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CNAS L0570

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Client **BTL Inc.**

Certificate No: **Z18-60374**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN: 1221**

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

Calibration date: **September 28, 2018**

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	102083	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
Power sensor NRP-Z91	100542	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
ReferenceProbe EX3DV4	SN 7514	27-Aug-18(SPEAG,No.EX3-7514_Aug18)	Aug-19
DAE4	SN 1555	20-Aug-18(SPEAG,No.DAE4-1555_Aug18)	Aug-19
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-18 (CTTL, No.J18X00560)	Jan-19
NetworkAnalyzerE5071C	MY46110673	24-Jan-18 (CTTL, No.J18X00561)	Jan-19

	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: September 31, 2018

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



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	52.10.1.1476
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	5200 MHz ± 1 MHz 5300 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.1 ± 6 %	4.75 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.71 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	76.8 mW / g ± 24.4 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.21 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	22.0 mW / g ± 24.2 % (k=2)



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Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.9 ± 6 %	4.86 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.94 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	79.0 mW / g ± 24.4 % (k=2)
SAR averaged over 10 cm³ (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.27 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	22.6 mW / g ± 24.2 % (k=2)

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.5 ± 6 %	5.19 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.07 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	80.3 mW / g ± 24.4 % (k=2)
SAR averaged over 10 cm³ (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.31 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	23.0 mW / g ± 24.2 % (k=2)



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Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.3 ± 6 %	5.41 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.72 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	76.9 mW /g ± 24.4 % (k=2)
SAR averaged over 10 cm³ (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.20 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	21.9 mW /g ± 24.2 % (k=2)

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.3 ± 6 %	5.34 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.22 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	72.0 mW /g ± 24.4 % (k=2)
SAR averaged over 10 cm³ (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.06 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	20.5 mW /g ± 24.2 % (k=2)



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Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.1 ± 6 %	5.48 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.56 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	75.4 mW / g ± 24.4 % (k=2)
SAR averaged over 10 cm³ (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.15 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.4 mW / g ± 24.2 % (k=2)

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.5 ± 6 %	5.88 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.96 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	79.3 mW / g ± 24.4 % (k=2)
SAR averaged over 10 cm³ (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.25 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	22.4 mW / g ± 24.2 % (k=2)



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Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.0 ± 6 %	6.18 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.51 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	74.8 mW /g ± 24.4 % (k=2)
SAR averaged over 10 cm³ (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.11 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.0 mW /g ± 24.2 % (k=2)



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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	52.3Ω - 9.30jΩ
Return Loss	- 20.6dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	52.9Ω - 1.49jΩ
Return Loss	- 29.9dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	54.4Ω - 3.77jΩ
Return Loss	- 25.2dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	53.4Ω +3.99jΩ
Return Loss	- 25.9dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	51.3Ω - 8.42jΩ
Return Loss	- 21.5dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	51.8Ω + 1.03jΩ
Return Loss	- 33.7dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	54.6Ω - 2.05jΩ
Return Loss	- 26.4dB



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Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	53.0Ω + 4.83jΩ
Return Loss	- 25.1dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.054 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: 09.27.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1221

Communication System: CW; Frequency: 5200 MHz, Frequency: 5300 MHz,
Frequency: 5600 MHz, Frequency: 5800 MHz,

Medium parameters used: $f = 5200$ MHz; $\sigma = 4.748$ S/m; $\epsilon_r = 35.09$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 4.864$ S/m; $\epsilon_r = 34.85$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 5.193$ S/m; $\epsilon_r = 34.51$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 5.411$ S/m; $\epsilon_r = 34.3$; $\rho = 1000$ kg/m³,

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7514; ConvF(5.05, 5.05, 5.05) @ 5200 MHz; Calibrated: 8/27/2018, ConvF(4.99, 4.99, 4.99) @ 5300 MHz; Calibrated: 8/27/2018, ConvF(4.41, 4.41, 4.41) @ 5600 MHz; Calibrated: 8/27/2018, ConvF(4.42, 4.42, 4.42) @ 5800 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 /Pin=100mW, d=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.34 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 32.0 W/kg
SAR(1 g) = 7.71 W/kg; SAR(10 g) = 2.21 W/kg
Maximum value of SAR (measured) = 18.5 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.74 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 34.7 W/kg
SAR(1 g) = 7.94 W/kg; SAR(10 g) = 2.27 W/kg
Maximum value of SAR (measured) = 19.4 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 66.14 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 37.5 W/kg
SAR(1 g) = 8.07 W/kg; SAR(10 g) = 2.31 W/kg
Maximum value of SAR (measured) = 19.8 W/kg

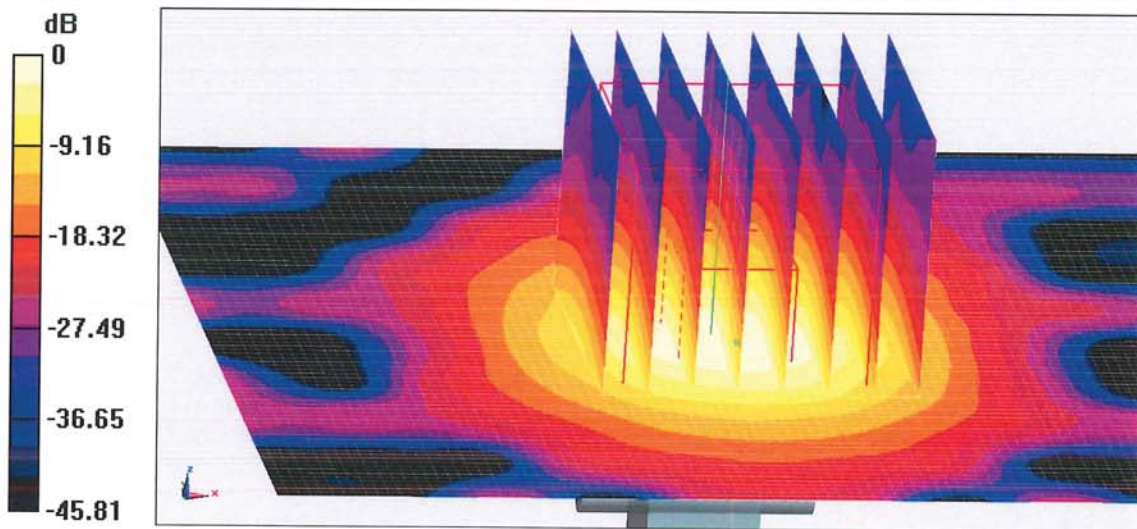


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Dipole Calibration /Pin=100mW, d=10mm, f=5800 MHz/Zoom Scan,
dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 60.94 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 37.4 W/kg
SAR(1 g) = 7.72 W/kg; SAR(10 g) = 2.2 W/kg
Maximum value of SAR (measured) = 19.3 W/kg



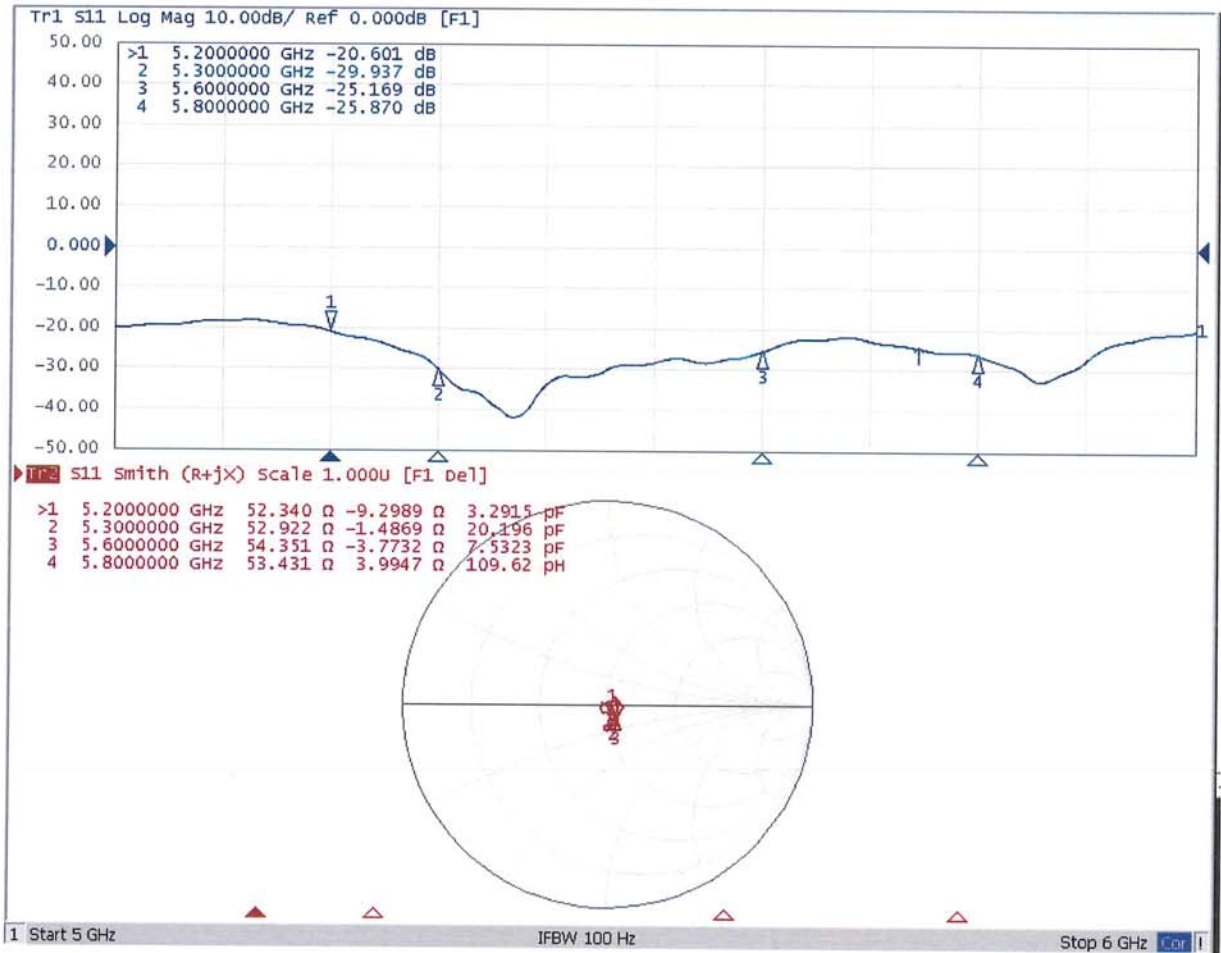
0 dB = 19.3 W/kg = 12.86 dBW/kg



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Impedance Measurement Plot for Head TSL





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DASY5 Validation Report for Body TSL

Date: 09.25.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1221

Communication System: CW; Frequency: 5200 MHz, Frequency: 5300 MHz,
Frequency: 5600 MHz, Frequency: 5800 MHz,

Medium parameters used: $f = 5200$ MHz; $\sigma = 5.344$ S/m; $\epsilon_r = 48.26$; $\rho = 1000$ kg/m³,
Medium parameters used: $f = 5300$ MHz; $\sigma = 5.475$ S/m; $\epsilon_r = 48.09$; $\rho = 1000$ kg/m³,
Medium parameters used: $f = 5600$ MHz; $\sigma = 5.88$ S/m; $\epsilon_r = 47.47$; $\rho = 1000$ kg/m³,
Medium parameters used: $f = 5800$ MHz; $\sigma = 6.175$ S/m; $\epsilon_r = 46.98$; $\rho = 1000$ kg/m³,

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7514; ConvF(4.59, 4.59, 4.59) @ 5200 MHz; Calibrated: 8/27/2018, ConvF(4.49, 4.49, 4.49) @ 5300 MHz; Calibrated: 8/27/2018, ConvF(4, 4, 4) @ 5600 MHz; Calibrated: 8/27/2018, ConvF(3.94, 3.94, 3.94) @ 5800 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 /Pin=100mW, d=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 61.19 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 28.0 W/kg
SAR(1 g) = 7.22 W/kg; SAR(10 g) = 2.06 W/kg
Maximum value of SAR (measured) = 17.1 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 61.08 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 30.7 W/kg
SAR(1 g) = 7.56 W/kg; SAR(10 g) = 2.15 W/kg
Maximum value of SAR (measured) = 18.4 W/kg

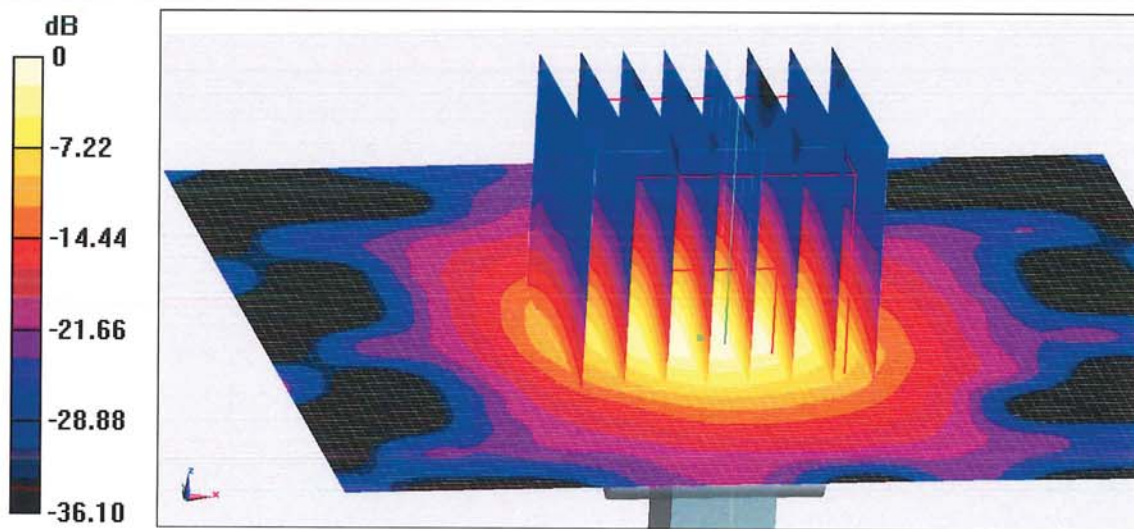
Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 62.98 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 35.3 W/kg
SAR(1 g) = 7.96 W/kg; SAR(10 g) = 2.25 W/kg
Maximum value of SAR (measured) = 19.7 W/kg



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Dipole Calibration /Pin=100mW, d=10mm, f=5800 MHz/Zoom Scan,
dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.20 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 35.7 W/kg
SAR(1 g) = 7.51 W/kg; SAR(10 g) = 2.11 W/kg
Maximum value of SAR (measured) = 19.0 W/kg

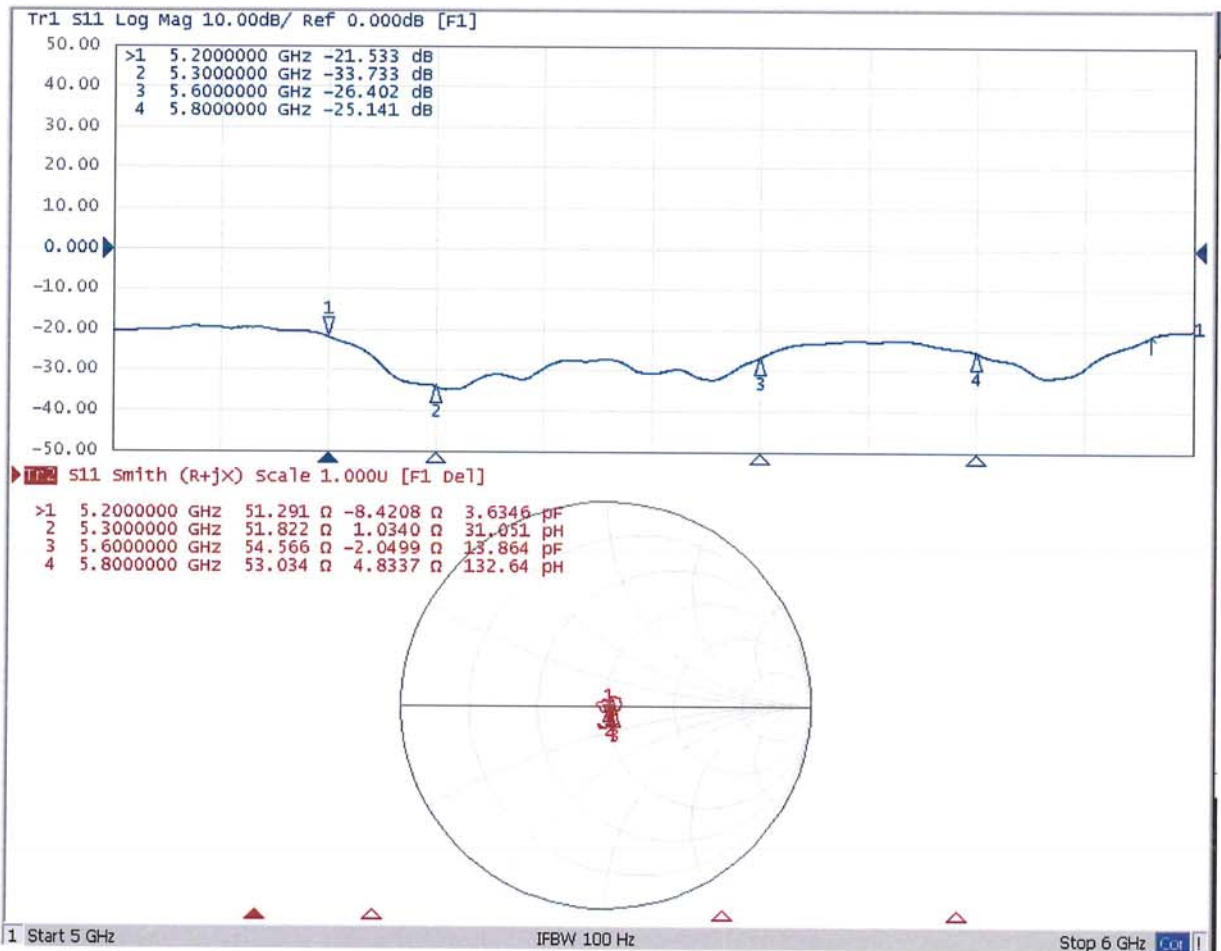


0 dB = 19.0 W/kg = 12.79 dBW/kg



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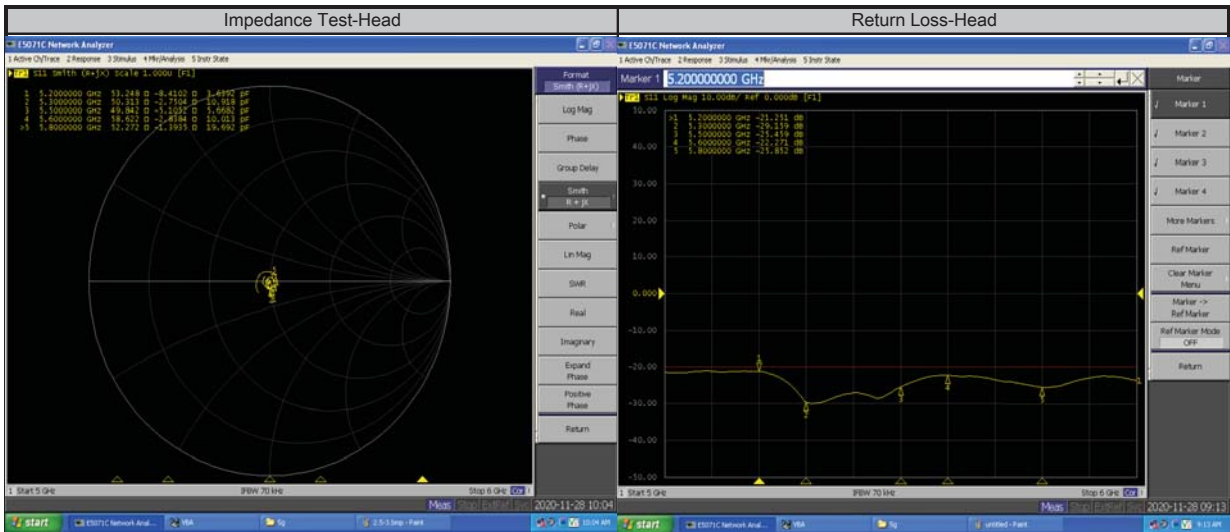
Impedance Measurement Plot for Body TSL





Dipole Internal Calibration Record

Asset No. :	E-436	Model No. :	D5GHzV2	Serial No. :	1221
Environmental	23.1°C, 50 %	Original Cal. Date :	September 28, 2018	Next Cal. Date :	September 27, 2021
Standard List					
1	IEEE Std 1528-2013	IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate(SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques, June 2013			
2	IEC 62209-2	Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body(frequency range of 30 MHz to 6 GHz), March 2010			
3	KDB865664	SAR Measurement Requirements for 100 MHz to 6 GHz			
Equipment Information					
Equipment :	Manufacturer :	Model No. :	Serial No. :	Cal.OrganiZation :	Cal. Date :
Power Amplifier	Mini-Circuits	ZHL-42W+	QA1333003	N/A	March 10, 2020
DC Source metter	Iteck	IT6154	006104126768201001	N/A	July 25, 2020
Power Meter	Anritsu	ML2495A	1128008	N/A	June 11, 2020
Power Sensor	Anritsu	MA2411B	1126001	N/A	June 11, 2020
Power Meter	Anritsu	MA2487A	6K00004714	N/A	September 3, 2020
Power Sensor	Anritsu	MA2491A	1725282	N/A	September 3, 2020
Directional Coupler	Woken	TS-PCC0M-05	107090019	N/A	March 1, 2020
Signal Generator	R & S	N5172B	MY53051229	N/A	June 20, 2020
ENA Network Analyzer	Agilent	E5071C	MY46524658	N/A	April 7, 2020
Model No	For Head Tissue				
	Item	Originak Cal. Result	Verified on 2020/11/28	Deviation	Result
D5GHzV2(5.2GHz)	Impedance, transformed to feed point	52.3Ω-9.30jΩ	53.2Ω-8.41jΩ	<5Ω	Pass
	Return Loss(dB)	-20.6	-21.251	3.2%	Pass
	SAR Value for	7.71	7.57	-1.8%	Pass
	SAR Value for	2.21	2.2	-0.5%	Pass
D5GHzV2(5.3GHz)	Impedance, transformed to feed point	52.9Ω-1.49jΩ	50.3Ω-2.75jΩ	<5Ω	Pass
	Return Loss(dB)	-29.9	-29.159	-2.5%	Pass
	SAR Value for	7.94	7.67	-3.4%	Pass
	SAR Value for	2.27	2.15	-5.3%	Pass
D5GHzV2(5.6GHz)	Impedance, transformed to feed point	54.4Ω-3.77jΩ	58.6Ω-2.84jΩ	<5Ω	Pass
	Return Loss(dB)	-25.2	-22.271	-11.6%	Pass
	SAR Value for	8.07	8.23	2.0%	Pass
	SAR Value for	2.31	2.3	-0.4%	Pass
D5GHzV2(5.8GHz)	Impedance, transformed to feed point	53.4Ω+3.99jΩ	52.3Ω-1.40jΩ	<5Ω	Pass
	Return Loss(dB)	-25.9	-25.852	-0.2%	Pass
	SAR Value for	7.72	7.48	-3.1%	Pass
	SAR Value for	2.2	2.12	-3.6%	Pass



Validation Report for Head TSL of 5.2GHz

Test Laboratory: BTL Inc. Date: 2020/11/28

System Check_H5200_1128

DUT: Dipole D5GHzV2;

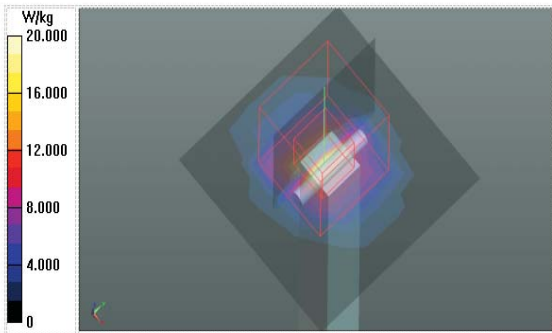
Communication System: UID 0, CW (0); Frequency: 5200 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 5200$ MHz; $\sigma = 4.514$ S/m; $\epsilon_r = 35.539$; $\rho = 1000$ kg/m³
 Ambient Temperature : 23.1 °C; Liquid Temperature : 22.3 °C

DASY Configuration:

- Probe: EX3DV4 - SN7544; ConvF(5.56, 5.56, 5.56) @ 5200 MHz; Calibrated: 2020/10/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 1.0, 23.0$
- Electronics: DAE4 Sn1390; Calibrated: 2020/11/6
- Phantom: SAM Left v5.0; Type: Twin SAM; Serial: TP.1896
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (6x6x1): Measurement grid: $dx=10$ mm, $dy=10$ mm
 Maximum value of SAR (measured) = 14.4 W/kg

Zoom Scan (7x7x12)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=2$ mm
 Reference Value = 70.19 V/m; Power Drift = 0.01 dB
 Peak SAR (extrapolated) = 37.0 W/kg
SAR(1 g) = 7.57 W/kg; SAR(10 g) = 2.2 W/kg
 Maximum value of SAR (measured) = 20.0 W/kg



Validation Report for Head TSL of 5.3GHz

Test Laboratory: BTL Inc. Date: 2020/11/28

System Check_H5300_1128

DUT: Dipole D5GHzV2;

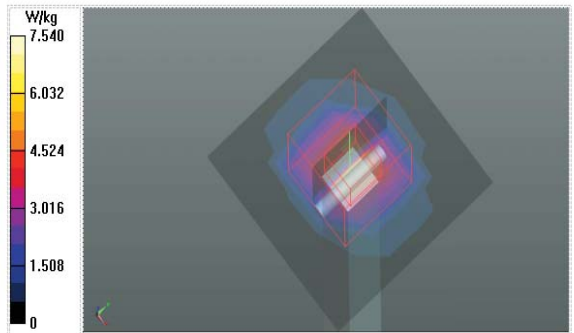
Communication System: UID 0, CW (0); Frequency: 5300 MHz; Duty Cycle: 1:1
 Medium parameters used (interpolated): $f = 5300$ MHz; $\sigma = 4.62$ S/m; $\epsilon_r = 35.321$; $\rho = 1000$ kg/m³
 Ambient Temperature : 23.1 °C; Liquid Temperature : 22.3 °C

DASY Configuration:

- Probe: EX3DV4 - SN7544; ConvF(5.25, 5.25, 5.25) @ 5300 MHz; Calibrated: 2020/10/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 1.0, 23.0$
- Electronics: DAE4 Sn1390; Calibrated: 2020/11/6
- Phantom: SAM Left v5.0; Type: Twin SAM; Serial: TP.1896
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (6x6x1): Measurement grid: $dx=10$ mm, $dy=10$ mm
 Maximum value of SAR (measured) = 4.69 W/kg

Zoom Scan (7x7x12)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=2$ mm
 Reference Value = 40.80 V/m; Power Drift = -0.01 dB
 Peak SAR (extrapolated) = 39.8 W/kg
SAR(1 g) = 7.67 W/kg; SAR(10 g) = 2.15 W/kg
 Maximum value of SAR (measured) = 7.54 W/kg



Validation Report for Head TSL of 5.6GHz

Test Laboratory: BTL Inc

Date: 2020/11/28

System Check_H5600_1128

DUT: Dipole D5GHzV2;

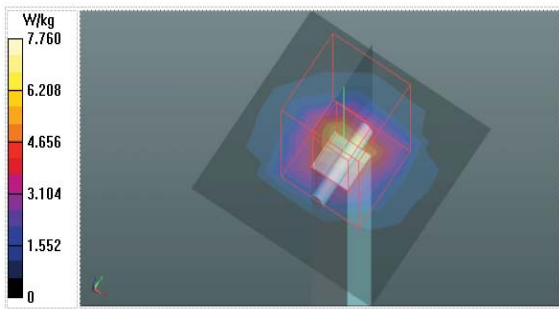
Communication System: UID 0, CW (0); Frequency: 5600 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 5600$ MHz; $\sigma = 5.156$ S/m; $\epsilon_r = 35.266$; $\rho = 1000$ kg/m³
 Ambient Temperature : 23.1 °C; Liquid Temperature : 22.3 °C

DASY Configuration:

- Probe: EX3DV4 - SN7544; ConvF(4.82, 4.82, 4.82) @ 5600 MHz; Calibrated: 2020/10/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 1.0, 23.0$
- Electronics: DAE4 Sn1390; Calibrated: 2020/11/6
- Phantom: SAM Left v5.0; Type: Twin SAM; Serial: TP-1896
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (6x6x1): Measurement grid: $dx=10$ mm, $dy=10$ mm
 Maximum value of SAR (measured) = 5.67 W/kg

Zoom Scan (7x7x12)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=2$ mm
 Reference Value = 38.73 V/m; Power Drift = 0.07 dB
 Peak SAR (extrapolated) = 44.9 W/kg
 SAR(1 g) = 8.23 W/kg; SAR(10 g) = 2.3 W/kg
 Maximum value of SAR (measured) = 7.76 W/kg



Validation Report for Head TSL of 5.8GHz

Test Laboratory: BTL Inc.

Date: 2020/11/28

System Check_H5800_1128

DUT: Dipole D5GHzV2;

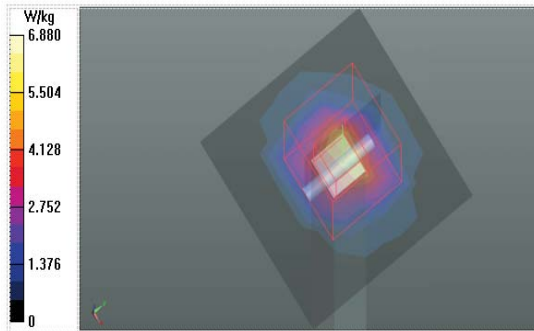
Communication System: UID 0, CW (0); Frequency: 5800 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 5800$ MHz; $\sigma = 5.19$ S/m; $\epsilon_r = 34.169$; $\rho = 1000$ kg/m³
 Ambient Temperature : 23.1 °C; Liquid Temperature : 22.3 °C

DASY Configuration:

- Probe: EX3DV4 - SN7544; ConvF(4.8, 4.8, 4.8) @ 5800 MHz; Calibrated: 2020/10/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 1.0, 23.0$
- Electronics: DAE4 Sn1390; Calibrated: 2020/11/6
- Phantom: SAM Left v5.0; Type: Twin SAM; Serial: TP-1896
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (6x6x1): Measurement grid: $dx=10$ mm, $dy=10$ mm
 Maximum value of SAR (measured) = 4.95 W/kg

Zoom Scan (7x7x12)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=2$ mm
 Reference Value = 35.90 V/m; Power Drift = -0.01 dB
 Peak SAR (extrapolated) = 42.9 W/kg
 SAR(1 g) = 7.48 W/kg; SAR(10 g) = 2.12 W/kg
 Maximum value of SAR (measured) = 6.88 W/kg



Calibrator:

Seven Lu

Approver:

Herbert Lin