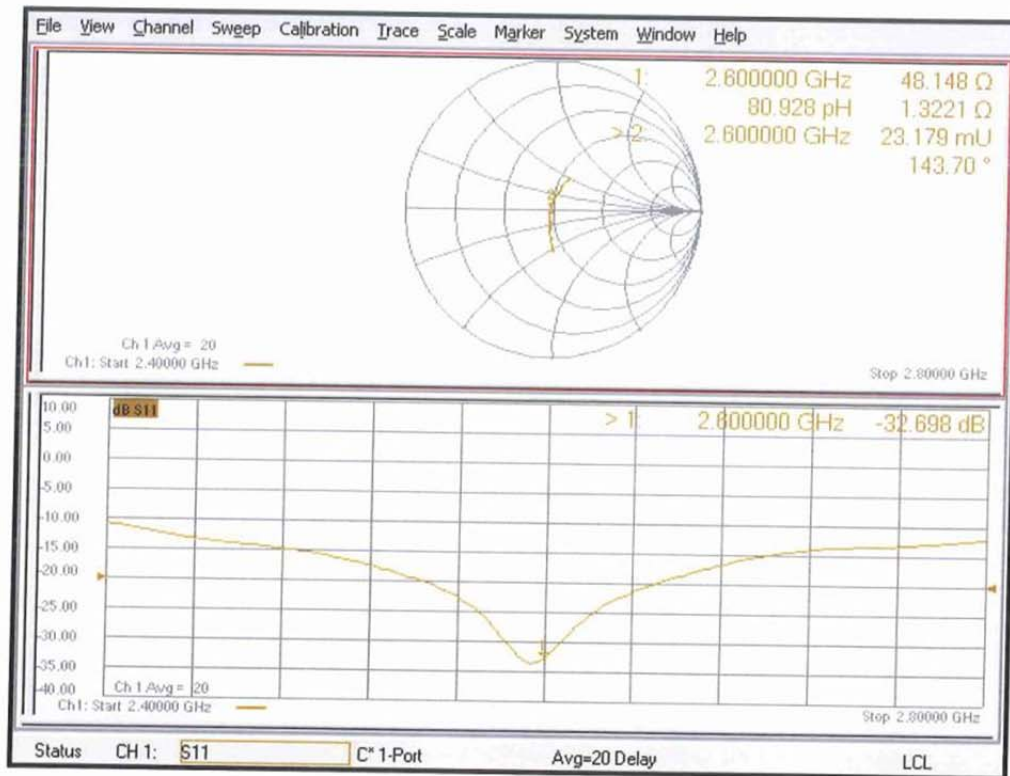
Smallest distance from peaks to all points 3 dB below = 9 mm

Ratio of SAR at M2 to SAR at M1 = 51%

Maximum value of SAR (measured) = 23.5 W/kg



### Impedance Measurement Plot for Head TSL





**D2600V2 - SN:1206 Extended Dipole Calibrations**

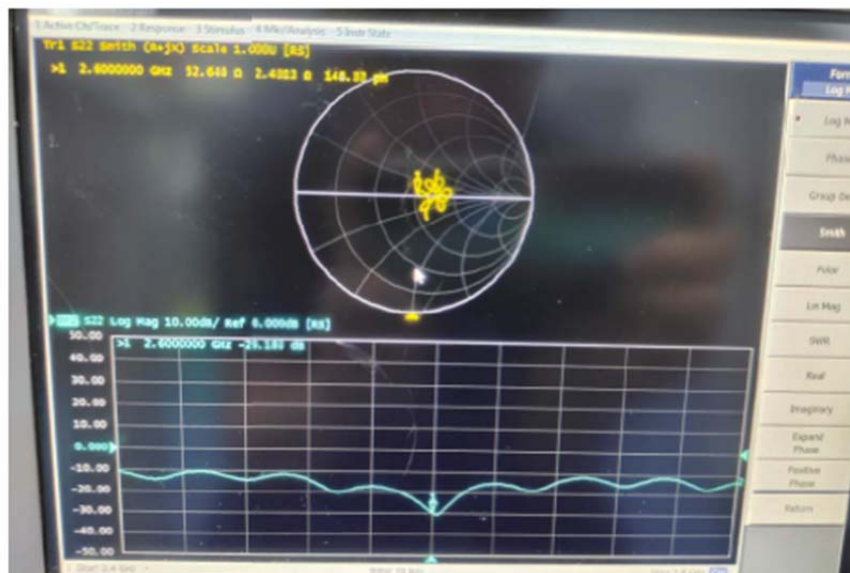
DUT Code:	ADK	Cal Date:	2024/3/26						
Description:	Antenna - Dipole	Temperature:	23.9°C						
Model:	D2600V2	Humidity:	51%						
Manufacturer:	SPEAG	Pressure:	101.9 kPa						
Certificate No.:	D2600V2-1206_Mar23	Tester:	Karl Gong	<i>Karl Gong</i>					
<b>TEST SPECIFICATIONS</b>									
Specification:	WP 438 SAR Dipole Verification	Version:	2020 - Rev 0						
Specification:		Version:							
<b>TEST PARAMETERS</b>									
Device Received In Tolerance:	Yes	Calibrated Frequency Range:	N/A	Next Cal Due Date:	2024/3/26				
<b>Equipment Used to perform Measure</b>									
Item:	Network Analyzer	Identifier:	NAM	Model:	8753B	Last Cal:	2023/10/17	Cal Due:	2024/10/16
Item:	Calibration Verification - Kit	Identifier:	NAM	Model:	85032F	Last Cal:	NCR	Cal Due:	NCR
Item:	Terminator	Identifier:	NANA	Model:	85032-10003	Last Cal:	2023/4/29	Cal Due:	2024/4/28
Item:		Identifier:		Model:		Last Cal:		Cal Due:	
Item:		Identifier:		Model:		Last Cal:		Cal Due:	
<b>COMMENTS, OPINIONS and INTERPRETATIONS</b>									
None									
<b>Measurement Uncertainty</b>									
	Probability Distribution	Impedance (dB)	Insertion Loss (dB)	Value (dB)	Value (+/- %)				
Expanded uncertainty U (level of confidence = 95%)	Normal(k=2)			0.93					
<b>RESULTS</b>									
Pass									
This measurement was a calibration verification. (Instrument parameters are within tolerances.) Measurements are traceable to the international System of Units (SI) via NIST									
CALIBRATION DATA ATTACHED									

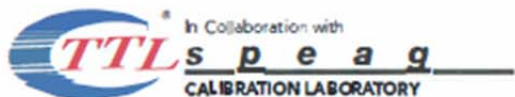
Per FCC KDB 865664 D01, calibration intervals of up to 3 years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements.

1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20 dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 3-year calibration period from calibration date.

		Return Loss		Real Impedance	Imaginary Impedance
D2600V2 - SN:1026	Measured Value (dB)	-29.186	Measured Value (Ω)	52.646	2.431
	Target Value (dB)	-32.698	Target Value (Ω)	48.148	1.322
	Devation (%)	-10.741	Devation (Ω)	4.498	1.109
	Limit (%)	±20	Limit (Ω)	5	5
	Limit (< dB)	20	Results	Pass	Pass
	Results	Pass			





In Collaboration with  
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 CALIBRATION  
 CNAS L0570



Client CCICT

Certificate No: 23J02Z80073

**CALIBRATION CERTIFICATE**

Object D3500V2 - SN: 1113

Calibration Procedure(s) FF-Z11-003-01  
 Calibration Procedures for dipole validation kits

Calibration date: October 18, 2023

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 (Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106276	15-May-23 (CTTL, No.J23X04183)	May-24
Power sensor NRP6A	101369	15-May-23 (CTTL, No.J23X04183)	May-24
Reference Probe EX3DV4	SN 3617	31-Mar-23(CTTL-SPEAG,No.Z23-60161)	Mar-24
DAE4	SN 1556	11-Jan-23(CTTL-SPEAG,No.Z23-60034)	Jan-24
Secondary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	05-Jan-23 (CTTL, No. J23X00107)	Jan-24
Network Analyzer E5071C	MY46110673	10-Jan-23 (CTTL, No. J23X00104)	Jan-24

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: October 31, 2023

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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:

- 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-mounted Wireless Communication Devices- Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020
- KDB 865664, "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	52.10.4
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	3500 MHz $\pm$ 1 MHz	

### Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.9	2.91 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	37.5 $\pm$ 6 %	2.87 mho/m $\pm$ 6 %
Head TSL temperature change during test	<1.0 °C	---	---

### SAR result with Head TSL

SAR averaged over 1 $cm^3$ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.63 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	66.4 W/kg $\pm$ 24.4 % ( $k=2$ )
SAR averaged over 10 $cm^3$ (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.53 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.3 W/kg $\pm$ 24.2 % ( $k=2$ )



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

**Antenna Parameters with Head TSL**

Impedance, transformed to feed point	49.7Ω+ 5.14jΩ
Return Loss	- 25.7dB

**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.047 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point 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 feed-point may be damaged.

**Additional EUT Data**

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

Date: 2023-10-18

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 3500 MHz; Type: D3500V2; Serial: D3500V2 - SN: 1113**

Communication System: UID 0, CW; Frequency: 3500 MHz

Medium parameters used:  $f = 3500 \text{ MHz}$ ;  $\sigma = 2.87 \text{ S/m}$ ;  $\epsilon_r = 37.52$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.02, 7.02, 7.02) @ 3500 MHz; Calibrated: 2023-03-31
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2023-01-11
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

**Dipole Calibration /Pin=100mW, d=10mm, f=3500 MHz/Zoom Scan,**

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

Reference Value = 60.39 V/m; Power Drift = -0.09 dB

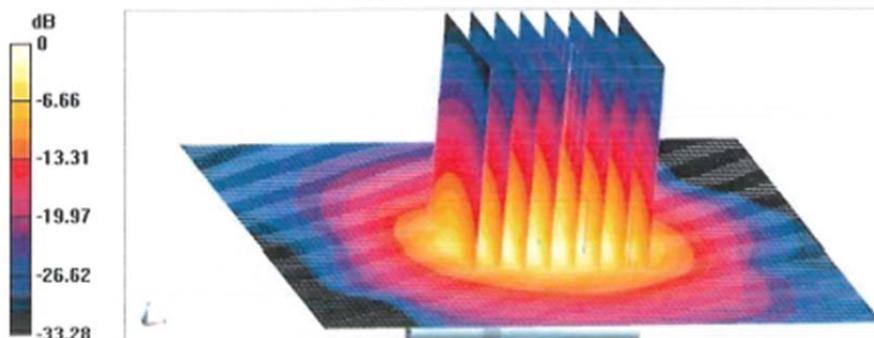
Peak SAR (extrapolated) = 17.4 W/kg

**SAR(1 g) = 6.63 W/kg; SAR(10 g) = 2.53 W/kg**

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

Ratio of SAR at M2 to SAR at M1 = 75.7%

Maximum value of SAR (measured) = 12.2 W/kg

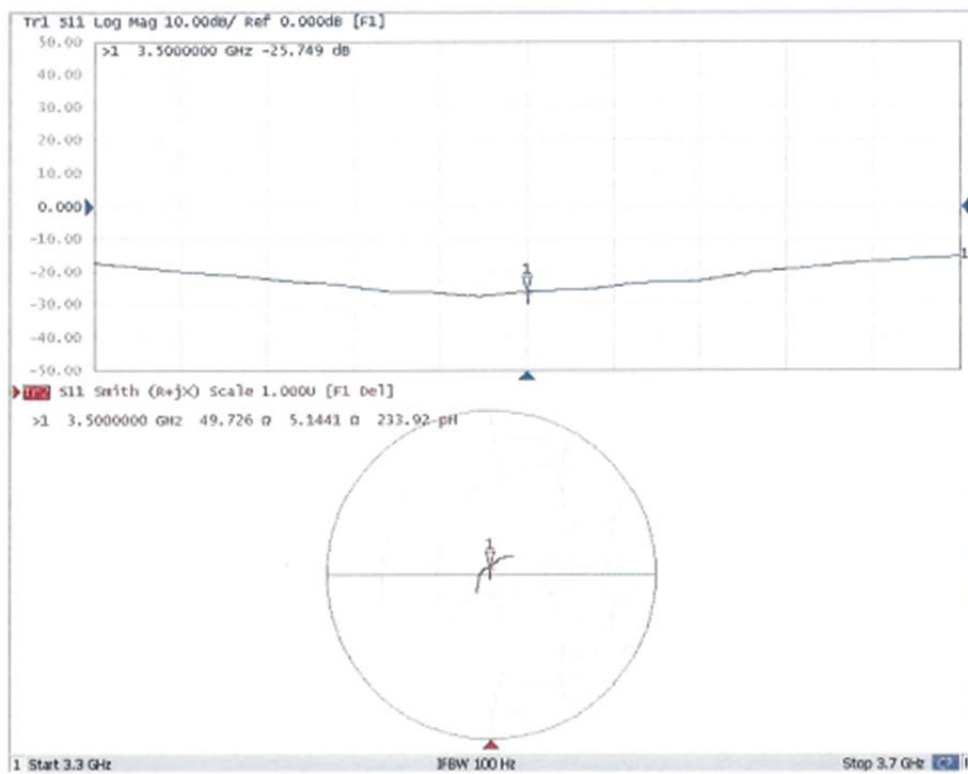


0 dB = 12.2 W/kg = 10.86 dBW/kg



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### Impedance Measurement Plot for Head TSL







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Client **CCICT**

Certificate No: **23J02Z80064**

<b>CALIBRATION CERTIFICATE</b>			
Object	D3900V2 - SN: 1058		
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits		
Calibration date:	September 26, 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>			
Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106276	15-May-23 (CTTL, No.J23X04183)	May-24
Power sensor NRP6A	101369	15-May-23 (CTTL, No.J23X04183)	May-24
Reference Probe EX3DV4	SN 3617	31-Mar-23(CTTL-SPEAG,No.Z23-60161)	Mar-24
DAE4	SN 1556	11-Jan-23(CTTL-SPEAG,No.Z23-60034)	Jan-24
Secondary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	05-Jan-23 (CTTL, No. J23X00107)	Jan-24
NetworkAnalyzer E5071C	MY46110673	10-Jan-23 (CTTL, No. J23X00104)	Jan-24
Calibrated by:	Name Zhao Jing	Function SAR Test Engineer	Signature 
Reviewed by:	Name Lin Hao	Function SAR Test Engineer	Signature 
Approved by:	Name Qi Dianyuan	Function SAR Project Leader	Signature 
Issued: October 4, 2023			
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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:

- 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-mounted Wireless Communication Devices- Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020
- KDB 865664, "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	52.10.4
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	3900 MHz ± 1 MHz	

**Head TSL parameters at 3900MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.5	3.32 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.8 ± 6 %	3.31 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

**SAR result with Head TSL at 3900MHz**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.88 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	68.6 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.0 W/kg ± 24.2 % (k=2)



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

**Antenna Parameters with Head TSL at 3900MHz**

Impedance, transformed to feed point	46.3Ω- 5.34jΩ
Return Loss	- 23.4dB

**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.008 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point 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 feed-point may be damaged.

**Additional EUT Data**

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

Date: 2023-09-26

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 3900 MHz; Type: D3900V2; Serial: D3900V2 - SN: 1058**

Communication System: UID 0, CW; Frequency: 3900 MHz

Medium parameters used:  $f = 3900$  MHz;  $\sigma = 3.309$  S/m;  $\epsilon_r = 36.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(6.76, 6.76, 6.76) @ 3900 MHz;  
Calibrated: 2023-03-31
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2023-01-11
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial:  
1062
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

**Dipole Calibration /Pin=100mW, d=10mm, f=3900 MHz/Zoom Scan,**

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

Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 67.56 V/m; Power Drift = -0.06 dB

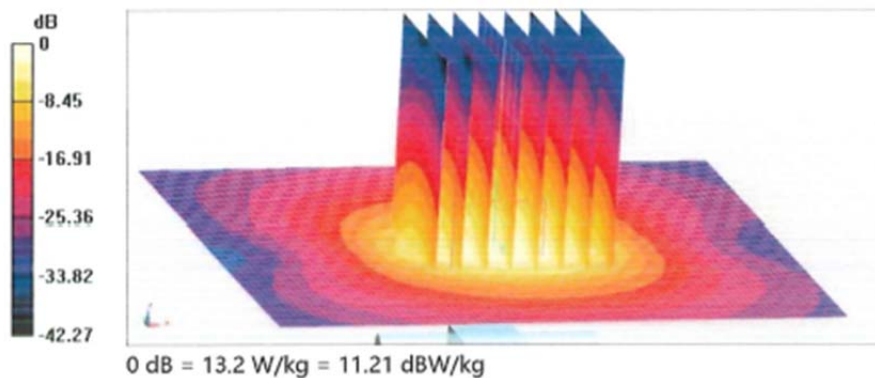
Peak SAR (extrapolated) = 19.8 W/kg

**SAR(1 g) = 6.88 W/kg; SAR(10 g) = 2.41 W/kg**

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

Ratio of SAR at M2 to SAR at M1 = 73.3%

Maximum value of SAR (measured) = 13.2 W/kg

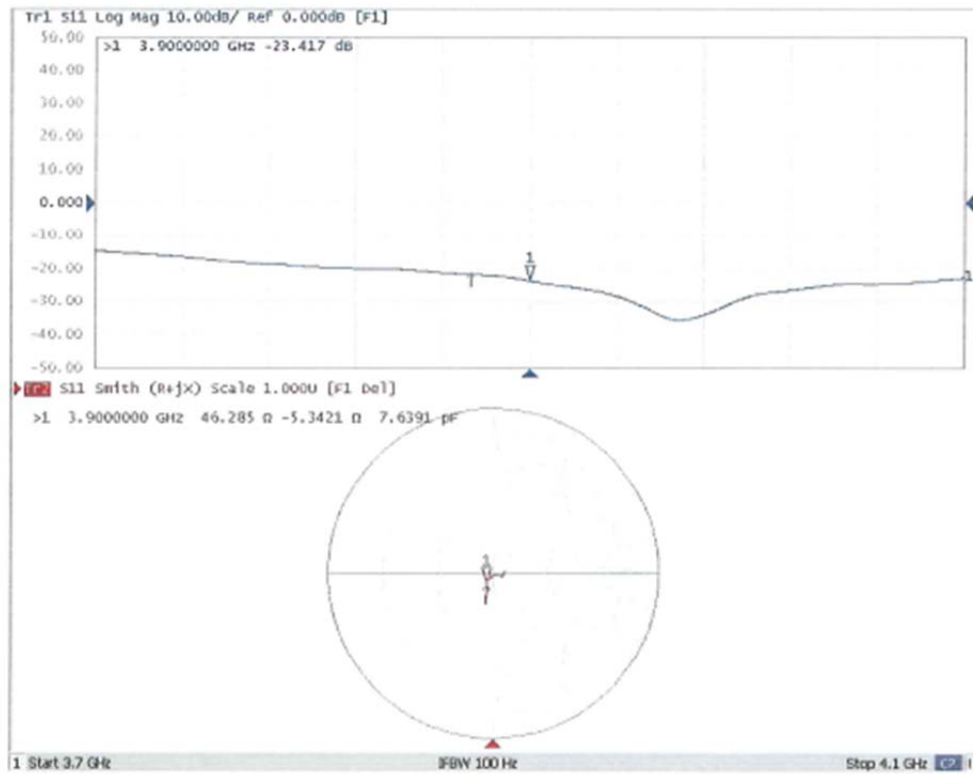






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### Impedance Measurement Plot for Head TSL





中国认可  
国际互认  
校准  
CALIBRATION  
CNAS L0570



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Client **BACL**

Certificate No: **J23Z60368**

**CALIBRATION CERTIFICATE**

Object **D5GHzV2 - SN: 1245**  
 Calibration Procedure(s) **FF-Z11-003-01**  
 Calibration Procedures for dipole validation kits  
 Calibration date: **August 23, 2023**

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 (Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	22-Sep-22 (CTTL, No.J22X09561)	Sep-23
Power sensor NRP8S	104291	22-Sep-22 (CTTL, No.J22X09561)	Sep-23
Reference Probe EX3DV4	SN 3617	31-Mar-23(CTTL-SPEAG,No.Z23-60161)	Mar-24
DAE4	SN 1556	11-Jan-23(CTTL-SPEAG,No.Z23-60034)	Jan-24
Secondary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	05-Jan-23 (CTTL, No. J23X00107)	Jan-24
NetworkAnalyzer E5071C	MY46110673	10-Jan-23 (CTTL, No. J23X00104)	Jan-24

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: August 30, 2023

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:**

- 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-mounted Wireless Communication Devices- Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020
- KDB 865664, "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.

<b>DASY Version</b>	DASY52	52.10.4
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Triple Flat Phantom 5.1C	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
<b>Frequency</b>	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

**Head TSL parameters at 5250MHz**

The following parameters and calculations were applied.

	<b>Temperature</b>	<b>Permittivity</b>	<b>Conductivity</b>
<b>Nominal Head TSL parameters</b>	22.0 °C	35.9	4.71 mho/m
<b>Measured Head TSL parameters</b>	(22.0 ± 0.2) °C	35.2 ± 6 %	4.63 mho/m ± 6 %
<b>Head TSL temperature change during test</b>	<1.0 °C	----	----

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

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	100 mW input power	7.84 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>78.0 W/kg ± 24.4 % (k=2)</b>
<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	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 ± 24.2 % (k=2)</b>





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**Head TSL parameters at 5600MHz**

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	34.6 ± 6 %	5.00 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

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

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>81.0 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	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>22.8 W/kg ± 24.2 % (k=2)</b>

**Head TSL parameters at 5750MHz**

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	34.4 ± 6 %	5.16 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

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

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.83 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>77.8 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	2.19 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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**Appendix (Additional assessments outside the scope of CNAS L0570)**

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

Impedance, transformed to feed point	47.0Ω- 2.60jΩ
Return Loss	- 27.8dB

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

Impedance, transformed to feed point	49.8Ω+ 3.05jΩ
Return Loss	- 30.3dB

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

Impedance, transformed to feed point	51.9Ω+ 0.96jΩ
Return Loss	- 33.5dB

**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.101 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point 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 feed-point may be damaged.

**Additional EUT Data**

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

Date: 2023-08-23

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1245**

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

Medium parameters used: f = 5250 MHz;  $\sigma = 4.627$  S/m;  $\epsilon_r = 35.17$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Medium parameters used: f = 5600 MHz;  $\sigma = 5$  S/m;  $\epsilon_r = 34.58$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Medium parameters used: f = 5750 MHz;  $\sigma = 5.162$  S/m;  $\epsilon_r = 34.36$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(5.5, 5.5, 5.5) @ 5250 MHz; ConvF(5.01, 5.01, 5.01) @ 5600 MHz; ConvF(5.15, 5.15, 5.15) @ 5750 MHz; Calibrated: 2023-03-31
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2023-01-11
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

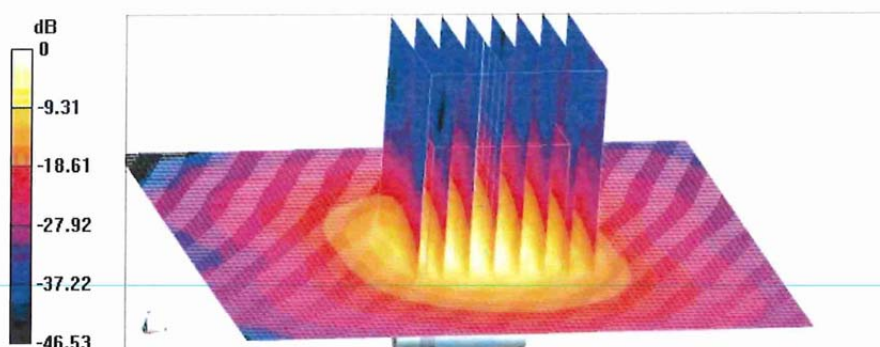
**Dipole Calibration /Pin=100mW, d=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
 Reference Value = 61.63 V/m; Power Drift = -0.08 dB  
 Peak SAR (extrapolated) = 31.2 W/kg  
**SAR(1 g) = 7.84 W/kg; SAR(10 g) = 2.22 W/kg**  
 Smallest distance from peaks to all points 3 dB below = 7.2 mm  
 Ratio of SAR at M2 to SAR at M1 = 65.4%  
 Maximum value of SAR (measured) = 18.5 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 = 61.43 V/m; Power Drift = -0.07 dB  
 Peak SAR (extrapolated) = 35.6 W/kg  
**SAR(1 g) = 8.15 W/kg; SAR(10 g) = 2.3 W/kg**  
 Smallest distance from peaks to all points 3 dB below = 7.2 mm  
 Ratio of SAR at M2 to SAR at M1 = 62.4%  
 Maximum value of SAR (measured) = 19.7 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 = 61.00 V/m; Power Drift = -0.03 dB  
Peak SAR (extrapolated) = 36.0 W/kg  
**SAR(1 g) = 7.83 W/kg; SAR(10 g) = 2.19 W/kg**  
Smallest distance from peaks to all points 3 dB below = 7.2 mm  
Ratio of SAR at M2 to SAR at M1 = 61%  
Maximum value of SAR (measured) = 19.8 W/kg



0 dB = 19.8 W/kg = 12.97 dBW/kg



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**Impedance Measurement Plot for Head TSL**

