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Accreditation No.: **SCS 0108**

Client **Auden**

Certificate No: **EX3-3887\_Sep19**

## CALIBRATION CERTIFICATE

Object: **EX3DV4 - SN:3887**

Calibration procedure(s): **QA CAL-01.v9, QA CAL-14.v5, QA CAL-23.v5, QA CAL-25.v7  
Calibration procedure for dosimetric E-field probes**

Calibration date: **September 20, 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)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-19 (No. 217-02894)	Apr-20
DAE4	SN: 660	19-Dec-18 (No. DAE4-660_Dec18)	Dec-19
Reference Probe ES3DV2	SN: 3013	31-Dec-18 (No. ES3-3013_Dec18)	Dec-19
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-18)	In house check: Jun-20
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

Calibrated by:	Name	Function	Signature
	Leif Klysner	Laboratory Technician	
Approved by:	Name	Function	Signature
	Katja Pokovic	Technical Manager	

Issued: September 24, 2019

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





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### Glossary:

TSL	tissue simulating liquid
NORM <sub>x,y,z</sub>	sensitivity in free space
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization $\varphi$	$\varphi$ rotation around probe axis
Polarization $\vartheta$	$\vartheta$ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

### 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 the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- 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
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Methods Applied and Interpretation of Parameters:

- NORM<sub>x,y,z</sub>**: Assessed for E-field polarization  $\vartheta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not affect the E<sup>2</sup>-field uncertainty inside TSL (see below ConvF).
- NORM(f)<sub>x,y,z</sub> = NORM<sub>x,y,z</sub> \* frequency\_response** (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP<sub>x,y,z</sub>**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A<sub>x,y,z</sub>; B<sub>x,y,z</sub>; C<sub>x,y,z</sub>; D<sub>x,y,z</sub>; VR<sub>x,y,z</sub>; A, B, C, D** are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800$  MHz) and inside waveguide using analytical field distributions based on power measurements for  $f > 800$  MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM<sub>x,y,z</sub> \* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from  $\pm 50$  MHz to  $\pm 100$  MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM<sub>x</sub> (no uncertainty required).

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3887

### Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ( $\mu\text{V}/(\text{V}/\text{m})^2$ ) <sup>A</sup>	0.36	0.39	0.48	$\pm 10.1 \%$
DCP (mV) <sup>B</sup>	104.4	100.4	101.1	

### Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Max dev.	Unc <sup>E</sup> (k=2)
0	CW	X	0.0	0.0	1.0	0.00	134.4	$\pm 2.2 \%$	$\pm 4.7 \%$
		Y	0.0	0.0	1.0		139.4		
		Z	0.0	0.0	1.0		138.5		

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%.

<sup>A</sup> The uncertainties of Norm X,Y,Z do not affect the  $E^2$ -field uncertainty inside TSL (see Page 5).

<sup>B</sup> Numerical linearization parameter: uncertainty not required.

<sup>E</sup> Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3887

### Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	61
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3887

### Calibration Parameter Determined in Head Tissue Simulating Media

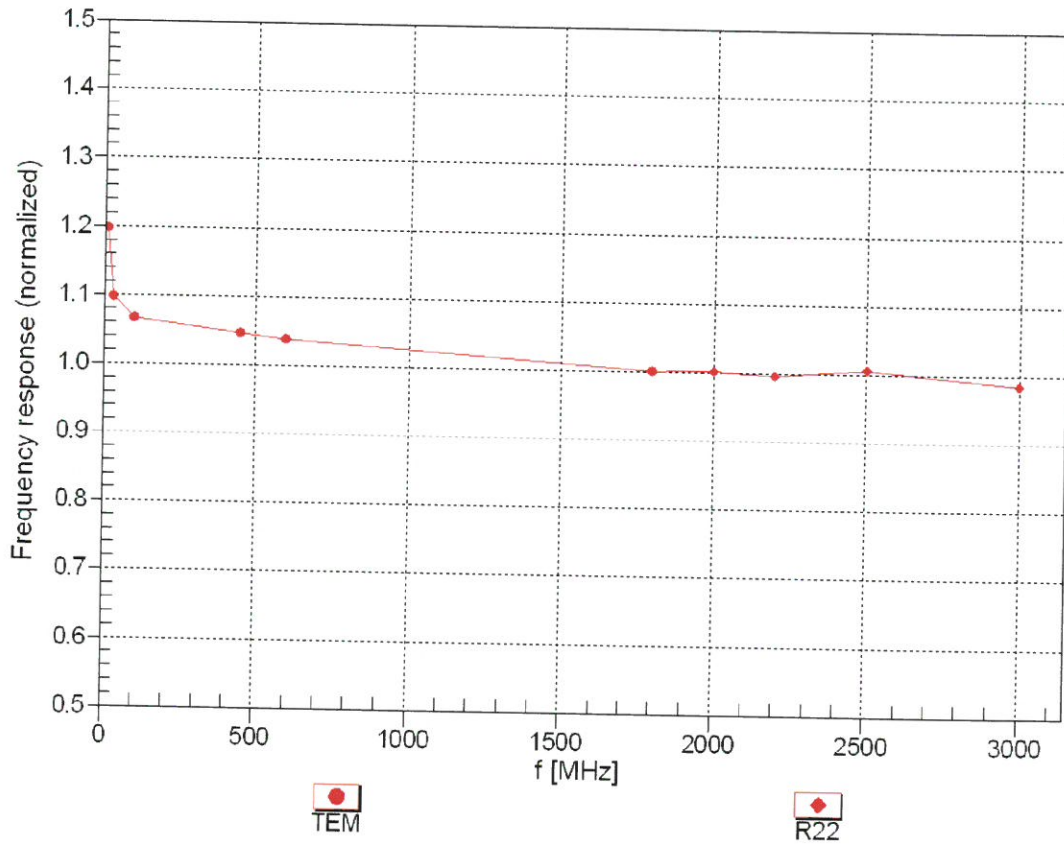
f (MHz) <sup>C</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) <sup>F</sup>	ConvF X	ConvF Y	ConvF Z	Alpha <sup>G</sup>	Depth (mm) <sup>G</sup>	Unc (k=2)
750	41.9	0.89	9.58	9.58	9.58	0.33	0.98	± 12.0 %
835	41.5	0.90	9.26	9.26	9.26	0.40	0.85	± 12.0 %
900	41.5	0.97	9.08	9.08	9.08	0.44	0.88	± 12.0 %
1450	40.5	1.20	8.45	8.45	8.45	0.31	0.88	± 12.0 %
1750	40.1	1.37	8.25	8.25	8.25	0.32	0.87	± 12.0 %
1900	40.0	1.40	7.93	7.93	7.93	0.38	0.86	± 12.0 %
2000	40.0	1.40	7.92	7.92	7.92	0.31	0.86	± 12.0 %
2300	39.5	1.67	7.70	7.70	7.70	0.31	0.87	± 12.0 %
2450	39.2	1.80	7.37	7.37	7.37	0.36	0.93	± 12.0 %
2600	39.0	1.96	7.23	7.23	7.23	0.36	0.90	± 12.0 %
3500	37.9	2.91	6.77	6.77	6.77	0.30	1.35	± 13.1 %
5250	35.9	4.71	4.75	4.75	4.75	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.28	4.28	4.28	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.46	4.46	4.46	0.40	1.80	± 13.1 %

<sup>C</sup> Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.

<sup>F</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

<sup>G</sup> Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

### Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)

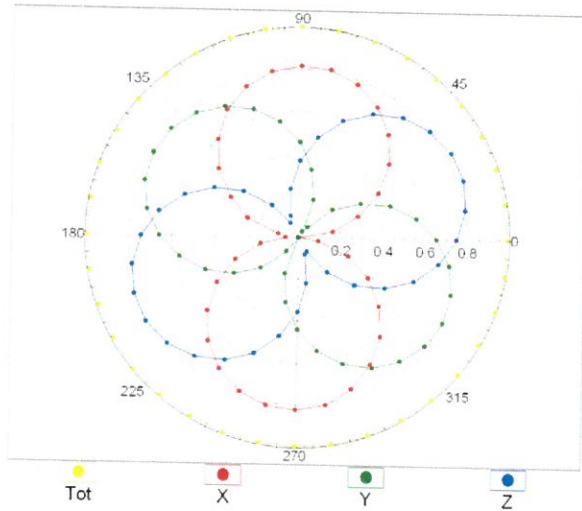


Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  (k=2)

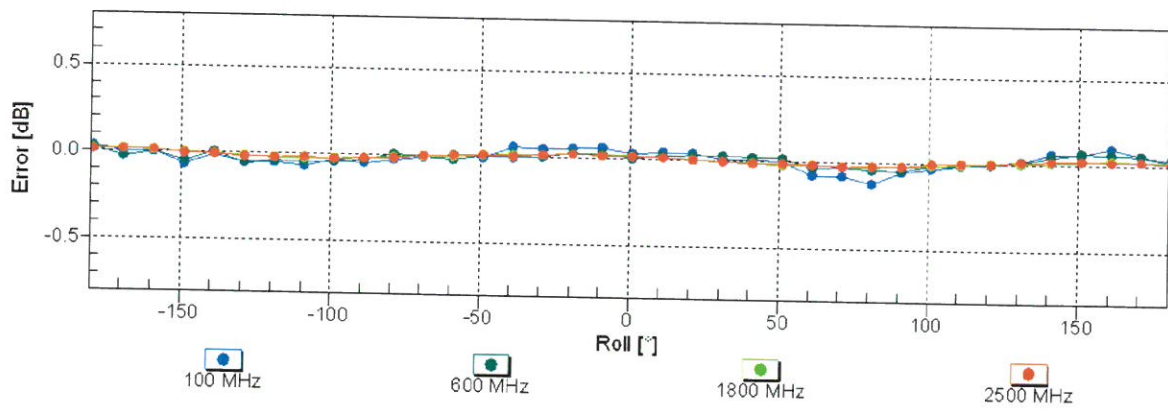
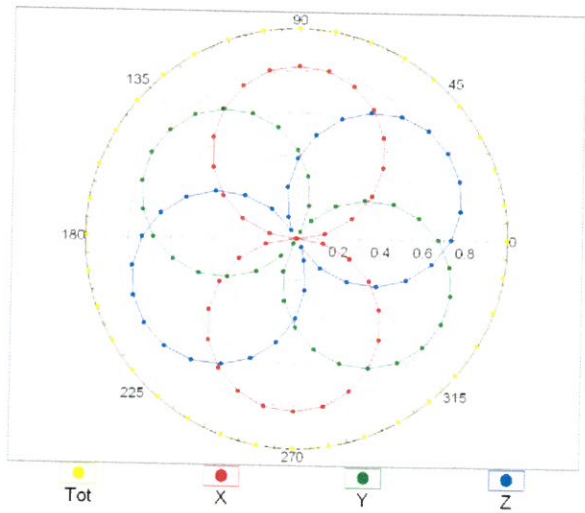


### Receiving Pattern ( $\phi$ ), $\theta = 0^\circ$

f=600 MHz, TEM

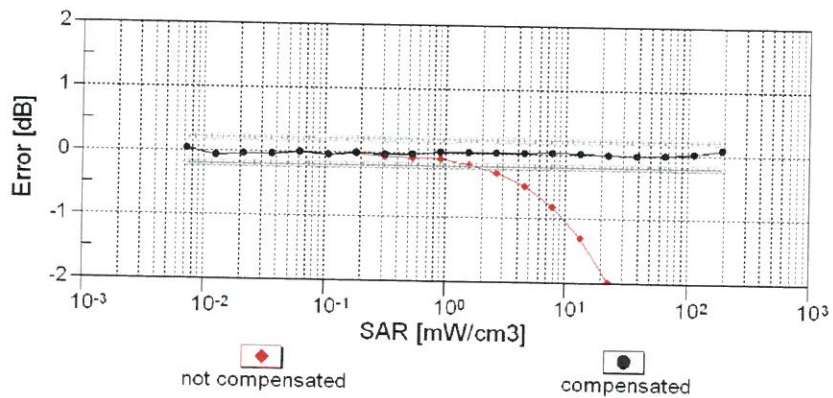
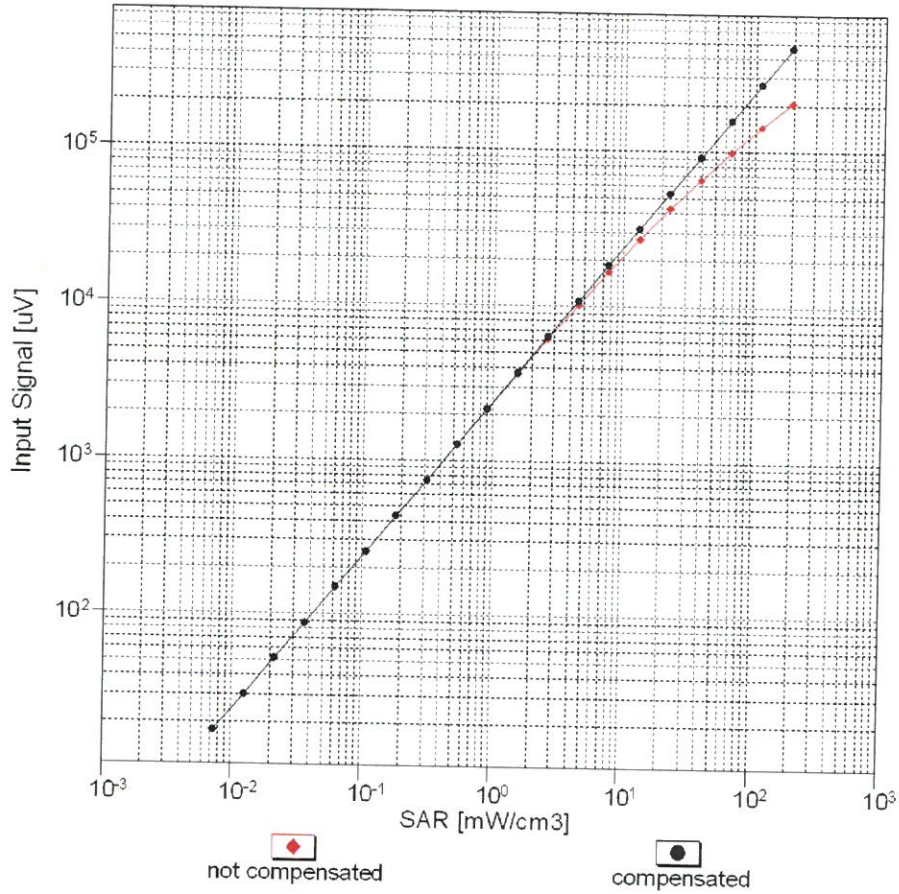


f=1800 MHz, R22



Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  (k=2)

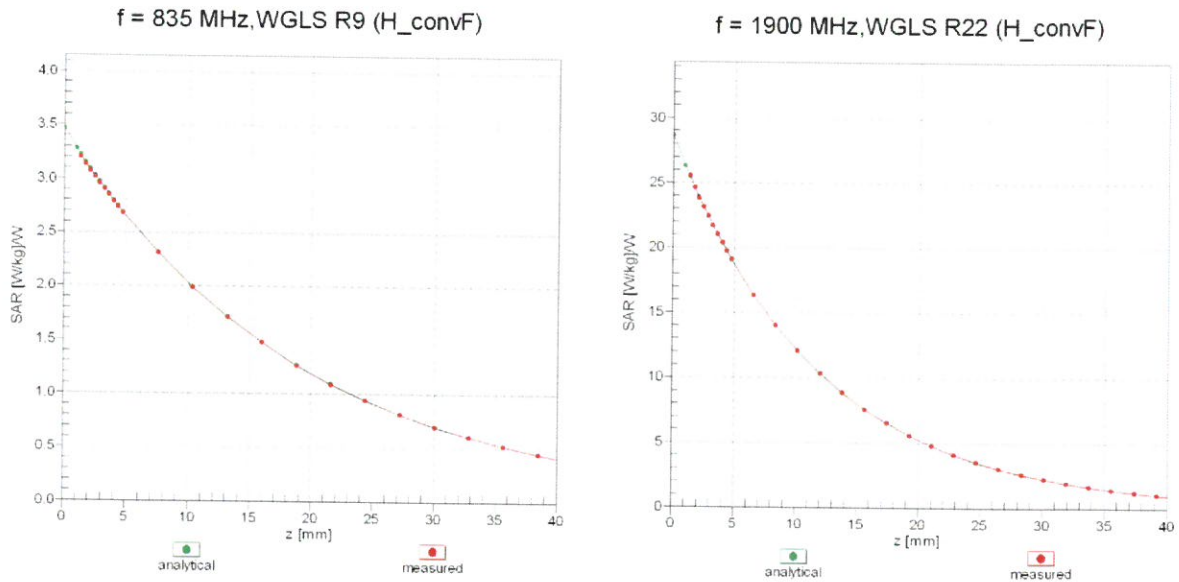
### Dynamic Range f(SAR<sub>head</sub>) (TEM cell , f<sub>eval</sub>= 1900 MHz)



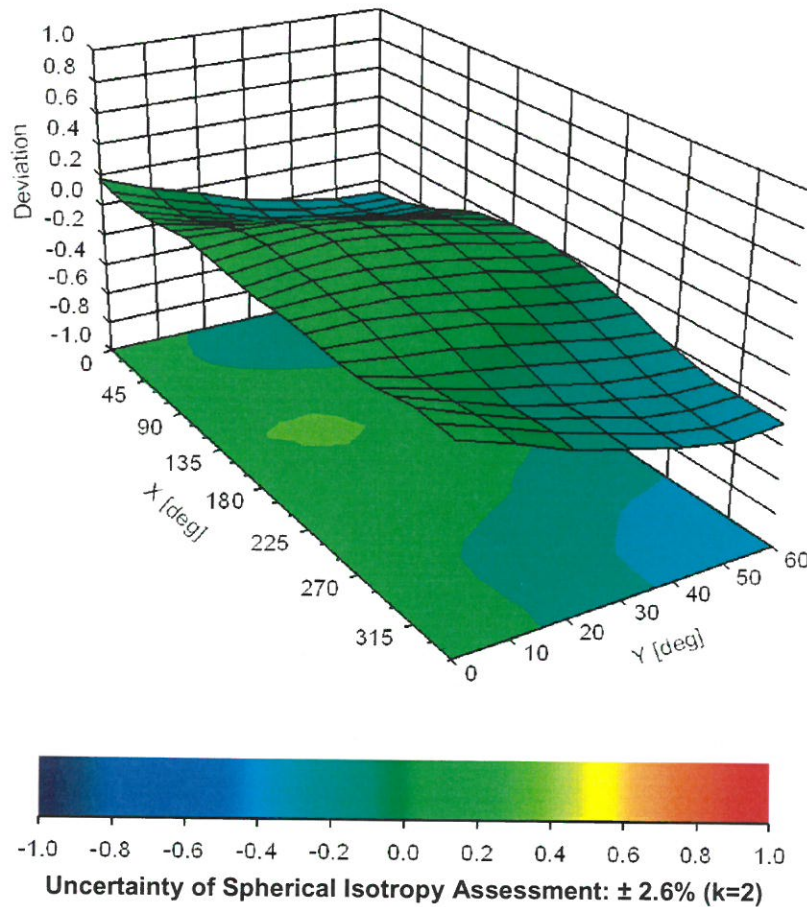
Uncertainty of Linearity Assessment: ± 0.6% (k=2)



## Conversion Factor Assessment



## Deviation from Isotropy in Liquid Error ( $\phi, \theta$ ), f = 900 MHz





## Dipole Internal Calibration Record

Asset No. :	E-434	Model No. :	D2450V2	Serial No. :	937
Environmental	23.1°C, 51 %	Original Cal. Date :	September 21, 2018	Next Cal. Date :	September 20, 2021

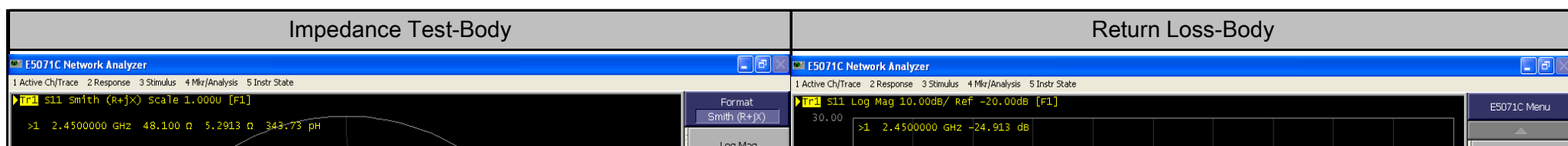
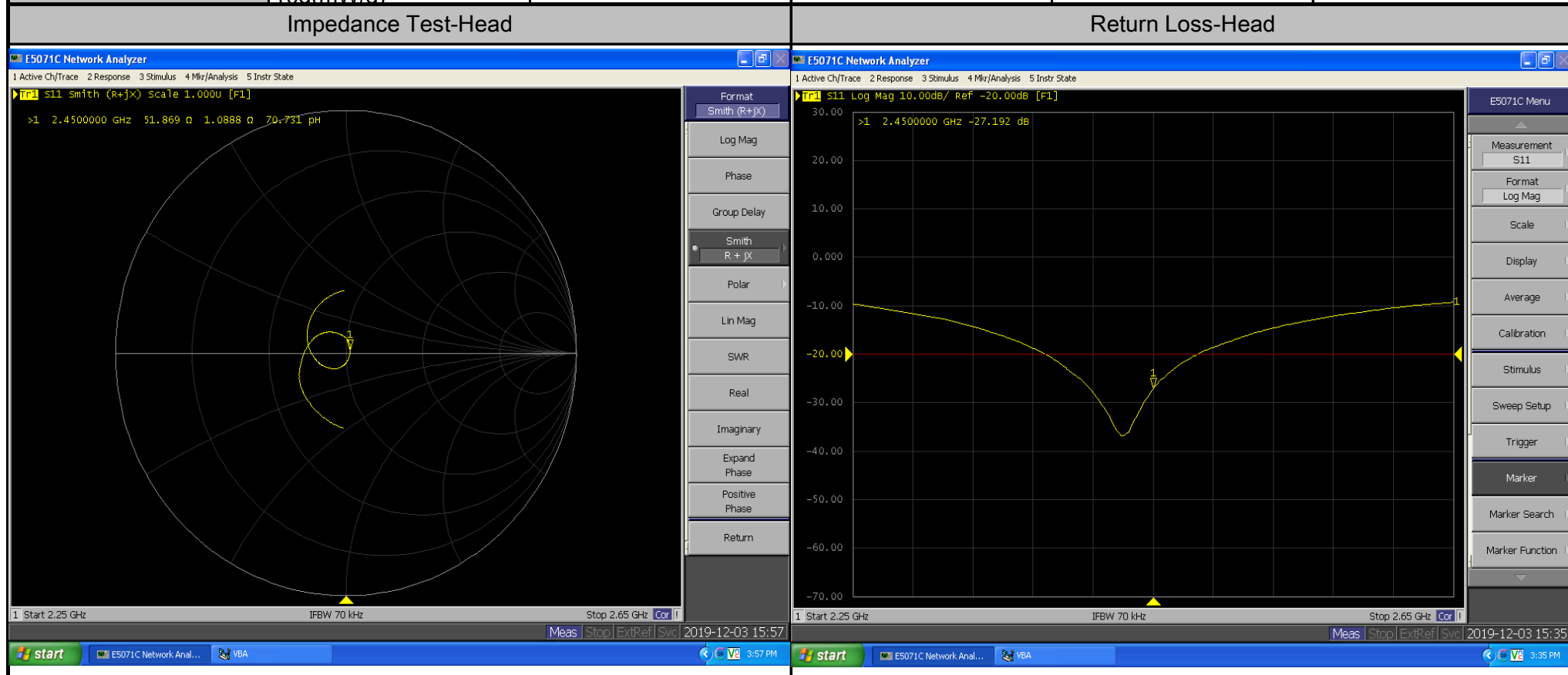
### Standard List

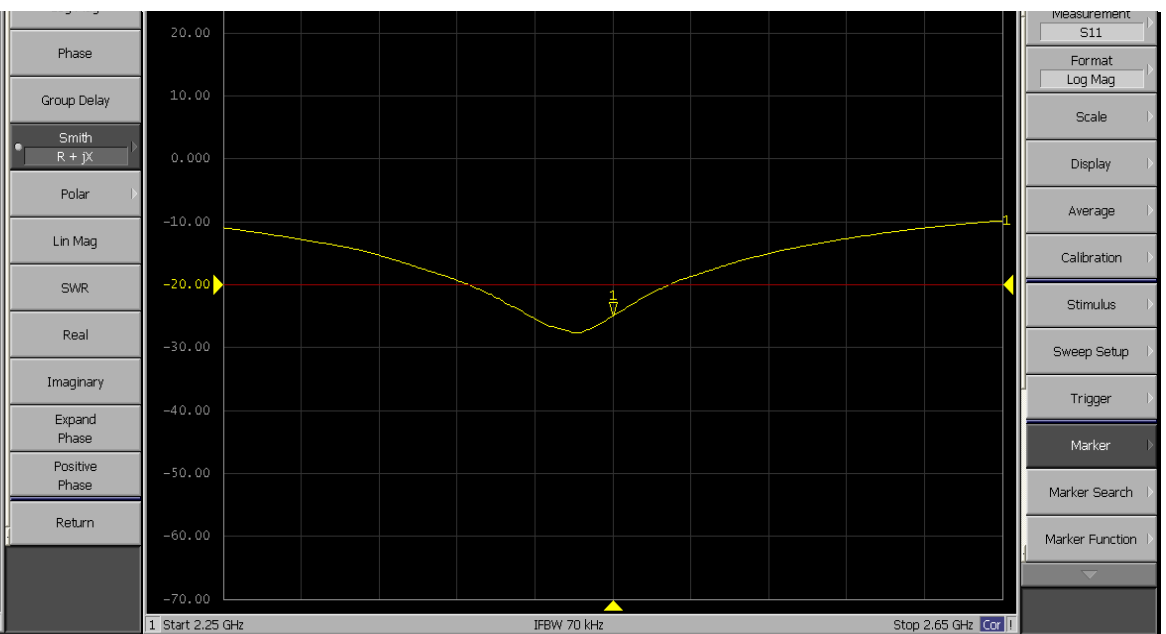
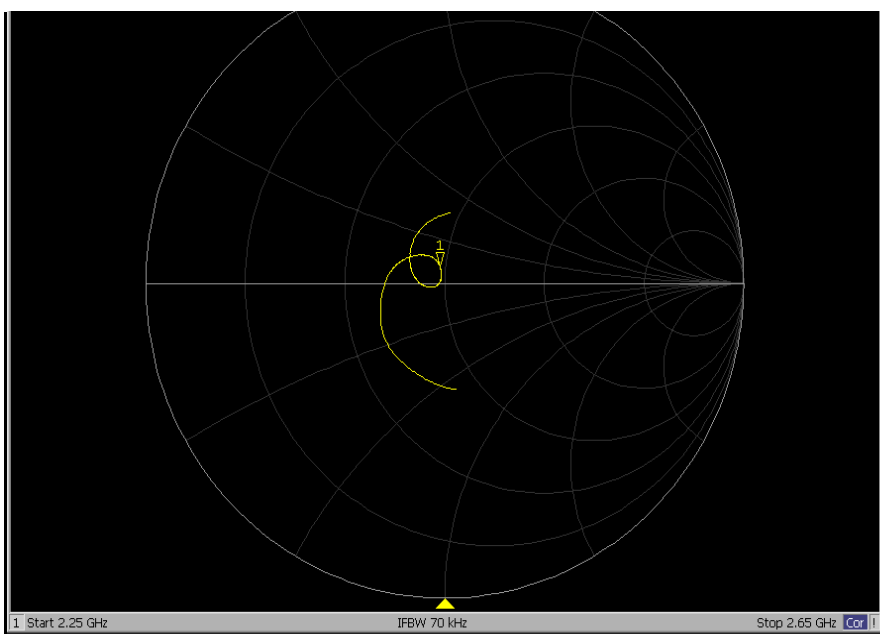
1	IEEE Std 1528-2013	IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate(SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques, June 2013
2	IEC 62209-2	Procedure to determine the Specific Absorption Rate (SAR) for wireless communication 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	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 sensor	Agilent	N1921A	MY51100041	NA	September 23, 2019
Smart Power Sensor	R&S	NRP-Z21	102209	NA	March 1, 2019
Dual directional coupler	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					
	Item	Originak Cal. Result	Verified on 2019/12/3	Deviation	Result	
D2450V2	Impedance, transformed to feed point	52.9Ω+2.01jΩ	51.869Ω+1.09jΩ	<5Ω	Pass	
	Return Loss(dB)	-29.3	-27.192	-7.2%	Pass	
	SAR Value for 1g(mW/g)	13.1	12.9	-1.5%	Pass	
	SAR Value for 10α(mW/α)	6.12	5.99	-2.1%	Pass	
	For Body Tissue					
		Item	Originak Cal. Result	Verified on 2019/12/3	Deviation	Result
		Impedance, transformed to feed point	49.9Ω+4.38jΩ	48.100Ω+5.29jΩ	<5Ω	Pass
		Return Loss(dB)	-27.2	-24.913	-8.4%	Pass
	SAR Value for 1g(mW/g)	12.8	13.1	2.3%	Pass	
	SAR Value for 10α(mW/α)	5.93	6.12	3.2%	Pass	





1 Start 2.25 GHz IFBW 70 kHz Stop 2.65 GHz Cor 1  
 Meas Stop ExtRef Svc 2019-12-03 16:51

1 Start 2.25 GHz IFBW 70 kHz Stop 2.65 GHz Cor 1  
 Meas Stop ExtRef Svc 2019-12-03 16:29

**Validation Report for Head TSL**

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

**System Check\_H2450\_1203**

DUT: Dipole 2450 MHz D2450V2;

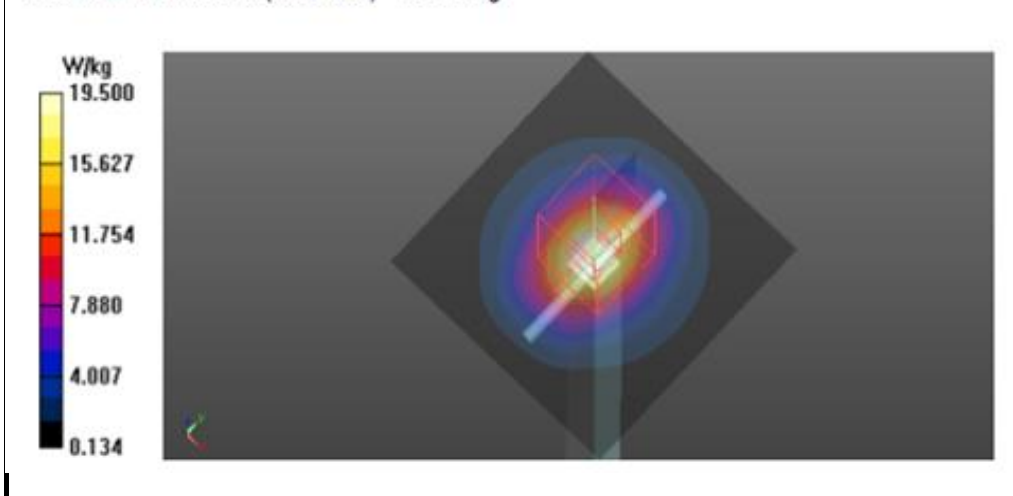
Communication System: UID 0, CW (0); Frequency: 2450 MHz; Duty Cycle: 1:1  
 Medium parameters used (interpolated):  $f = 2450$  MHz;  $\sigma = 1.874$  S/m;  $\epsilon_r = 38.311$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Ambient Temperature : 23.1 °C; Liquid Temperature : 22.4 °C

DASY Configuration:

- Probe: EX3DV4 - SN7544; ConvF(7.58, 7.58, 7.58) @ 2450 MHz; Calibrated: 2019/9/9
- Sensor-Surface: 4mm (Mechanical Surface Detection),  $z = 1.0, 31.0$
- Electronics: DAE4 Sn1390; Calibrated: 2019/10/29
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1222
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (7x7x1): Interpolated grid:  $dx=12$  mm,  $dy=12$  mm  
 Maximum value of SAR (interpolated) = 21.3 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm  
 Reference Value = 106.2 V/m; Power Drift = 0.00 dB  
 Peak SAR (extrapolated) = 23.5 W/kg  
 SAR(1 g) = 12.4 W/kg; SAR(10 g) = 6.2 W/kg  
 Maximum value of SAR (measured) = 19.5 W/kg



**Validation Report for Body TSL**

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

**System Check\_B2450\_1203**

DUT: Dipole 2450 MHz D2450V2;

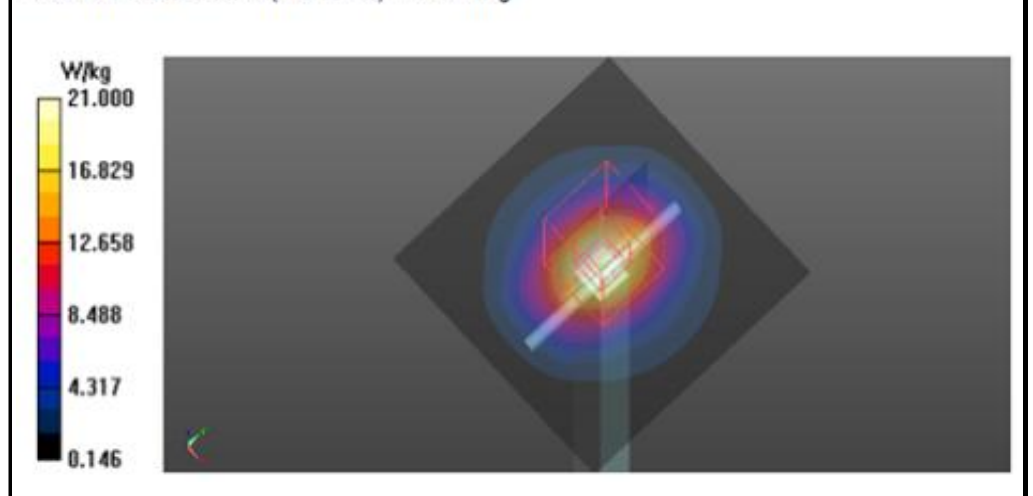
Communication System: UID 0, CW (0); Frequency: 2450 MHz; Duty Cycle: 1:1  
 Medium parameters used (interpolated):  $f = 2450$  MHz;  $\sigma = 2.036$  S/m;  $\epsilon_r = 52.015$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Ambient Temperature : 23.1 °C; Liquid Temperature : 22.4 °C

DASY Configuration:

- Probe: EX3DV4 - SN7544; ConvF(7.57, 7.57, 7.57) @ 2450 MHz; Calibrated: 2019/9/9
- Sensor-Surface: 4mm (Mechanical Surface Detection),  $z = 1.0, 31.0$
- Electronics: DAE4 Sn1390; Calibrated: 2019/10/29
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1222
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (7x7x1): Interpolated grid:  $dx=12$  mm,  $dy=12$  mm  
 Maximum value of SAR (interpolated) = 22.9 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm  
 Reference Value = 106.3 V/m; Power Drift = 0.00 dB  
 Peak SAR (extrapolated) = 25.2 W/kg  
 SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.12 W/kg  
 Maximum value of SAR (measured) = 21.0 W/kg



Calibrator: *Rot - Liang*

Approver: *Herbert Liu*





### Dipole Internal Calibration Record

Asset No. :	E-436	Model No. :	D5GHzV2	Serial No. :	1160
Environmental	22.3°C, 55 %	Original Cal. Date :	June 20, 2018	Next Cal. Date :	June 20, 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

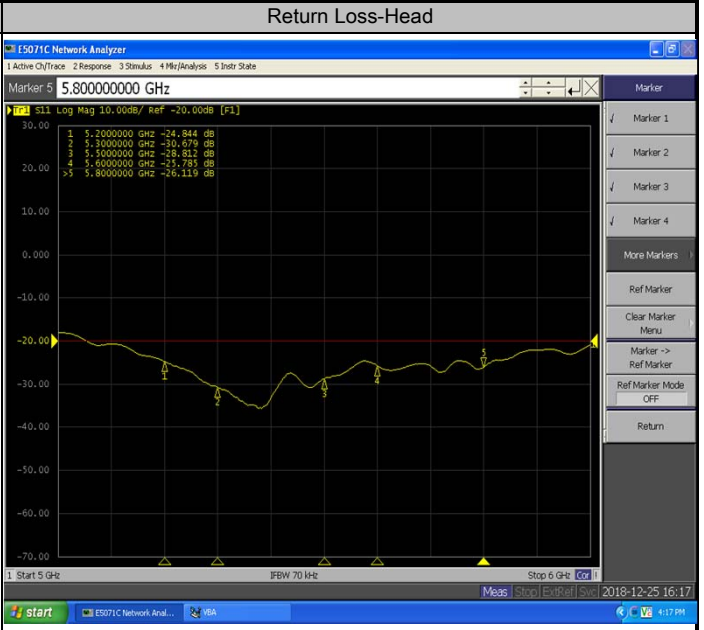
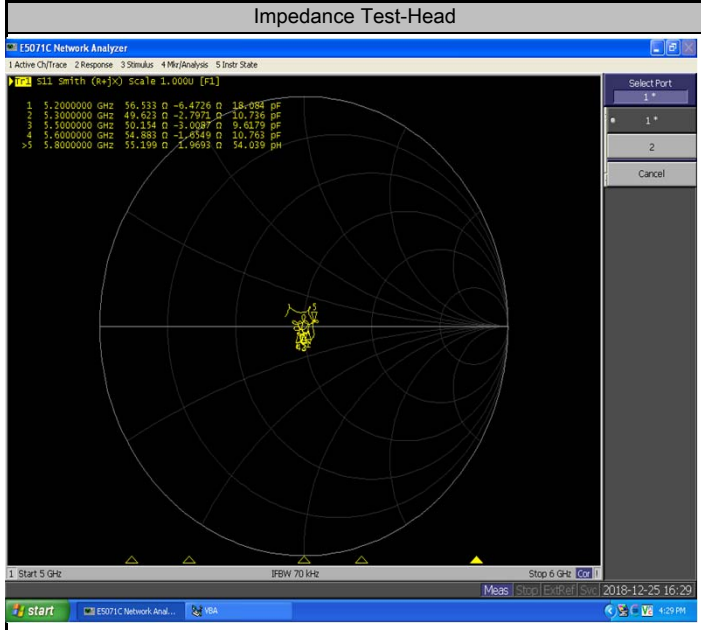
#### Equipment Information

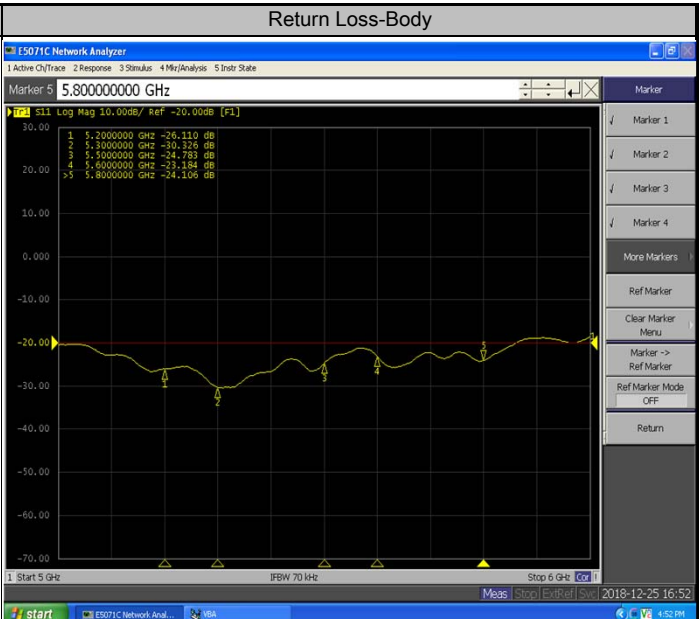
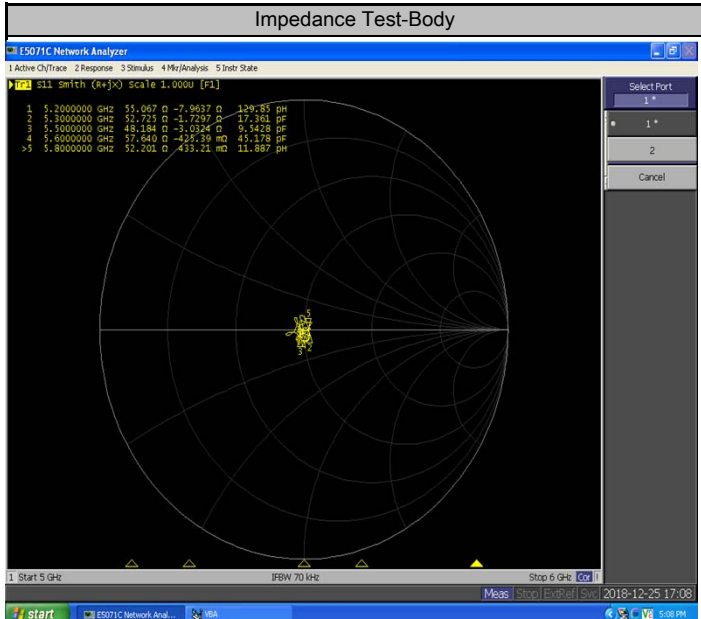
Equipment :	Manufacturer :	Model No. :	Serial No. :	Cal.Organization :	Cal. Date :
Power Amplifier	Mini-Circuits	ZVE-8G+	520701341	NA	March 9, 2018
DC Source	Iteck	OT6154	M00157	NA	October 12, 2018
P-series power meter	Agilent	N1911A	MY45100473	NA	August 11, 2018
wideband power sensor	Agilent	N1921A	MY51100041	NA	August 11, 2018
power Meter	Anritsu	ML2495A	1128009	NA	Mar. 11, 2018
Pulse Power Sensor	Anritsu	MA 2411B	1027500	NA	Mar. 11, 2018
Dual directional coupler	Woken	TS-PCC0M-05	107090019	NA	Mar. 11, 2018
MXG Analog Signal Generator	Agilent	N5181A	MY49060710	NA	August 11, 2018
ENA Network Analyzer	Agilent	E5071C	MY46102965	NA	March 11, 2018

Model No	For Head Tissue				
	Item	Originak Cal. Result	Verified on 2018/12/25	Deviation	Result
D5GHzV2(5.2GHz)	Impedance, transformed to feed point	53.5Ω-8.96jΩ	56.5Ω-6.47jΩ	<5Ω	Pass
	Return Loss(dB)	-20.7	-24.8	19.8%	Pass
	SAR Value for 1g(mW/g)	7.5	7.27	-3.1%	Pass
	SAR Value for 10g(mW/g)	2.16	2.07	-4.2%	Pass
D5GHzV2(5.3GHz)	Impedance, transformed to feed point	50.1Ω-3jΩ	49.6Ω-2.8jΩ	<5Ω	Pass
	Return Loss(dB)	-30.5	-30.7	0.7%	Pass
	SAR Value for 1g(mW/g)	7.66	7.34	-4.2%	Pass
	SAR Value for 10g(mW/g)	2.2	2.07	-5.9%	Pass
D5GHzV2(5.5GHz)	Impedance, transformed to feed point	51.4Ω-5.39jΩ	50.2Ω-3.01jΩ	<5Ω	Pass
	Return Loss(dB)	-25.2	-28.8	14.3%	Pass
	SAR Value for 1g(mW/g)	8.08	8.32	3.0%	Pass
	SAR Value for 10g(mW/g)	2.3	2.33	1.3%	Pass
D5GHzV2(5.6GHz)	Impedance, transformed to feed point	57.5Ω-2.95jΩ	54.9Ω-1.65jΩ	<5Ω	Pass
	Return Loss(dB)	-22.5	-25.8	14.7%	Pass
	SAR Value for 1g(mW/g)	7.85	7.84	-0.1%	Pass
	SAR Value for 10g(mW/g)	2.25	2.2	-2.2%	Pass
D5GHzV2(5.8GHz)	Impedance, transformed to feed point	54.5Ω-1.38jΩ	55.2Ω+1.97jΩ	<5Ω	Pass
	Return Loss(dB)	-26.9	-26.1	-3.0%	Pass
	SAR Value for 1g(mW/g)	7.78	7.89	1.4%	Pass
	SAR Value for 10g(mW/g)	2.21	2.21	0.0%	Pass



Model No	For Body Tissue				
	Item	Originak Cal. Result	Verified on 2018/12/25	Deviation	Result
D5GHzV2(5.2GHz)	Impedance, transformed to feed point	53.1Ω-7.52jΩ	55.1Ω-7.96jΩ	<5Ω	Pass
	Return Loss(dB)	-22.1	-26.1	18.1%	Pass
	SAR Value for 1g(mW/g)	6.99	7.28	4.1%	Pass
	SAR Value for 10g(mW/g)	1.92	2.06	7.3%	Pass
D5GHzV2(5.3GHz)	Impedance, transformed to feed point	49.3Ω-2.06jΩ	52.7Ω-1.73jΩ	<5Ω	Pass
	Return Loss(dB)	-33.1	-30.3	-8.5%	Pass
	SAR Value for 1g(mW/g)	7.25	7.16	-1.2%	Pass
	SAR Value for 10g(mW/g)	2.04	2	-2.0%	Pass
D5GHzV2(5.5GHz)	Impedance, transformed to feed point	50.9Ω-4.94jΩ	48.2Ω-3.03jΩ	<5Ω	Pass
	Return Loss(dB)	-26.1	-24.8	-5.0%	Pass
	SAR Value for 1g(mW/g)	7.63	7.72	1.2%	Pass
	SAR Value for 10g(mW/g)	2.13	2.16	1.4%	Pass
D5GHzV2(5.6GHz)	Impedance, transformed to feed point	58.5Ω-0.79jΩ	57.6Ω-0.43jΩ	<5Ω	Pass
	Return Loss(dB)	-22.1	-23.2	5.0%	Pass
	SAR Value for 1g(mW/g)	7.78	7.92	1.8%	Pass
	SAR Value for 10g(mW/g)	2.14	2.2	2.8%	Pass
D5GHzV2(5.8GHz)	Impedance, transformed to feed point	54.3Ω+0.12jΩ	52.2Ω+0.43jΩ	<5Ω	Pass
	Return Loss(dB)	-27.6	-24.1	-12.7%	Pass
	SAR Value for 1g(mW/g)	7.66	7.79	1.7%	Pass
	SAR Value for 10g(mW/g)	2.15	2.16	0.5%	Pass





### Validation Report for Head TSL of 5.2GHz

Test Laboratory: BTL Inc. Date: 2018/12/25<sup>+</sup>

**System Check\_H5200\_7396<sup>+</sup>**

**DUT: Dipole D5GHzV2;SN;1160;<sup>+</sup>**

Communication System: UID 0, CW (0); Frequency: 5200 MHz; Duty Cycle: 1:1  
 Medium parameters used: f = 5200 MHz;  $\sigma = 4.766$  S/m;  $\epsilon_r = 35.64$ ;  $\rho = 996$  kg/m<sup>3</sup>  
 Ambient Temperature : 23.2 °C; Liquid Temperature : 22.5 °C<sup>+</sup>

DASY Configuration:<sup>+</sup>

- Probe: EX3DV4 - SN7396; ConvE(5.7, 5.7, 5.7) @ 5200 MHz; Calibrated: 2018/5/29<sup>+</sup>
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 23.0<sup>+</sup>
- Electronics: DAE4 Sn1390; Calibrated: 2018/5/11<sup>+</sup>
- Phantom: SAM Right; Type: Twin SAM; Serial: 1896<sup>+</sup>
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)<sup>+</sup>

↓

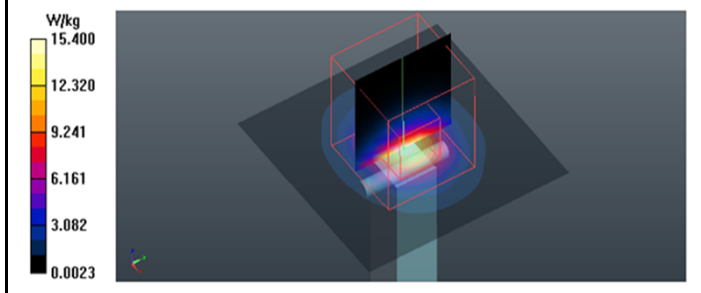
**Area Scan (6x6x1):** Interpolated grid: dx=10 mm, dy=10 mm  
 Maximum value of SAR (interpolated) = 15.4 W/kg<sup>+</sup>

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**Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm  
 Reference Value = 41.93 V/m; Power Drift = -0.11 dB  
 Peak SAR (extrapolated) = 30.7 W/kg<sup>+</sup>

**SAR(1 g) = 7.27 W/kg; SAR(10 g) = 2.07 W/kg<sup>+</sup>**

Maximum value of SAR (measured) = 15.4 W/kg



### Validation Report for Head TSL of 5.3GHz

Test Laboratory: BTL Inc. Date: 2018/12/25<sup>+</sup>

**System Check\_H5300\_7396<sup>+</sup>**

**DUT: Dipole D5GHzV2;SN;1160;<sup>+</sup>**

Communication System: UID 0, CW (0); Frequency: 5300 MHz; Duty Cycle: 1:1  
 Medium parameters used (interpolated): f = 5300 MHz;  $\sigma = 4.882$  S/m;  $\epsilon_r = 35.392$ ;  $\rho = 996$  kg/m<sup>3</sup>  
 Ambient Temperature : 23.2 °C; Liquid Temperature : 22.5 °C<sup>+</sup>

DASY Configuration:<sup>+</sup>

- Probe: EX3DV4 - SN7396; ConvE(5.35, 5.35, 5.35) @ 5300 MHz; Calibrated: 2018/5/29<sup>+</sup>
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 23.0<sup>+</sup>
- Electronics: DAE4 Sn1390; Calibrated: 2018/5/11<sup>+</sup>
- Phantom: SAM Right; Type: Twin SAM; Serial: 1896<sup>+</sup>
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)<sup>+</sup>

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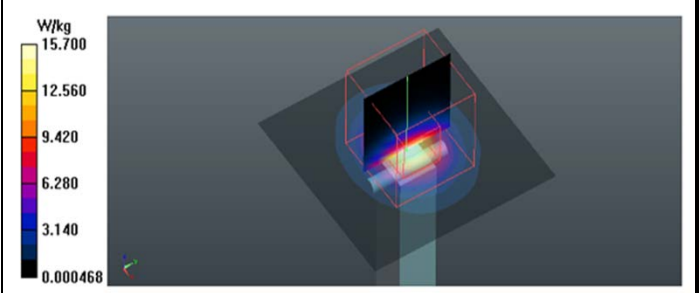
**Area Scan (6x6x1):** Interpolated grid: dx=10 mm, dy=10 mm  
 Maximum value of SAR (interpolated) = 16.5 W/kg<sup>+</sup>

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**Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm  
 Reference Value = 41.02 V/m; Power Drift = -0.06 dB  
 Peak SAR (extrapolated) = 31.4 W/kg<sup>+</sup>

**SAR(1 g) = 7.34 W/kg; SAR(10 g) = 2.07 W/kg<sup>+</sup>**

Maximum value of SAR (measured) = 15.7 W/kg



Validation Report for Head TSL of 5.5GHz

Validation Report for Head TSL of 5.6GHz

Test Laboratory: BTL Inc. Date: 2018/12/25

Test Laboratory: BTL Inc. Date: 2018/12/25

System Check\_H5500\_7396

System Check\_H5600\_7396

DUT: Dipole D5GHzV2;SN:1160

DUT: Dipole D5GHzV2;SN:1160

Communication System: UID 0, CW (0); Frequency: 5500 MHz; Duty Cycle: 1:1  
 Medium parameters used:  $f = 5500$  MHz;  $\sigma = 5.112$  S/m;  $\epsilon_r = 34.912$ ;  $\rho = 996$  kg/m<sup>3</sup>  
 Ambient Temperature : 23.2 °C; Liquid Temperature : 22.5 °C

Communication System: UID 0, CW (0); Frequency: 5600 MHz; Duty Cycle: 1:1  
 Medium parameters used:  $f = 5600$  MHz;  $\sigma = 5.235$  S/m;  $\epsilon_r = 34.669$ ;  $\rho = 996$  kg/m<sup>3</sup>  
 Ambient Temperature : 23.2 °C; Liquid Temperature : 22.5 °C

DASY Configuration

DASY Configuration

- Probe: EX3DV4 - SN7396; ConnE(4.94, 4.94, 4.94) @ 5500 MHz; Calibrated: 2018/5/29
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 23.0
- Electronics: DAE4 Sn1390; Calibrated: 2018/5/11
- Phantom: SAM Right; Type: Twin SAM; Serial: 1896
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

- Probe: EX3DV4 - SN7396; ConnE(4.94, 4.94, 4.94) @ 5600 MHz; Calibrated: 2018/5/29
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 23.0
- Electronics: DAE4 Sn1390; Calibrated: 2018/5/11
- Phantom: SAM Right; Type: Twin SAM; Serial: 1896
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (6x6x1): Interpolated grid: dx=10 mm, dy=10 mm  
 Maximum value of SAR (interpolated) = 18.5 W/kg

Area Scan (6x6x1): Interpolated grid: dx=10 mm, dy=10 mm  
 Maximum value of SAR (interpolated) = 17.4 W/kg

Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm  
 Reference Value = 42.15 V/m; Power Drift = -0.07 dB  
 Peak SAR (extrapolated) = 38.9 W/kg

Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm  
 Reference Value = 40.04 V/m; Power Drift = -0.09 dB  
 Peak SAR (extrapolated) = 37.1 W/kg

SAR(1 g) = 8.32 W/kg; SAR(10 g) = 2.33 W/kg  
 Maximum value of SAR (measured) = 17.9 W/kg

SAR(1 g) = 7.84 W/kg; SAR(10 g) = 2.2 W/kg  
 Maximum value of SAR (measured) = 17.0 W/kg

