No. I21N00886-SAR





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DASY5 Validation Report for Body TSL Test Laboratory: CTTL, Beijing, China DUT: Dipola 750 MHz: Type: D750V3: Soviel: D750V3 - SN: 1163

Date: 09.03.2019

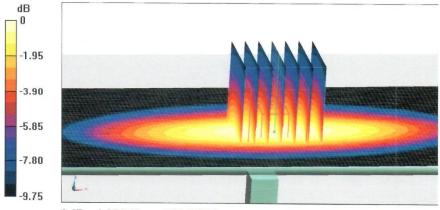
DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1163 Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1 Medium parameters used: f = 750 MHz; $\sigma = 0.942$ S/m; $\varepsilon_r = 55.87$; $\rho = 1000$ kg/m3 Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(9.85, 9.85, 9.85) @ 750 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/22/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

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

Reference Value = 52.88 V/m; Power Drift = 0.03 dBPeak SAR (extrapolated) = 3.20 W/kgSAR(1 g) = 2.16 W/kg; SAR(10 g) = 1.45 W/kgMaximum value of SAR (measured) = 2.85 W/kg



0 dB = 2.85 W/kg = 4.55 dBW/kg

Certificate No: Z19-60291

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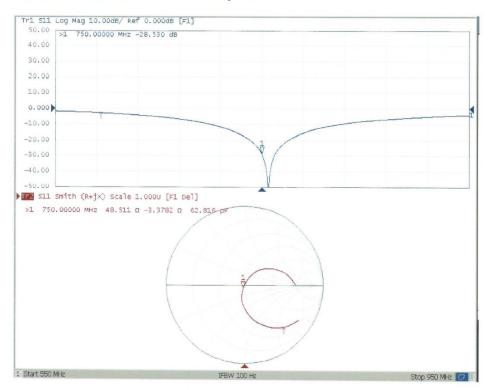


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Impedance Measurement Plot for Body TSL



Certificate No: Z19-60291

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835 MHz Dipole Calibration Certificate

Client CTTL	ttl.com http://	-86-10-62304633-2504 www.chinattl.en h) Certificate No: Z1	CNAS L057
		h) Certificate No: Z1	
CALIBRATION CI		And the second	8-60385
	ERTIFICAT	E	
Object	D835V	2 - SN: 4d057	
Calibration Procedure(s)	EE 711	-003-01	
		tion Procedures for dipole validation kits	
Calibration date:			
sansiatori date.	Octobe	er 9, 2018	
pages and are part of the ce	entincate.		
All calibrations have been humidity<70%.	conducted in	the closed laboratory facility: environment	temperature(22±3)°C ar
humidity<70%. Calibration Equipment used	(M&TE critical f	or calibration)	
numidity<70%. Calibration Equipment used Primary Standards	(M&TE critical f	or calibration) Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
numidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD	(M&TE critical for ID # 102083	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756)	Scheduled Calibration Oct-18
numidity<70%. Calibration Equipment used Primary Standards	(M&TE critical for ID # 102083 100542	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756)	Scheduled Calibration Oct-18 Oct-18
aumidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5	(M&TE critical for ID # 102083 100542	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756)	Scheduled Calibration Oct-18
Dumidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4	(M&TE critical f ID # 102083 100542 SN 7514	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 27-Aug-18(SPEAG,No.EX3-7514_Aug18)	Scheduled Calibration Oct-18 Oct-18 Aug-19
numidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4	(M&TE critical f ID # 102083 100542 SN 7514 SN 1555	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 27-Aug-18(SPEAG,No.EX3-7514_Aug18) 20-Aug-18(SPEAG,No.DAE4-1555_Aug18)	Scheduled Calibration Oct-18 Oct-18 Aug-19 Aug-19
Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4 Secondary Standards	(M&TE critical fr ID # 102083 100542 SN 7514 SN 1555 ID #	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 27-Aug-18(SPEAG,No.EX3-7514_Aug18) 20-Aug-18(SPEAG,No.DAE4-1555_Aug18) Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration Oct-18 Oct-18 Aug-19 Aug-19 Scheduled Calibration
numidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	(M&TE critical f ID # 102083 100542 SN 7514 SN 1555 ID # MY49071430 MY46110673	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 27-Aug-18(SPEAG,No.EX3-7514_Aug18) 20-Aug-18(SPEAG,No.DAE4-1555_Aug18) Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560) 24-Jan-18 (CTTL, No.J18X00561)	Scheduled Calibration Oct-18 Oct-18 Aug-19 Aug-19 Scheduled Calibration Jan-19 Jan-19
Aumidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	(M&TE critical f 10 # 102083 100542 SN 7514 SN 1555 ID # MY49071430 MY46110673 Name	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 27-Aug-18(SPEAG,No.EX3-7514_Aug18) 20-Aug-18(SPEAG,No.DAE4-1555_Aug18) Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560) 24-Jan-18 (CTTL, No.J18X00561)	Scheduled Calibration Oct-18 Oct-18 Aug-19 Aug-19 Scheduled Calibration Jan-19 Jan-19 Signature
aumidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	(M&TE critical f ID # 102083 100542 SN 7514 SN 1555 ID # MY49071430 MY46110673	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 27-Aug-18(SPEAG,No.EX3-7514_Aug18) 20-Aug-18(SPEAG,No.DAE4-1555_Aug18) Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560) 24-Jan-18 (CTTL, No.J18X00561)	Scheduled Calibration Oct-18 Oct-18 Aug-19 Aug-19 Scheduled Calibration Jan-19 Jan-19
aumidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	(M&TE critical f 10 # 102083 100542 SN 7514 SN 1555 ID # MY49071430 MY46110673 Name	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 27-Aug-18(SPEAG,No.EX3-7514_Aug18) 20-Aug-18(SPEAG,No.DAE4-1555_Aug18) Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560) 24-Jan-18 (CTTL, No.J18X00561)	Scheduled Calibration Oct-18 Oct-18 Aug-19 Aug-19 Scheduled Calibration Jan-19 Jan-19 Signature

Certificate No: Z18-60385

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Glossary:

TSLtissue simulating liquidConvFsensitivity in TSL / NORMx,y,zN/Anot applicable or not measured

Calibration is Performed According to the Following Standards:

- a) 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
- b) 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
- c) 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
- d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) 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	52.10.1.1476
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.2 ± 6 %	0.91 mho/m ± 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	250 mW input power	2.42 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.62 mW /g ± 18.8 % (k=2)
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.58 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.29 mW /g ± 18.7 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.9 ± 6 %	0.99 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C		

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.51 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.90 mW /g ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.66 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.56 mW /g ± 18.7 % (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	49.6Ω- 4.08jΩ	
Return Loss	- 27.7dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.8Ω- 4.96jΩ	
Return Loss	- 24.3dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.260 ns	
	1.200 113	

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 Test Laboratory: CTTL, Beijing, China

Date: 10.08.2018

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d057

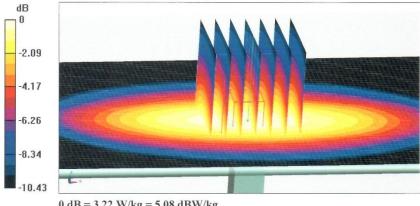
Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1 Medium parameters used: f = 835 MHz; $\sigma = 0.912$ S/m; $\epsilon_r = 42.22$; $\rho = 1000$ kg/m3 Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 SN7514; ConvF(9.09, 9.09, 9.09) @ 835 MHz; Calibrated: 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/20/2018
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

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

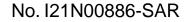
Reference Value = 55.57 V/m; Power Drift = -0.04 dB Peak SAR (extrapolated) = 3.61 W/kgSAR(1 g) = 2.42 W/kg; SAR(10 g) = 1.58 W/kgMaximum value of SAR (measured) = 3.22 W/kg



0 dB = 3.22 W/kg = 5.08 dBW/kg

Certificate No: Z18-60385

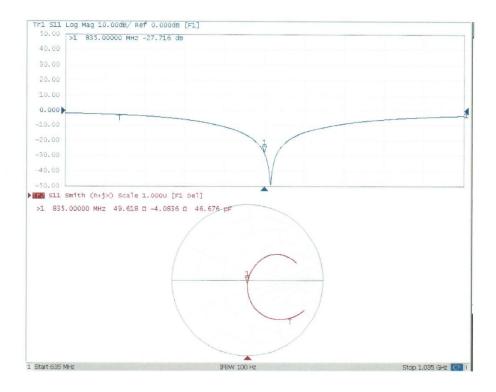
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Impedance Measurement Plot for Head TSL



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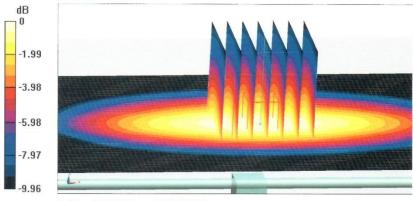
Date: 10.08.2018

DASY5 Configuration:

- Probe: EX3DV4 SN7514; ConvF(9.47, 9.47, 9.47) @ 835 MHz; Calibrated: 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/20/2018
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/**Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 56.64 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.83 W/kgSAR(1 g) = 2.51 W/kg; SAR(10 g) = 1.66 W/kgMaximum value of SAR (measured) = 3.36 W/kg



0 dB = 3.36 W/kg = 5.26 dBW/kg

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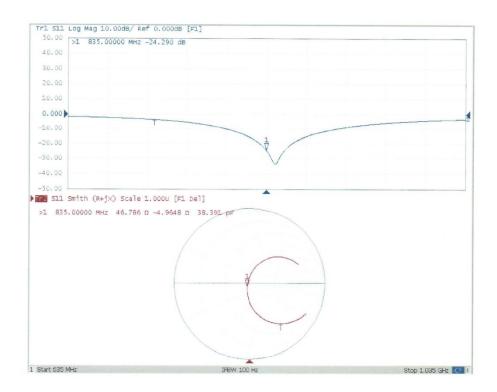




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Impedance Measurement Plot for Body TSL



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1750 MHz Dipole Calibration Certificate

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Client CTTL(S	South Branch) Certificate No: Z19	-60292
ALIBRATION CE	RTIFICAT	E	
Dbject	D1750V	/2 - SN: 1152	
Calibration Procedure(s)	FF-Z11- Calibrat	-003-01 ion Procedures for dipole validation kits	
Calibration date:	August	30, 2019	
bages and are part of the ce	rtificate.		
numidity<70%.	conducted in t	the closed laboratory facility: environment	temperature(22±3)°C an
All calibrations have been numidity<70%. Calibration Equipment used	conducted in t	or calibration)	
ul calibrations have been umidity<70%. Calibration Equipment used Primary Standards	Conducted in the conduc	or calibration) Cal Date(Calibrated by, Certificate No.)	
Il calibrations have been umidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2	conducted in t	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605)	Scheduled Calibration
Il calibrations have been umidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A	Conducted in the conducted in the conducted in the conducted in the conducted for th	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605)	Scheduled Calibration Apr-20
ul calibrations have been umidity<70%. Calibration Equipment used Primary Standards	Conducted in 1 (M&TE critical for ID # 106276 101369	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605)	Scheduled Calibration Apr-20 Apr-20
Il calibrations have been umidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4	conducted in 1 (M&TE critical fo ID # 106276 101369 SN 3617	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19(SPEAG,No.EX3-3617_Jan19)	Scheduled Calibration Apr-20 Apr-20 Jan-20 Aug-20
Il calibrations have been iumidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4	Conducted in 1 (M&TE critical for ID # 106276 101369 SN 3617 SN 1555	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19(SPEAG,No.EX3-3617_Jan19) 22-Aug-19(CTTL-SPEAG,No.Z19-60295)	Scheduled Calibration Apr-20 Apr-20 Jan-20 Aug-20
All calibrations have been numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards	Conducted in 1 (M&TE critical for 10 # 106276 101369 SN 3617 SN 1555 ID #	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19(SPEAG,No.EX3-3617_Jan19) 22-Aug-19(CTTL-SPEAG,No.Z19-60295) Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration Apr-20 Apr-20 Jan-20 Aug-20 Scheduled Calibration
All calibrations have been numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	conducted in f (M&TE critical fo ID # 106276 101369 SN 3617 SN 1555 ID # MY49071430	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19 (CTTL, No.J19X02605) 22-Aug-19 (CTTL-SPEAG,No.Z19-60295) Cal Date(Calibrated by, Certificate No.) 23-Jan-19 (CTTL, No.J19X00336)	Scheduled Calibration Apr-20 Apr-20 Jan-20 Aug-20 Scheduled Calibration Jan-20
All calibrations have been numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	conducted in t (M&TE critical for 106276 101369 SN 3617 SN 1555 ID # MY49071430 MY46110673	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19(SPEAG,No.EX3-3617_Jan19) 22-Aug-19(CTTL-SPEAG,No.Z19-60295) Cal Date(Calibrated by, Certificate No.) 23-Jan-19 (CTTL, No.J19X00336) 24-Jan-19 (CTTL, No.J19X00547)	Scheduled Calibration Apr-20 Jan-20 Aug-20 Scheduled Calibration Jan-20 Jan-20
All calibrations have been numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	conducted in 1 (M&TE critical for 10 # 106276 101369 SN 3617 SN 1555 ID # MY49071430 MY46110673 Name	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19 (CTTL, No.J19X02605) 32-Aug-19 (CTTL-SPEAG,No.Z19-60295) Cal Date(Calibrated by, Certificate No.) 23-Jan-19 (CTTL, No.J19X00336) 24-Jan-19 (CTTL, No.J19X00547) Function	Scheduled Calibration Apr-20 Jan-20 Aug-20 Scheduled Calibration Jan-20 Jan-20

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Glossary:

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

Calibration is Performed According to the Following Standards:

- a) 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
- b) 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
- c) 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
- d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) 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%.

Certificate No: Z19-60292

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Measurement Conditions

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

DASY Version	DASY52	V52.10.2
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	1750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittiv	ity C	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1	.37 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.9 ± 6	% 1.3	6 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C			
R result with Head TSL				
SAR averaged over 1 cm ³ (1 g) of Head TSL	Conc	lition		
SAR measured	250 mW i	input power	9.05	5 W/kg
SAR for nominal Head TSL parameters	normaliz	ed to 1W	36.4 W/kg	± 18.8 % (k=2)
SAR averaged over 10 cm^3 (10 g) of Head T	SL Cond	dition		

250 mW input power

normalized to 1W

4.80 W/kg

19.3 W/kg ± 18.7 % (k=2)

SAR measured

Body TSL parameters The following parameters and calculations were applied.

SAR for nominal Head TSL parameters

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.1 ± 6 %	1.52 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C		

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.45 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.3 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.05 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.0 W/kg ± 18.7 % (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	49.1Ω- 0.84 jΩ
Return Loss	- 38.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.2Ω- 1.37 jΩ	
Return Loss	- 25.5 dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.084 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

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DASY5 Validation Report for Head TSL

Date: 08.30.2019

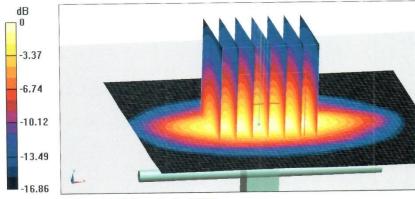
Test Laboratory: CTTL, Beijing, China **DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1152** Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1750 MHz; $\sigma = 1.358$ S/m; $\epsilon_r = 39.91$; $\rho = 1000$ kg/m3 Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(8.38, 8.38, 8.38) @ 1750 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/22/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 97.38 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 16.8 W/kg SAR(1 g) = 9.05 W/kg; SAR(10 g) = 4.8 W/kg

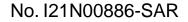
Maximum value of SAR (measured) = 13.9 W/kg



0 dB = 13.9 W/kg = 11.43 dBW/kg

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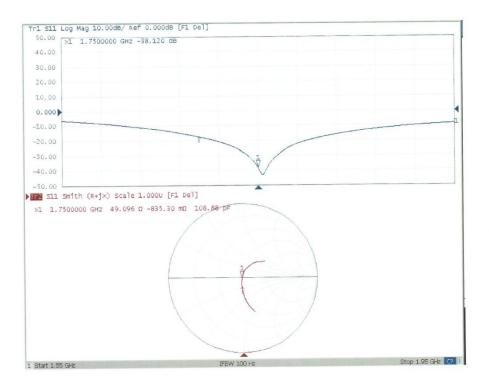


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Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL Test Laboratory: CTTL, Beijing, China

Date: 08.30.2019

Test Laboratory: CTTL, Beijing, China **DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1152**Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium parameters used: f = 1750 MHz; σ = 1.516 S/m; ϵ_r = 53.05; ρ = 1000 kg/m3

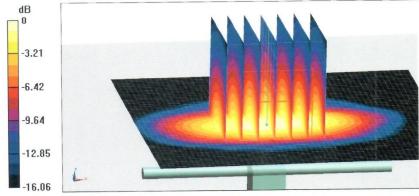
Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(8.03, 8.03, 8.03) @ 1750 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/22/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 87.16 V/m; Power Drift = 0.06 dBPeak SAR (extrapolated) = 17.0 W/kgSAR(1 g) = 9.45 W/kg; SAR(10 g) = 5.05 W/kgMaximum value of SAR (measured) = 14.4 W/kg



0 dB = 14.4 W/kg = 11.58 dBW/kg

Certificate No: Z19-60292

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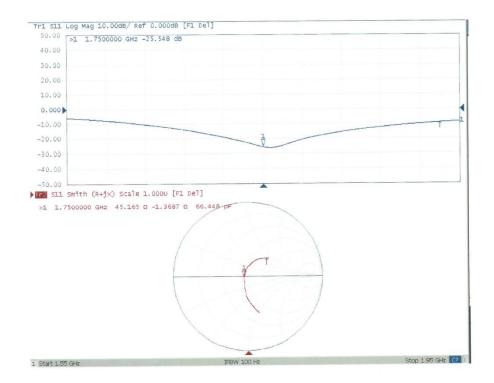


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Impedance Measurement Plot for Body TSL



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1900 MHz Dipole Calibration Certificate

	CALIBRA		中国认可国际互认
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Client CT	TL(South Bran		8-60387
CALIBRATION C	ERTIFICAT	TE	
Object	D1900	V2 - SN: 5d088	
Calibration Procedure(s)	FF-Z11	1-003-01	
	Calibra	ation Procedures for dipole validation kits	
Calibration date:	Octobe	er 24, 2018	
measurements(SI). The me pages and are part of the ce	asurements and ertificate.	traceability to national standards, which rea the uncertainties with confidence probability	are given on the following
Il calibrations have been	conducted in		
All calibrations have been numidity<70%. Calibration Equipment used			temperature(22±3) C and
numidity<70%. Calibration Equipment used		or calibration)	
numidity<70%. Calibration Equipment used	I (M&TE critical f		Scheduled Calibration
numidity<70%. Calibration Equipment used Primary Standards	I (M&TE critical fo	or calibration) Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
numidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD	I (M&TE critical fr ID # 102083 100542	or calibration) Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756)	Scheduled Calibration Oct-18
numidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5	I (M&TE critical fr ID # 102083 100542	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756)	Scheduled Calibration Oct-18 Oct-18 Aug-19
Primary Standards Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4	I (M&TE critical fr ID # 102083 100542 SN 7514	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 27-Aug-18(SPEAG,No.EX3-7514_Aug18)	Scheduled Calibration Oct-18 Oct-18 Aug-19
Primary Standards Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4	I (M&TE critical fr ID # 102083 100542 SN 7514 SN 1555	or calibration) Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 27-Aug-18(SPEAG,No.EX3-7514_Aug18) 20-Aug-18(SPEAG,No.DAE4-1555_Aug18)	Scheduled Calibration Oct-18 Oct-18 Aug-19 Aug-19
numidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	I (M&TE critical fr ID # 102083 100542 SN 7514 SN 1555 ID #	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 27-Aug-18(SPEAG,No.EX3-7514_Aug18) 20-Aug-18(SPEAG,No.DAE4-1555_Aug18) Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration Oct-18 Oct-18 Aug-19 Aug-19 Scheduled Calibration
numidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4 Secondary Standards	I (M&TE critical fr ID # 102083 100542 SN 7514 SN 1555 ID # MY49071430	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 27-Aug-18(SPEAG,No.EX3-7514_Aug18) 20-Aug-18(SPEAG,No.DAE4-1555_Aug18) Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560)	Scheduled Calibration Oct-18 Oct-18 Aug-19 Aug-19 Scheduled Calibration Jan-19
numidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	I (M&TE critical f ID # 102083 100542 SN 7514 SN 1555 ID # MY49071430 MY46110673	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 27-Aug-18(SPEAG,No.EX3-7514_Aug18) 20-Aug-18(SPEAG,No.DAE4-1555_Aug18) Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560) 24-Jan-18 (CTTL, No.J18X00561)	Scheduled Calibration Oct-18 Oct-18 Aug-19 Aug-19 Scheduled Calibration Jan-19 Jan-19
Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	I (M&TE critical fr ID # 102083 100542 SN 7514 SN 1555 ID # MY49071430 MY46110673 Name	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 27-Aug-18(SPEAG,No.EX3-7514_Aug18) 20-Aug-18(SPEAG,No.DAE4-1555_Aug18) Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560) 24-Jan-18 (CTTL, No.J18X00561) Function	Scheduled Calibration Oct-18 Oct-18 Aug-19 Aug-19 Scheduled Calibration Jan-19 Jan-19
Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	I (M&TE critical fr ID # 102083 100542 SN 7514 SN 1555 ID # MY49071430 MY46110673 Name Zhao Jing	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 27-Aug-18(SPEAG,No.EX3-7514_Aug18) 20-Aug-18(SPEAG,No.DAE4-1555_Aug18) Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560) 24-Jan-18 (CTTL, No.J18X00561) Function SAR Test Engineer	Scheduled Calibration Oct-18 Oct-18 Aug-19 Aug-19 Scheduled Calibration Jan-19 Jan-19
Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C Calibrated by:	I (M&TE critical fr ID # 102083 100542 SN 7514 SN 1555 ID # MY49071430 MY46110673 Name Zhao Jing Lin Hao	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 27-Aug-18(SPEAG,No.EX3-7514_Aug18) 20-Aug-18(SPEAG,No.DAE4-1555_Aug18) Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560) 24-Jan-18 (CTTL, No.J18X00561) Function SAR Test Engineer SAR Test Engineer	Scheduled Calibration Oct-18 Oct-18 Aug-19 Aug-19 Scheduled Calibration Jan-19 Jan-19 Jan-19 Jan-4 HAR

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los TSI

lossary:	
TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- a) 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
- b) 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
- c) 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
- d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) 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	52.10.2.1495
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	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

Temperature	Permittivity	Conductivity
22.0 °C	40.0	1.40 mho/m
(22.0 ± 0.2) °C	41.1 ± 6 %	1.37 mho/m ± 6 %
<1.0 °C		
	22.0 °C (22.0 ± 0.2) °C	22.0 °C 40.0 (22.0 ± 0.2) °C 41.1 ± 6 %

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.92 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	40.5 mW /g ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.17 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	21.0 mW /g ± 18.7 % (k=2)

Body TSL parameters The following parameters and calculations were applied.

	Te	emperature	Permitti	vity	Conductivity
Nominal Body TSL parameters		22.0 °C	53.3		1.52 mho/m
Measured Body TSL parameters	(22	.0 ± 0.2) °C	52.6 ± 6	s %	1.55 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C				
R result with Body TSL					
SAR averaged over 1 cm^3 (1 g) of Body TSL		Condit	ion		
SAR measured		250 mW in	put power		10.3 mW / g
SAR for nominal Body TSL parameters		normalize	d to 1W	40.6 1	mW /g ± 18.8 % (k=2
SAR averaged over 10 cm^3 (10 g) of Body T	SL	Condit	ion		
SAR measured		250 mW inj	out power		5.41 mW / g
SAR for nominal Body TSL parameters		normalized	d to 1W	21.4 r	nW /g ± 18.7 % (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	52.7Ω+ 6.63jΩ	
Return Loss	- 23.2dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.5Ω+ 7.40jΩ
Return Loss	- 22.3dB

General Antenna Parameters and Design

FILL I DI CONTRA	
Electrical Delay (one direction)	1.058 ns
	1.000 110

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 Test Laboratory: CTTL, Beijing, China

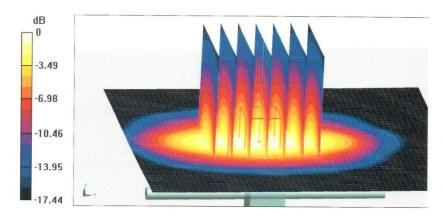
Date: 10.24.2018

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d088 Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1900 MHz; $\sigma = 1.367$ S/m; $\varepsilon_r = 41.1$; $\rho = 1000$ kg/m3 Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 SN7514; ConvF(7.73, 7.73, 7.73) @ 1900 MHz; Calibrated: 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/20/2018
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 102.2 V/m; Power Drift = 0.05 dB Peak SAR (extrapolated) = 19.0 W/kg SAR(1 g) = 9.92 W/kg; SAR(10 g) = 5.17 W/kgMaximum value of SAR (measured) = 15.7 W/kg



0 dB = 15.7 W/kg = 11.96 dBW/kg

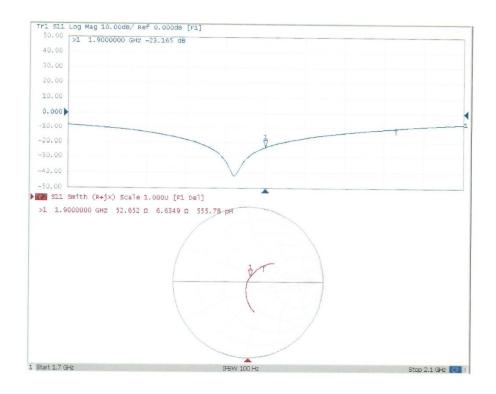
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Impedance Measurement Plot for Head TSL



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Date: 10.24.2018

DASY5 Validation Report for Body TSL Test Laboratory: CTTL, Beijing, China DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d088 Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

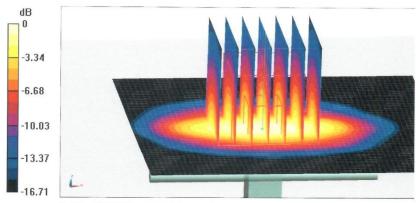
Medium parameters used: f = 1900 MHz; σ = 1.551 S/m; ϵ_r = 52.63; ρ = 1000 kg/m3 Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 SN7514; ConvF(7.53, 7.53, 7.53) @ 1900 MHz; Calibrated: 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/20/2018
- . Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 97.60 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 19.0 W/kg SAR(1 g) = 10.3 W/kg; SAR(10 g) = 5.41 W/kgMaximum value of SAR (measured) = 15.9 W/kg



0 dB = 15.9 W/kg = 12.01 dBW/kg

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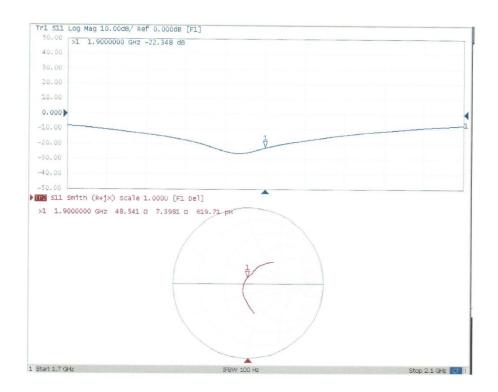


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Impedance Measurement Plot for Body TSL



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