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E-mail: ctl@chinatl.com [Http://www.chinatl.cn](http://www.chinatl.cn)

DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3842

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	67.2
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

1.2. D900V2 Dipole Calibration Certificate



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CNAS L0570

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 E-mail: cttl@chinattl.com http://www.chinattl.cn

Client **CIQ(Shenzhen)** Certificate No: **Z17-97207**

CALIBRATION CERTIFICATE

Object **D900V2 - SN:1d129**

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

Calibration date: **October 27, 2017**

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 NRVD	102196	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Power sensor NRV-Z5	100596	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Reference Probe EX3DV4	SN 7307	17-Mar-17(CTTL-SPEAG,No.Z17-97028)	Mar-18
DAE3	SN 536	09-Oct-17(CTTL-SPEAG,No.Z17-97198)	Oct-18

Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No.J17X00286)	Jan-18
Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan-18

	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 30, 2017

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Certificate No: Z17-97207

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Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM _{x,y,z}
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- a) 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, "Procedure to measure the Specific Absorption Rate (SAR) For hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005
- 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	52.10.0.1446
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	900 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.97 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	42.1 $\pm$ 6 %	0.98 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	250 mW input power	2.70 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	10.7 mW / g $\pm$ 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.73 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.88 mW / g $\pm$ 18.7 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.0	1.05 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.1 $\pm$ 6 %	1.03 mho/m $\pm$ 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	2.69 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	10.9 mW / g $\pm$ 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.75 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	7.08 mW / g $\pm$ 18.7 % (k=2)

Certificate No: Z17-97207

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.0Ω- 3.57jΩ
Return Loss	- 28.5dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.8Ω- 4.28jΩ
Return Loss	- 24.1dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.518 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: 10.27.2017

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN: 1d129

Communication System: UID 0, CW; Frequency: 900 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 900 \text{ MHz}$; $\sigma = 0.984 \text{ S/m}$; $\epsilon_r = 42.05$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(9.76,9.76,9.76); Calibrated: 3/17/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 10/9/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

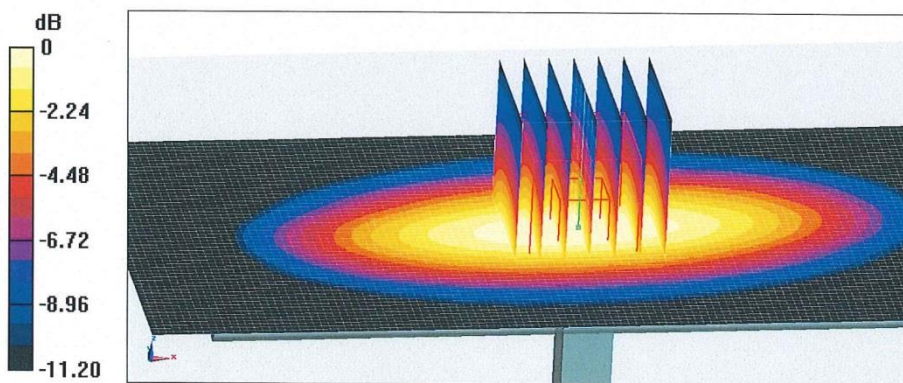
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 59.53 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 4.26 W/kg

SAR(1 g) = 2.7 W/kg; SAR(10 g) = 1.73 W/kg

Maximum value of SAR (measured) = 3.70 W/kg



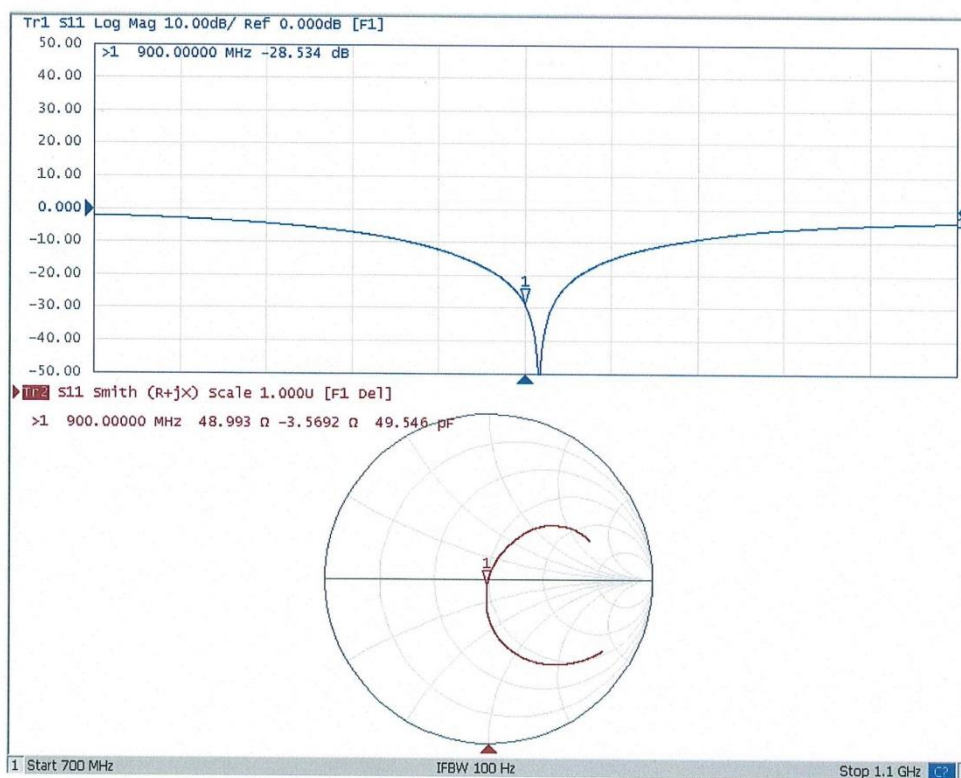
0 dB = 3.70 W/kg = 5.68 dBW/kg



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Impedance Measurement Plot for Head TSL



Certificate No: Z17-97207

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DASY5 Validation Report for Body TSL

Date: 10.27.2017

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN: 1d129

Communication System: UID 0, CW; Frequency: 900 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 900 \text{ MHz}$; $\sigma = 1.026 \text{ S/m}$; $\epsilon_r = 54.12$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(9.89, 9.89, 9.89); Calibrated: 3/17/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 10/9/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

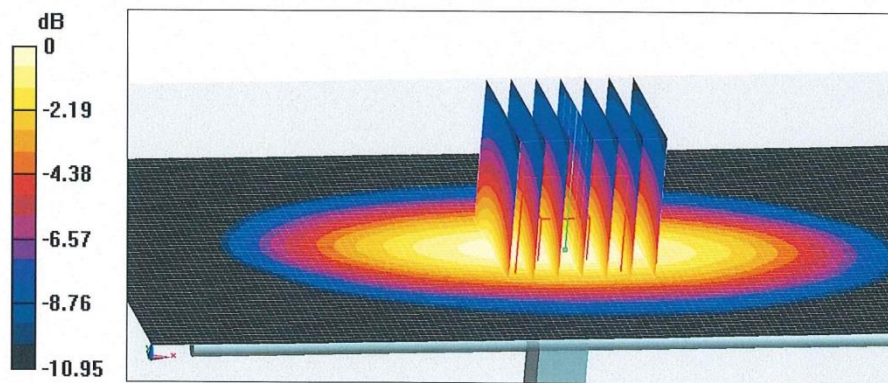
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 57.71 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 4.22 W/kg

SAR(1 g) = 2.69 W/kg; SAR(10 g) = 1.75 W/kg

Maximum value of SAR (measured) = 3.67 W/kg



0 dB = 3.67 W/kg = 5.65 dBW/kg

Certificate No: Z17-97207

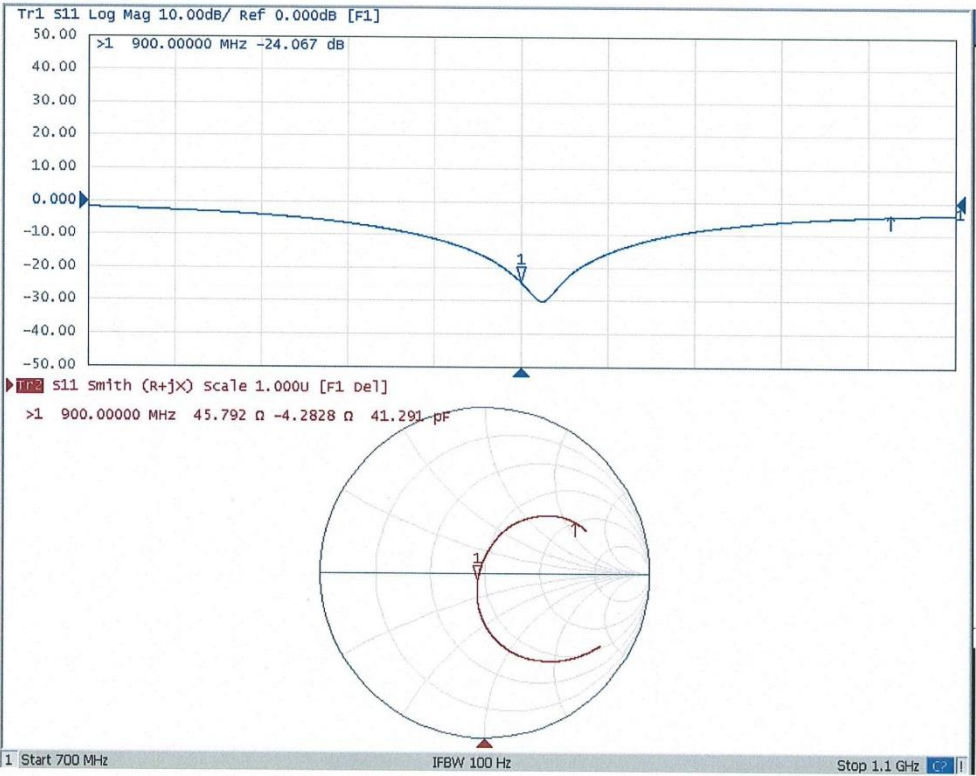
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Impedance Measurement Plot for Body TSL



1.3. D1750V2 Dipole Calibration Certificate

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E-mail: cttl@chinattl.com http://www.chinattl.cn

Client **CIQ(Shenzhen)** Certificate No: **Z17-97208**

CALIBRATION CERTIFICATE

Object: D1750V2 - SN: 1062

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

Calibration date: October 26, 2017

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)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102196	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Power sensor NRV-Z5	100596	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Reference Probe EX3DV4	SN 7307	17-Mar-17(CTTL-SPEAG,No.Z17-97028)	Mar-18
DAE3	SN 536	09-Oct-17(CTTL-SPEAG,No.Z17-97198)	Oct-18

Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No.J17X00286)	Jan-18
Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan-18

Calibrated by: Zhao Jing SAR Test Engineer

Reviewed by: Lin Hao SAR Test Engineer

Approved by: Qi Dianyuan SAR Project Leader



Issued: October 29, 2017

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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:

- 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	52.10.0.1446
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 $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.7 $\pm$ 6 %	1.37 mho/m $\pm$ 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.14 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	36.6 mW / g $\pm$ 18.8 % (k=2)
SAR averaged over 10 cm³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	4.86 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	19.4 mW / g $\pm$ 18.7 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.8 $\pm$ 6 %	1.46 mho/m $\pm$ 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.27 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	37.6 mW / g $\pm$ 18.8 % (k=2)
SAR averaged over 10 cm³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	4.94 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	19.9 mW / g $\pm$ 18.7 % (k=2)

Certificate No: Z17-97208

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.5Ω- 1.43 jΩ
Return Loss	- 33.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.1Ω- 0.22 jΩ
Return Loss	- 25.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.324 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: 10.26.2017

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1062

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.365$ S/m; $\epsilon_r = 39.72$; $\rho = 1000$ kg/m³

Phantom section: Left Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(8.63,8.63,8.63); Calibrated: 3/17/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 10/9/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid:

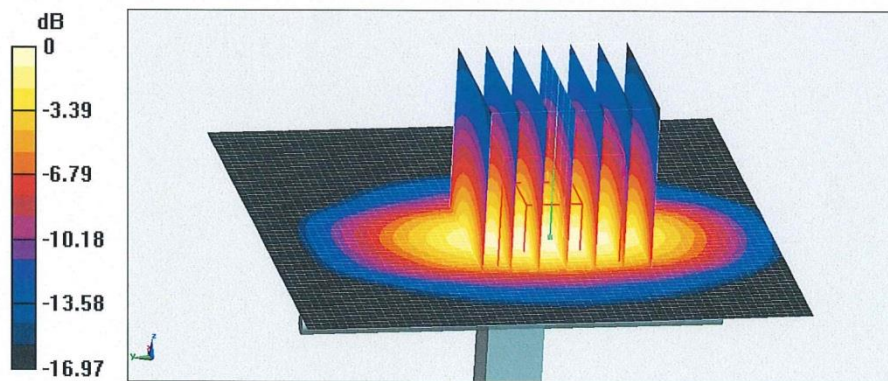
dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.07 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 16.8 W/kg

SAR(1 g) = 9.14 W/kg; SAR(10 g) = 4.86 W/kg

Maximum value of SAR (measured) = 14.1 W/kg

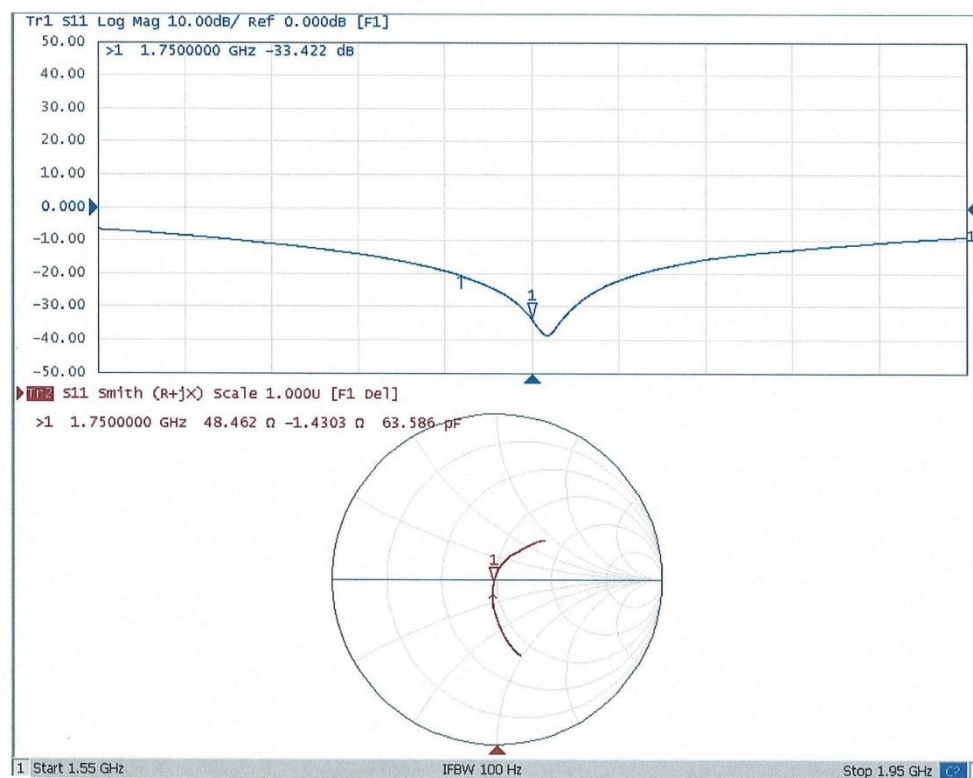
**0 dB = 14.1 W/kg = 11.49 dBW/kg**



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Impedance Measurement Plot for Head TSL





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DASY5 Validation Report for Body TSL

Date: 10.26.2017

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1062

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 1750 \text{ MHz}$; $\sigma = 1.462 \text{ S/m}$; $\epsilon_r = 53.78$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(8.35, 8.35, 8.35); Calibrated: 3/17/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 10/9/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid:

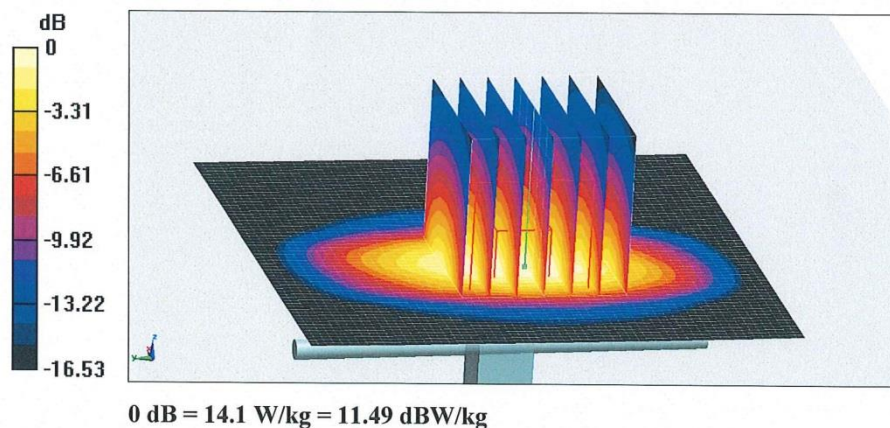
dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.81 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 16.9 W/kg

SAR(1 g) = 9.27 W/kg; SAR(10 g) = 4.94 W/kg

Maximum value of SAR (measured) = 14.1 W/kg

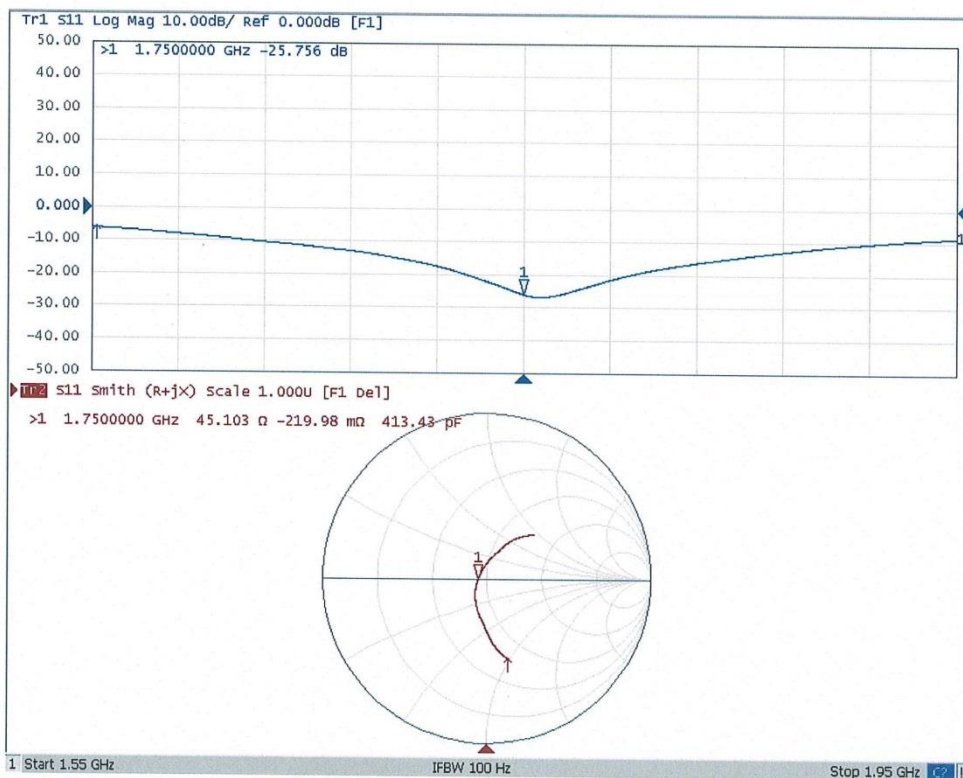




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E-mail: cttl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Body TSL



1.4. D1900V2 Dipole Calibration Certificate



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国际互认
校准
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CNAS L0570

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E-mail: cttl@chinattl.com http://www.chinattl.cn

Client

CIQ(Shenzhen)

Certificate No: Z17-97209

CALIBRATION CERTIFICATE

Object D1900V2 - SN: 5d150

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

Calibration date: October 26, 2017

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 NRVD	102196	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Power sensor NRV-Z5	100596	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Reference Probe EX3DV4	SN 7307	17-Mar-17(CTTL-SPEAG,No.Z17-97028)	Mar-18
DAE3	SN 536	09-Oct-17(CTTL-SPEAG,No.Z17-97198)	Oct-18
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No.J17X00286)	Jan-18
Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan-18

	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 29, 2017

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

Certificate No: Z17-97209

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