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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.9Ω+ 5.91jΩ
Return Loss	- 24.6dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.1Ω+ 6.03jΩ
Return Loss	- 23.3dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.066 ns

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

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

Additional EUT Data

Manufactured by	SPEAG

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DASY5 Validation Report for Head TSL Date: 06.10.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d208

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium parameters used: f = 1900 MHz; σ = 1.387 S/m; ε_r = 40.2; ρ = 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 Sn1556; 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 (7470)

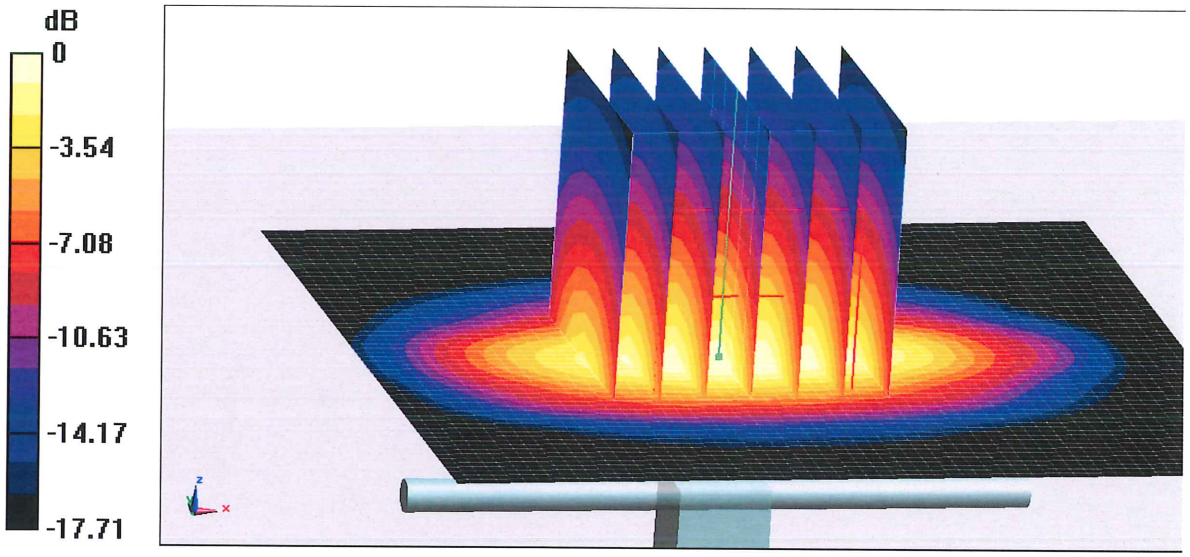
System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 100.7 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 18.9 W/kg

SAR(1 g) = 9.8 W/kg; SAR(10 g) = 5.07 W/kg

Maximum value of SAR (measured) = 15.5 W/kg



0 dB = 15.5 W/kg = 11.90 dBW/kg

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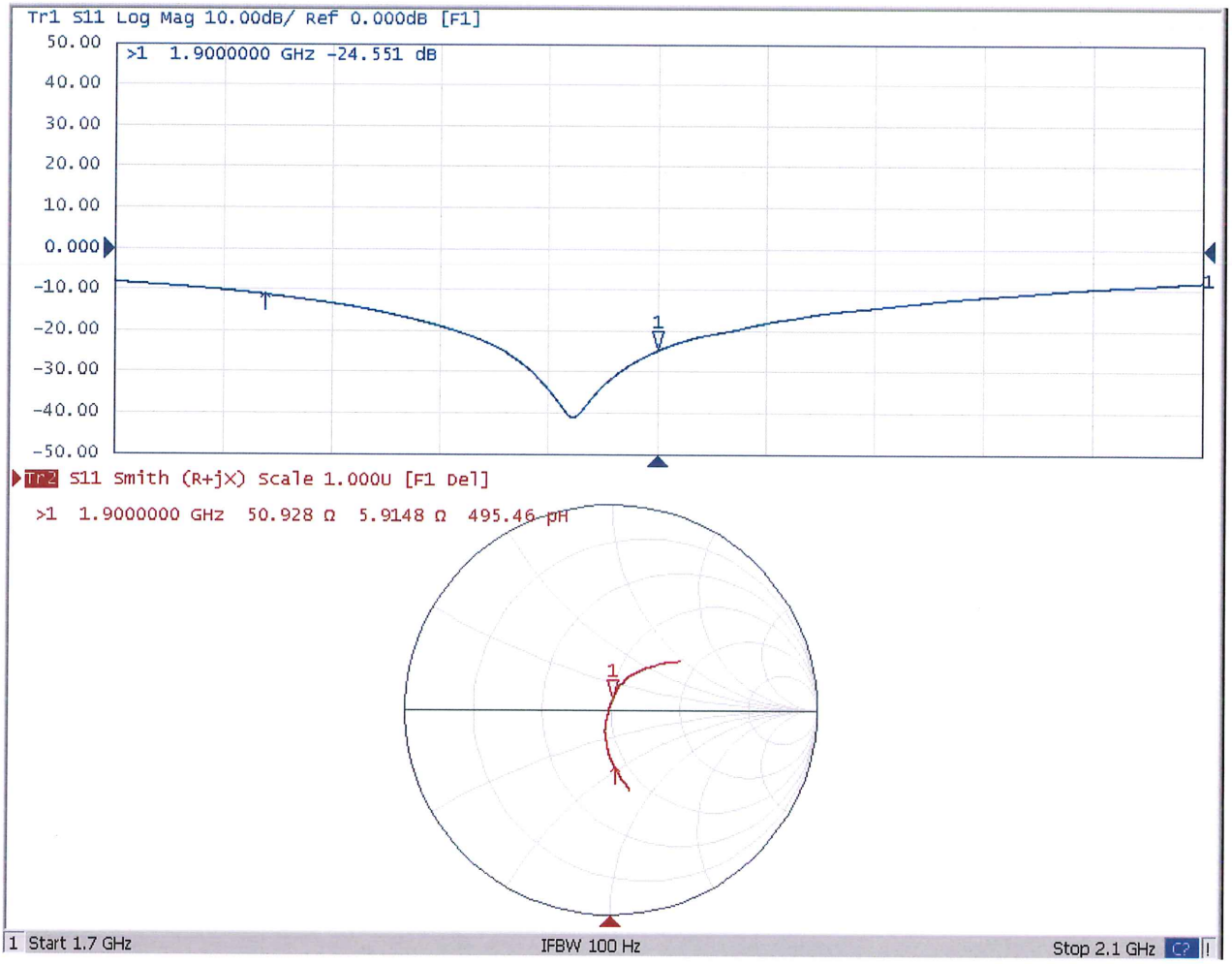
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL Date: 06.11.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d208

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium parameters used: f = 1900 MHz; σ = 1.499 S/m; ε_r = 52.18; 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 Sn1556; 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 (7470)

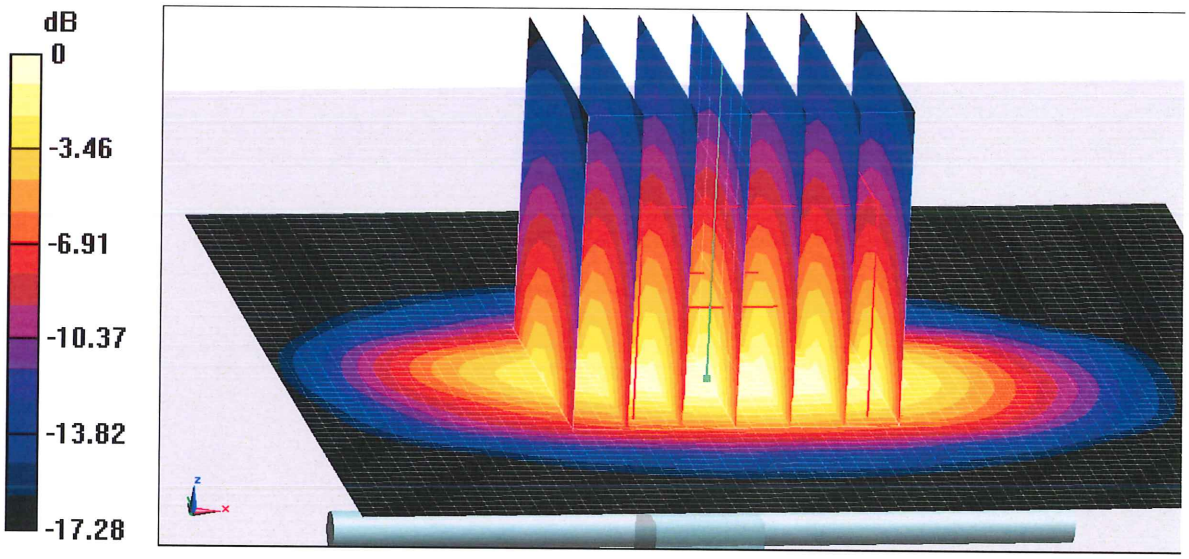
System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 89.17 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 18.9 W/kg

SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.25 W/kg

Maximum value of SAR (measured) = 15.6 W/kg



0 dB = 15.6 W/kg = 11.93 dBW/kg

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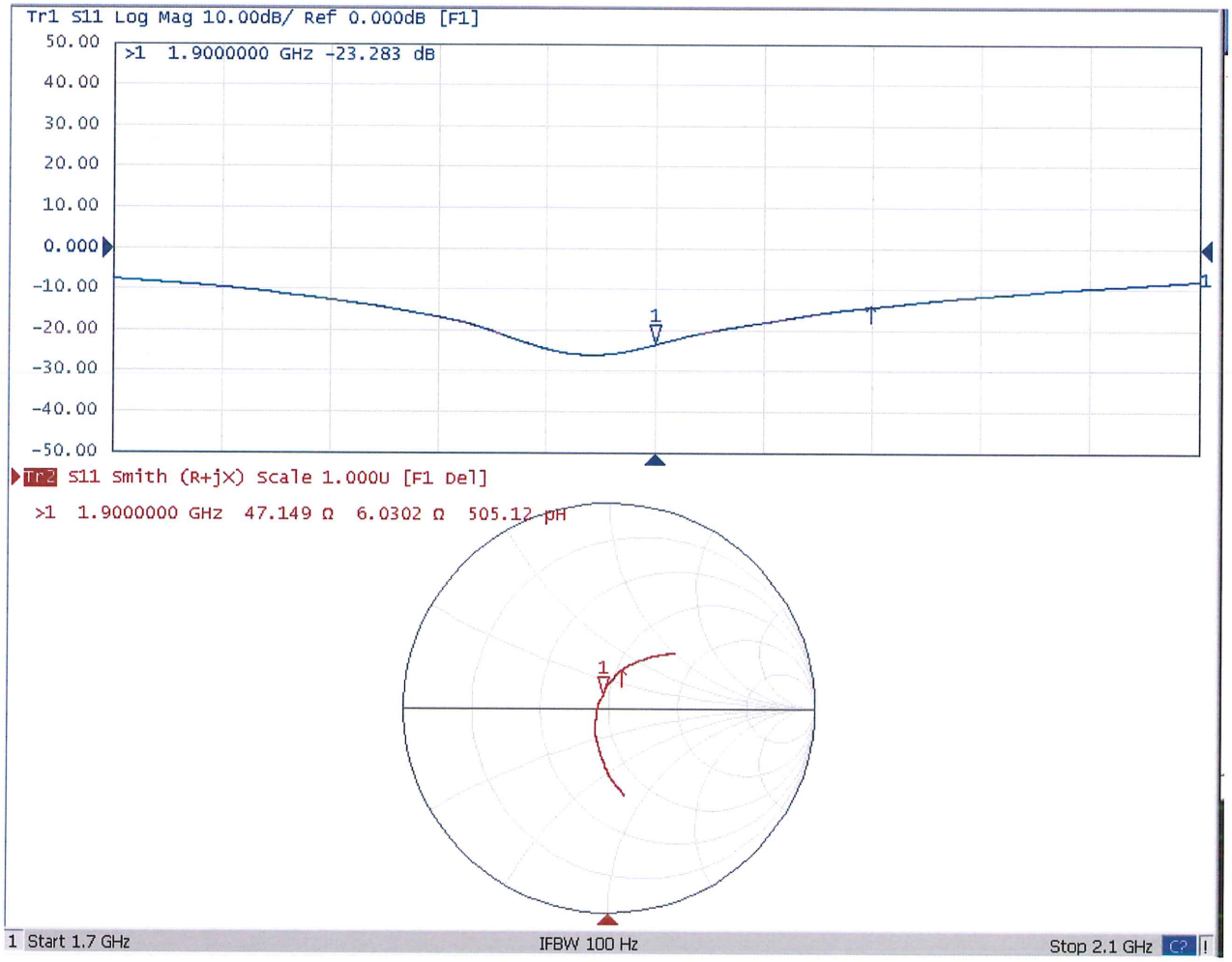
Impedance Measurement Plot for Body TSL



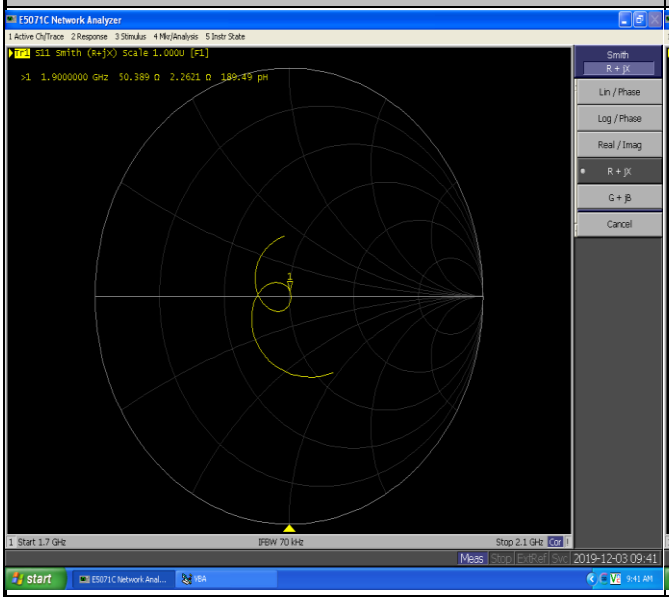
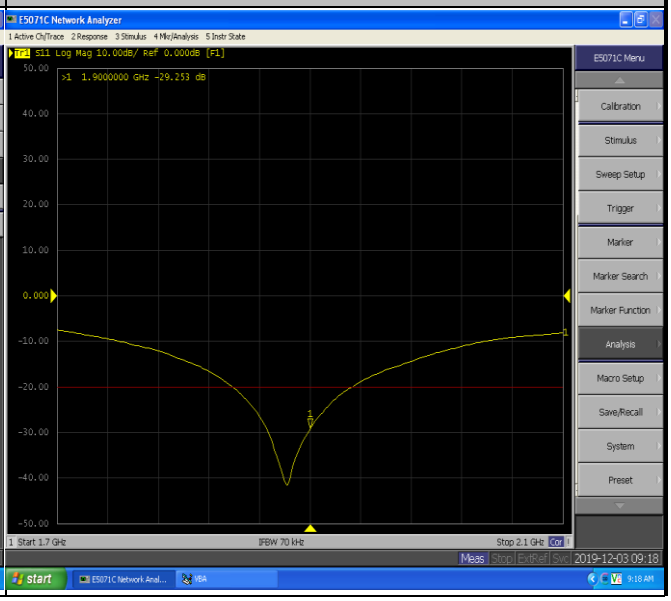
Dipole Internal Calibration Record

Asset No. :	E-431	Model No. :	D1900V2	Serial No. :	5d208
Environmental	23.5℃, 55 %	Original Cal. Date :	June 11, 2019	Next Cal. Date :	June 11, 2022

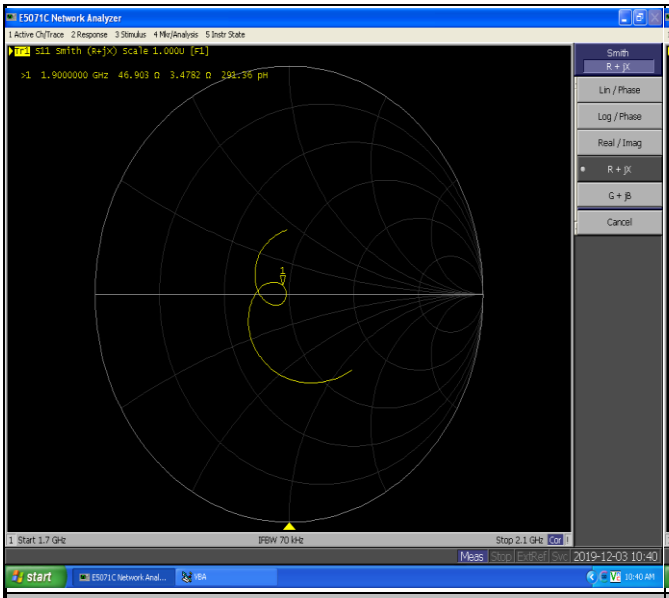
Standard List		
1	IEEE Std 1528-2013	IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorpiton Rate(SAR) in the Human Head from Wireless Communication Devices: Measurement Texhniques, June 2013
2	IEC 62209-2	Procedure to determine the Specific Absorption Rate (SAR) for wireless 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

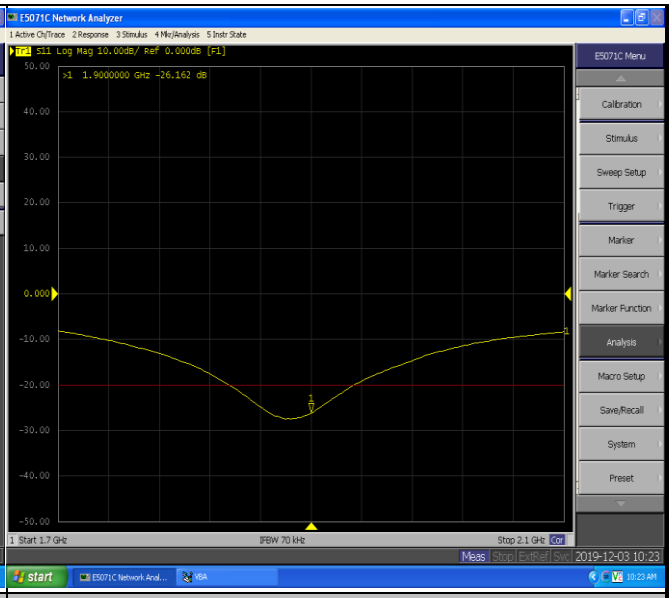
Equipment Information					
Equipment :	Manufacturer :	Model No. :	Serial No. :	Cal.Organization :	Cal. Date :
Power Amplifier	Mini-Circuits	ZHL-42W+	QA1333003	NA	February 25, 2019
DC Source	Iteck	OT6154	M00157	NA	August 3, 2019
P-series power meter	Agilent	N1911A	MY45100473	NA	September 23, 2019
wideband power	Agilent	N1921A	MY51100041	NA	September 23, 2019
Smart Power Sensor	R&S	NRP-Z21	102209	NA	March 1, 2019
Dual directional	Woken	TS-PCC0M-05	107090019	NA	March 10, 2019
Signal Generator	Agilent	E4438C	MY4907131	NA	Mar. 10, 2019
ENA Network Analyzer	Agilent	E5071C	MY46102965	NA	March 10, 2019

Model No	For Head Tissue				
D1900V2	Item	Originak Cal. Result	Verified on 2019/12/3	Deviation	Result
	Impedance, transformed to feed	50.9Ω+5.91jΩ	50.389Ω+2.26jΩ	<5Ω	Pass
	Return Loss(dB)	-24.6	-29.253	18.9%	Pass
	SAR Value for 1g(mW/g)	9.96	9.46	-5.0%	Pass
	SAR Value for 10g(mW/g)	5.21	4.95	-5.0%	Pass
	For Body Tissue				
	Item	Originak Cal. Result	Verified on 2019/12/3	Deviation	Result
	Impedance, transformed to feed	47.1Ω+6.03jΩ	46.903Ω+3.48jΩ	<5Ω	Pass
	Return Loss(dB)	-23.3	-26.162	12.3%	Pass
	SAR Value for 1g(mW/g)	10.2	10.3	1.0%	Pass
	SAR Value for 10g(mW/g)	5.29	5.35	1.1%	Pass

Impedance Test-Head	Return Loss-Head
	

Impedance Test-Body	Return Loss-Body





Validation Report for Head TSL

Test Laboratory: BTL Inc. Date: 2019/12/03

System Check_H1900_1203

DUT: Dipole 1900 MHz D1900V2;SN:5d179;

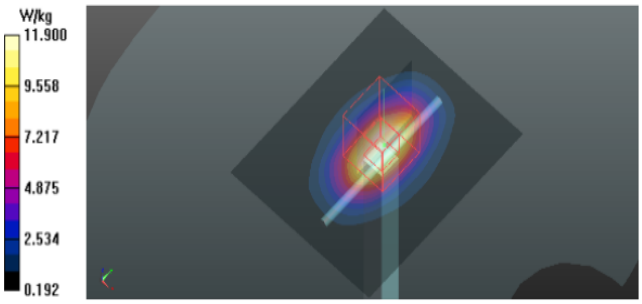
Communication System: UID 0, CW (0); Frequency: 1900 MHz; Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.379 S/m; ε_r = 39.603; ρ = 1000 kg/m^3
Ambient Temperature : 23.2 ℃; Liquid Temperature : 22.4 ℃

DASY Configuration:

- Probe: EX3DV4 - SN7544; ConvF(8.26, 8.26, 8.26) @ 1900 MHz; Calibrated: 2019/9/9
- Sensor-Surface: 4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1390; Calibrated: 2019/10/29
- Phantom: SAM Front; Type: Twin SAM; Serial: 1784
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (6x7x1): Interpolated grid: dx=15 mm, dy=15 mm
Maximum value of SAR (interpolated) = 13.3 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 108.8 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 17.0 W/kg
SAR(1 g) = 9.46 W/kg; SAR(10 g) = 4.95 W/kg
Maximum value of SAR (measured) = 11.9 W/kg



Validation Report for Body TSL

Test Laboratory: BTL Inc. Date: 2019/12/03

System Check_B1900_1203

DUT: Dipole 1900 MHz D1900V2;SN:5d179;

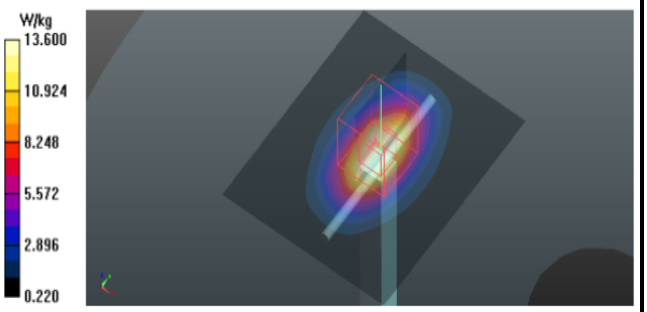
Communication System: UID 0, CW (0); Frequency: 1900 MHz; Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.513 S/m; ε_r = 51.305; ρ = 1000 kg/m^3
Ambient Temperature : 23.3 ℃; Liquid Temperature : 22.2 ℃

DASY Configuration:

- Probe: EX3DV4 - SN7544; ConvF(7.9, 7.9, 7.9) @ 1900 MHz; Calibrated: 2019/9/9
- Sensor-Surface: 4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1390; Calibrated: 2019/10/29
- Phantom: SAM Front; Type: Twin SAM; Serial: 1784
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (6x7x1): Interpolated grid: dx=15 mm, dy=15 mm
Maximum value of SAR (interpolated) = 15.2 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 111.0 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 19.3 W/kg
SAR(1 g) = 10.3 W/kg; SAR(10 g) = 5.35 W/kg
Maximum value of SAR (measured) = 13.6 W/kg



Calibrator: Rot - Liang

Approver: Herbert Liu

Dipole Internal Calibration Record

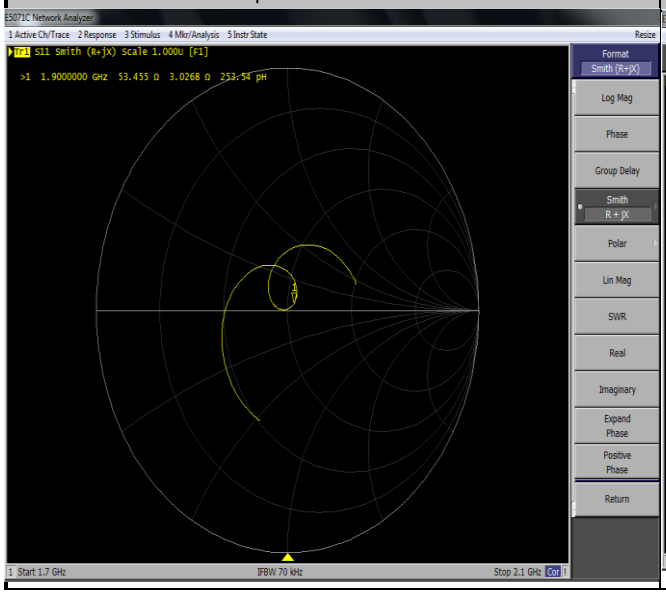
Asset No. :	E-431	Model No. :	D1900V2	Serial No. :	5d208
Environmental condition :	23.0℃, 44.2 %	Original Cal. Date :	June 11, 2019	Next Cal. Date :	June 10, 2021

Standard List		
1	IEEE Std 1528-2013	IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorpiton Rate(SAR) in the Human Head from Wireless Communication Devices: Measurement Texhniques, 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

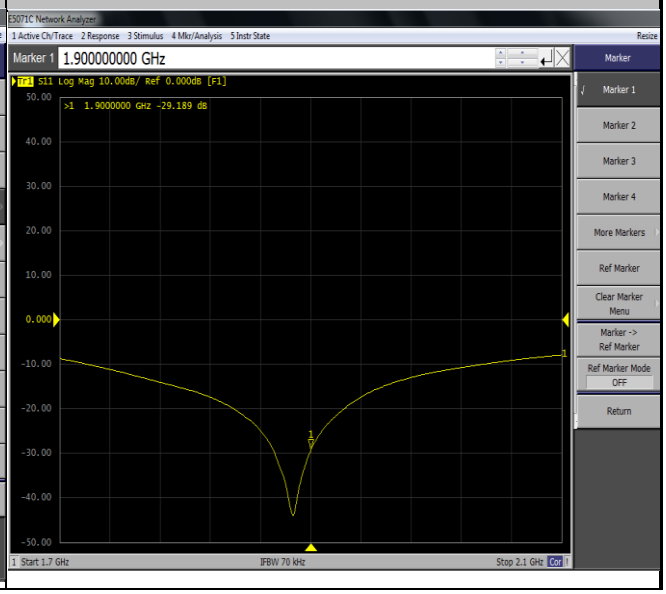
Equipment Information					
Equipment :	Manufacturer :	Model No. :	Serial No. :	Cal.Organization :	Cal. Date :
Power Amplifier	Mini-Circuits	ZHL-42W+	QA1333003	N/A	March 10, 2020
DC Source metter	Iteck	IT6154	006104126768201001	N/A	July 25, 2020
Power Meter	Anritsu	ML2495A	1128008	N/A	June 11, 2020
Power 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	Original Cal. Result	Verified on 2021/1/15	Deviation	Result
D1900V2	Impedance, transformed to feed point	50.9Ω+5.91jΩ	53.455Ω+3.0268jΩ	<5Ω	Pass
	Return Loss(dB)	-29.7	-29.189	-1.7%	Pass
	SAR Value for 1g(mW/g)	9.8	9.26	-5.5%	Pass
	SAR Value for 10g(mW/g)	5.07	4.7	-7.3%	Pass

Impedance Test-Head



Return Loss-Head



Validation Report for Head TSL

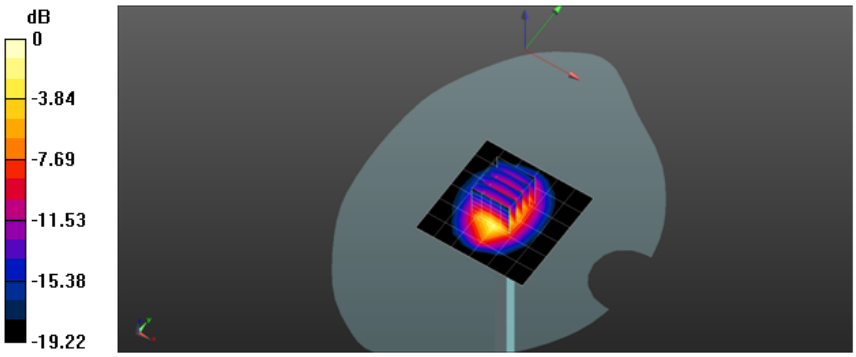
Test Laboratory: BTL Date: 2021/1/15

System Check_H1900

Frequency: 1900 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 23.0°C; Liquid Temperature: 22.0°C
Medium parameters used: f = 1900 MHz; σ = 1.406 S/m; ε_r = 40.658; ρ = 1000 kg/m^3
DASY5 Configuration:
- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1486; Calibrated: 2020/6/4
- Probe: EX3DV4 - SN7369; ConvF(8.32, 8.32, 8.32) @ 1900 MHz; Calibrated: 2020/5/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Phantom: SAM Twin Phantom V5.0; Type: QD 000 P40 C; Serial: TP-1897

Configuration/Pin=250mW/Area Scan (7x7x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 13.8 W/kg

Configuration/Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 96.24 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 17.8 W/kg
SAR(1 g) = 9.26 W/kg; SAR(10 g) = 4.7 W/kg
Smallest distance from peaks to all points 3 dB below = 10.1 mm
Ratio of SAR at M2 to SAR at M1 = 51.6%
Maximum value of SAR (measured) = 14.8 W/kg



0 dB = 14.8 W/kg = 11.70 dBW/kg

Calibrator: Approver:

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CALIBRATION
CNAS L0570

Client **BTL Inc .** **Certificate No: Z19-60210**

CALIBRATION CERTIFICATE

Object D2300V2 - SN: 1054

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

Calibration date: June 13, 2019

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 NRP2	106277	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Power sensor NRP8S	104291	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Reference Probe EX3DV4	SN 7514	27-Aug-18(SPEAG,No.EX3-7514_Aug18)	Aug-19
DAE4	SN 1556	20-Aug-18(SPEAG,No.DAE4-1556_Aug18)	Aug-19
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-19 (CTTL, No.J19X00336)	Jan-20
NetworkAnalyzer E5071C	MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan-20

	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: June 17, 2019

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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%.