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eNeura, Inc SAR TEST REPORT

SCOPE OF WORK

Specific Absorption Rate – SAVI

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SPECIFIC ABSORPTION RATE TEST REPORT

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Product Name: SAVI

Model Number: SAVI

Standards: FCC Part 2.1093

RSS-102 Issue 5

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TABLE OF CONTENTS

1	INTRODUCTION	4
2	TEST SITE DESCRIPTION.....	5
3	JOB DESCRIPTION	10
4	SYSTEM VERIFICATION.....	12
5	EVALUATION PROCEDURES.....	17
6	CRITERIA	22
7	TEST CONFIGURATION	22
8	TEST RESULTS	24
9	SAR DATA:.....	24
1.0	REFERENCES	31
	APPENDIX A – SYSTEM VALIDATION SUMMARY.....	32
	APPENDIX B – WORST CASE SAR PLOTS	33
	APPENDIX C – DIPOLE VALIDATION PLOTS	37



1 INTRODUCTION

At the request of eNeura, Inc the SAVI was evaluated for SAR in accordance with the requirements for FCC Part 2.1093 and RSS-102 Issue 5. Testing was performed in accordance with IEEE Std 1528:2013, IEC62209-2:2010, and the Office of Engineering and Technology KDB 447498. Testing was performed at the Intertek facility in Lexington, Kentucky.

For the evaluation, the dosimetric assessment system DASY52 was used. The total uncertainty for the evaluation of the spatial peak SAR values averaged over a cube of 1g tissue mass had been assessed for this system to be $\pm 22.2\%$ from 300MHz – 3GHz and 24.6% from 3GHz – 6GHz.

The SAVI was tested at the maximum output power measured by Intertek. Maximum output power measurements are tabulated under Section 8 Test Results. The maximum spatial peak SAR value for the sample device averaged over 1g (for body worn mode) and 10g (for hand held mode) is shown below.

Based on the worst-case data presented below, the SAVI was found to be **compliant** with the 1.6 W/kg and 4W/kg requirements for general population / uncontrolled exposure.

Table 1: Worst Case Reported SAR per Exposure Condition

Device Position	Transmit Mode	Separation Distance	Channel	Maximum Conducted Output Power (dBm)	Reported SAR (W/kg)	Limit (W/kg)
Extremity Worn, Back Side	QPSK	0mm	Band 4, Channel 20175	23.56dBm	1.63W/kg (10g)	4.0W/kg
Body Worn, Back Side	QPSK	5mm	Band 4, Channel 20175	23.56dBm	1.056W/kg (1g)	1.6W/kg



2 TEST SITE DESCRIPTION

The SAR test site located at 731 Enterprise Drive, Lexington KY 40510 is comprised of the SPEAG model DASY 5.2 automated near-field scanning system, which is a package, optimized for dosimetric evaluation of mobile radios [3]. This system is installed in an ambient-free shielded chamber. The ambient temperature is controlled to $22.0 \pm 2^\circ\text{C}$. During the SAR evaluations, the RF ambient conditions are monitored continuously for signals that might interfere with the test results. The tissue simulating liquid is also stored in this area in order to keep it at the same constant ambient temperature as the room.

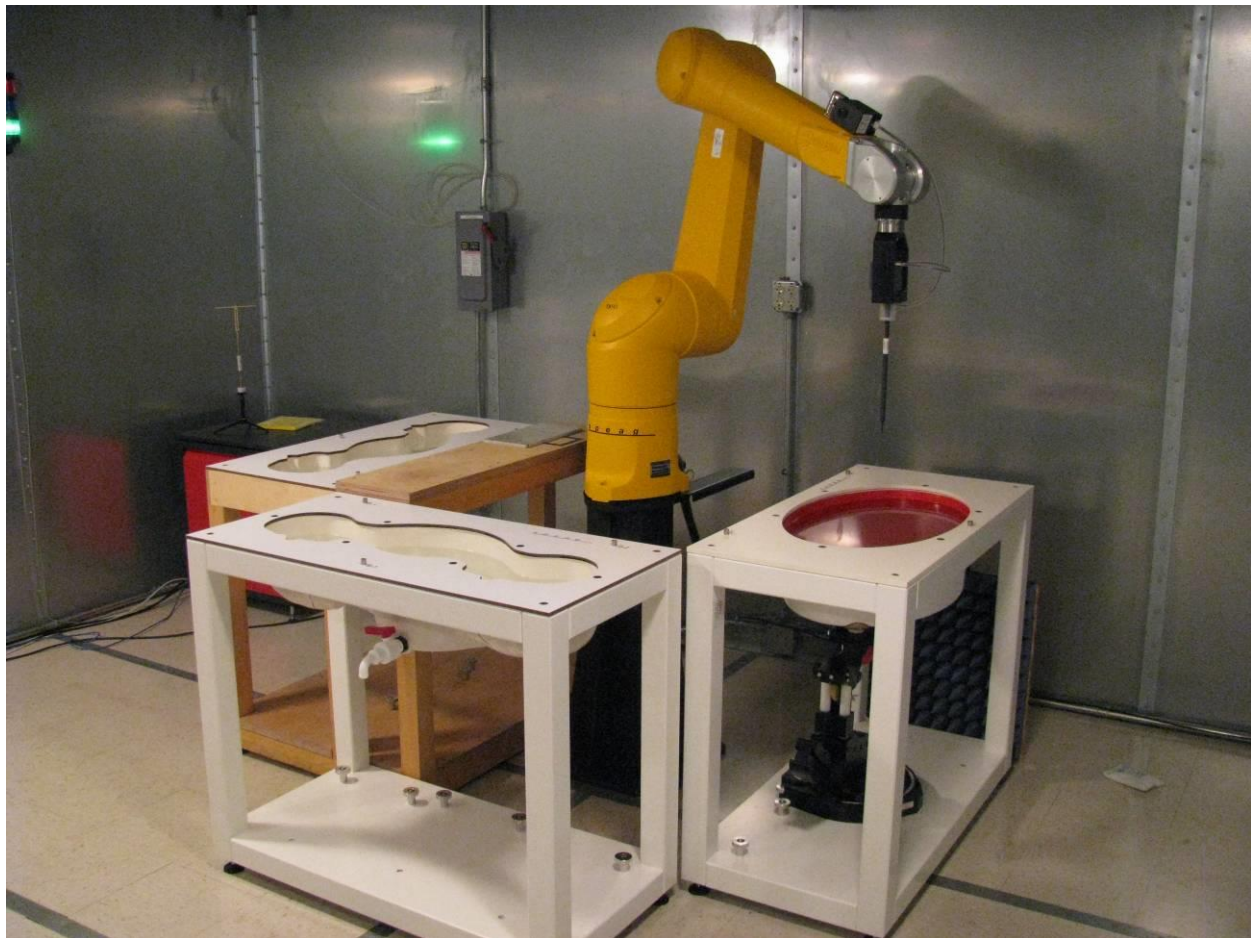


Figure 1: Intertek SAR Test Site



2.1 Measurement Equipment

The following major equipment/components were used for the SAR evaluation:

Table 2: Test Equipment Used for SAR Evaluation

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
SAR Probe	3516	Speag	EXDV3	11/19/2010	11/19/2020
1900MHz Dipole	5d154	Speag	D1900V2	11/13/2019	11/13/2020
1800MHz Dipole	224	Speag	D1800V2	11/13/2019	11/13/2020
750MHz Dipole	1042	Speag	D750V3	11/11/2019	11/11/2020
DAE	358	Speag	DAE4	11/13/2019	11/13/2020
Vector Signal Generator	257708	Rohde & Schwarz	SMBV100A	9/18/2019	9/18/2020
Network Analyzer	US39173983	Agilent	8753ES	3/4/2019	3/4/2020
USB Power Sensor	100155	Rohde & Schwarz	NRP-Z81	9/18/2019	9/18/2020
USB Power Sensor	100705	Rohde & Schwarz	NRP-Z51	9/18/2019	9/18/2020
Dielectric Probe Kit	1111	Speag	DAK-3.5	11/12/2019	11/12/2020
Spectrum Analyzer	3099	Rohde & Schwarz	FSP7	9/21/2019	9/21/2020
SAM Twin Phantom	1663	Speag	QD 000 P40 C	NCR	NCR
6-axis robot	F11/5H1YA/A/01	Staubli	RX-90	NCR	NCR

**NCR – No Calibration Required*



SAR Test Report

2.2 Measurement Uncertainty

The Tables below includes the uncertainty budget suggested by the IEEE Std 1528-2013 and IEC62209-2: 2010 as determined by SPEAG for the DASY5 measurement System.

Error Description	Uncertainty Value	Prob. Dist.	Div.	c_i (1g)	c_i (10g)	Std.Unc. (1g)	Std.Unc. (10g)	$(v_i)_{V_{eff}}$
Measurement System								
Probe Calibration	±6.0%	N	1	1	1	±6.0%	±6.0%	∞
Axial Isotropy	±4.7%	R	√3	0.7	0.7	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.6%	R	√3	0.7	0.7	±3.9%	±3.9%	∞
Boundary Effect	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
Linearity	±4.7%	R	√3	1	1	±2.7%	±2.7%	∞
System Detection Limits	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
Modulation Response	±2.4%	R	√3	1	1	±1.4%	±1.4%	∞
Readout Electronics	±0.3%	N	1	1	1	±0.3%	±0.3%	∞
Response Time	±0.8%	R	√3	1	1	±0.5%	±0.5%	∞
Integration Time	±2.6%	R	√3	1	1	±1.5%	±1.5%	∞
RF Ambient Noise	±3.0%	R	√3	1	1	±1.7%	±1.7%	∞
RF Ambient Reflections	±3.0%	R	√3	1	1	±1.7%	±1.7%	∞
Probe Positioner	±0.4%	R	√3	1	1	±0.2%	±0.2%	∞
Probe Positioning	±2.9%	R	√3	1	1	±1.7%	±1.7%	∞
Max. SAR Eval.	±2.0%	R	√3	1	1	±1.2%	±1.2%	∞
Test sample Related								
Device Positioning	±2.9%	N	1	1	1	±2.9%	±2.9%	145
Device Holder	±3.6%	N	1	1	1	±3.6%	±3.6%	5
Power Drift	±5.0%	R	√3	1	1	±2.9%	±2.9%	∞
Power Scaling	±0.0%	R	√3	1	1	±0%	±0%	∞
Phantom and Setup								
Phantom Uncertainty	±6.1%	R	√3	1	1	±3.5%	±3.5%	∞
SAR Correction	±1.9%	R	√3	1	0.84	±1.1%	±0.9%	∞
Liquid Conductivity (mea.)	±2.5%	R	√3	0.78	0.71	±1.1%	±1.0%	∞
Liquid Permittivity(mea.)	±2.5%	R	√3	0.26	0.26	±0.3%	±0.4%	∞
Temp unc. - Conductivity	±3.4%	R	√3	0.78	0.71	±1.5%	±1.4%	∞
Temp unc. - Permittivity	±0.4%	R	√3	0.23	0.26	±0.1%	±0.1%	∞
Combined Standard Uncertainty						±11.2%	±11.1%	361
Expanded STD Uncertainty						±22.3%	±22.2%	

Notes:

Worst Case uncertainty budget for DASY5 assessed according to IEEE 1528-2013. The budget is valid for the frequency range 300 MHz – 3 GHz and represents a worst-case analysis. For specific tests and configurations, the uncertainty could be considerably smaller.



SAR Test Report

Error Description	Uncertainty Value	Prob. Dist.	Div.	c_i (1g)	c_i (10g)	Std.Unc. (1g)	Std.Unc. (10g)	$(V_i)_{V_{eff}}$
Measurement System								
Probe Calibration	±6.55%	N	1	1	1	±6.55%	±6.55%	∞
Axial Isotropy	±4.7%	R	√3	0.7	0.7	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.6%	R	√3	0.7	0.7	±3.9%	±3.9%	∞
Boundary Effect	±2.0%	R	√3	1	1	±1.2%	±1.2%	∞
Linearity	±4.7%	R	√3	1	1	±2.7%	±2.7%	∞
System Detection Limits	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
Modulation Response	±2.4%	R	√3	1	1	±1.4%	±1.4%	∞
Readout Electronics	±0.3%	N	1	1	1	±0.3%	±0.3%	∞
Response Time	±0.8%	R	√3	1	1	±0.5%	±0.5%	∞
Integration Time	±2.6%	R	√3	1	1	±1.5%	±1.5%	∞
RF Ambient Noise	±3.0%	R	√3	1	1	±1.7%	±1.7%	∞
RF Ambient Reflections	±3.0%	R	√3	1	1	±1.7%	±1.7%	∞
Probe Positioner	±0.8%	R	√3	1	1	±0.5%	±0.5%	∞
Probe Positioning	±6.7%	R	√3	1	1	±3.9%	±3.9%	∞
Max. SAR Eval.	±4.0%	R	√3	1	1	±2.3%	±2.3%	∞
Test sample Related								
Device Positioning	±2.9%	N	1	1	1	±2.9%	±2.9%	145
Device Holder	±3.6%	N	1	1	1	±3.6%	±3.6%	5
Power Drift	±5.0%	R	√3	1	1	±2.9%	±2.9%	∞
Power Scaling	±0.0%	R	√3	1	1	±0%	±0%	∞
Phantom and Setup								
Phantom Uncertainty	±6.6%	R	√3	1	1	±3.8%	±3.8%	∞
SAR Correction	±1.9%	R	√3	1	0.84	±1.1%	±0.9%	∞
Liquid Conductivity (mea.)	±2.5%	R	√3	0.78	0.71	±1.1%	±1.0%	∞
Liquid Permittivity(mea.)	±2.5%	R	√3	0.26	0.26	±0.3%	±0.4%	∞
Temp unc. - Conductivity	±3.4%	R	√3	0.78	0.71	±1.5%	±1.4%	∞
Temp unc. - Permittivity	±0.4%	R	√3	0.23	0.26	±0.1%	±0.1%	∞
Combined Standard Uncertainty						±12.3%	±12.2%	748
Expanded STD Uncertainty						±24.6%	±24.5%	

Notes.

Worst Case uncertainty budget for DASY5 assessed according to IEEE 1528-2013. The budget is valid for the frequency range 3 GHz – 6 GHz and represents a worst-case analysis. Probe calibration error reflects uncertainty of the EX3D probe. For specific tests and configurations, the uncertainty could be considerably smaller.



SAR Test Report

Error Description	Uncertainty Value	Prob. Dist.	Div.	c_i (1g)	c_i (10g)	Std.Unc. (1g)	Std.Unc. (10g)	$(V_i)_{V_{eff}}$
Measurement System								
Probe Calibration	±6.55%	N	1	1	1	±6.55%	±6.55%	∞
Axial Isotropy	±4.7%	R	√3	0.7	0.7	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.6%	R	√3	0.7	0.7	±3.9%	±3.9%	∞
Boundary Effect	±2.0%	R	√3	1	1	±1.2%	±1.2%	∞
Linearity	±4.7%	R	√3	1	1	±2.7%	±2.7%	∞
System Detection Limits	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
Modulation Response	±2.4%	R	√3	1	1	±1.4%	±1.4%	∞
Readout Electronics	±0.3%	N	1	1	1	±0.3%	±0.3%	∞
Response Time	±0.8%	R	√3	1	1	±0.5%	±0.5%	∞
Integration Time	±2.6%	R	√3	1	1	±1.5%	±1.5%	∞
RF Ambient Noise	±3.0%	R	√3	1	1	±1.7%	±1.7%	∞
RF Ambient Reflections	±3.0%	R	√3	1	1	±1.7%	±1.7%	∞
Probe Positioner	±0.8%	R	√3	1	1	±0.5%	±0.5%	∞
Probe Positioning	±6.7%	R	√3	1	1	±3.9%	±3.9%	∞
Post-Processing	±4.0%	R	√3	1	1	±2.3%	±2.3%	∞
Test sample Related								
Device Positioning	±2.9%	N	1	1	1	±2.9%	±2.9%	145
Device Holder	±3.6%	N	1	1	1	±3.6%	±3.6%	5
Power Drift	±5.0%	R	√3	1	1	±2.9%	±2.9%	∞
Power Scaling	±0.0%	R	√3	1	1	±0%	±0%	∞
Phantom and Setup								
Phantom Uncertainty	±7.9%	R	√3	1	1	±4.6%	±4.6%	∞
SAR Correction	±1.9%	R	√3	1	0.84	±1.1%	±0.9%	∞
Liquid Conductivity (mea.)	±2.5%	R	√3	0.78	0.71	±1.1%	±1.0%	∞
Liquid Permittivity(me.)	±2.5%	R	√3	0.26	0.26	±0.3%	±0.4%	∞
Temp unc. - Conductivity	±3.4%	R	√3	0.78	0.71	±1.5%	±1.4%	∞
Temp unc. - Permittivity	±0.4%	R	√3	0.23	0.26	±0.1%	±0.1%	∞
Combined Standard Uncertainty						±12.5%	±12.5%	748
Expanded STD Uncertainty						±25.1%	±25.0%	

Notes.

Worst Case uncertainty budget for DASY5 assessed according to IEC62209-2: 2010. The budget is valid for the frequency range 30MHz – 6 GHz and represents a worst-case analysis. Probe calibration error reflects uncertainty of the EX3D probe. For specific tests and configurations, the uncertainty could be considerably smaller.



3 JOB DESCRIPTION

At the request eNeura, Inc, SAR testing was performed on the SAVI (Model: SAVI).

The SAVI is a therapeutic device used in the treatment of migraine headaches. It applies magnetic stimulation therapy and then transmits data back to the supervising clinician via an embedded cellular module (Sierra Wireless Model HL7648). The data transmission occurs after the therapy has completed. The data transmission does not occur whilst the device is being held to the head.

Table 3: Product Information

Test Sample Information	
Manufacturer	eNeura, Inc
Product Name	SAVI
Model Number	SAVI
Serial Number	30001002
Receive Date	1/13/2020
Device Received Condition	Good
Test Dates	1/23/2020 to 2/3/2020
Device Category	Portable
RF Exposure Category	General Population/Uncontrolled Environment
Integrated Module	Sierra Wireless HL7648 (FCCID: N7NHL7648)
Antenna Type	Internal
Test sample Accessories	
Accessory	None

Table 4: Operating Bands

Operating Bands	Technology	Modulation	Frequency Range (MHz)	Max Upper Tolerance Output Power (dBm)	Duty Cycle
LTE Band 4	LTE	QPSK, 16QAM	1710 to 1755MHz	25dBm	1:1
LTE Band 12	LTE	QPSK, 16QAM	699 to 716MHz	25dBm	1:1
LTE Band 2	LTE	QPSK, 16QAM	1850 to 1910MHz	25dBm	1:1



3.1 EUT Photo (Front):



3.2 EUT Photo (Back):





4 SYSTEM VERIFICATION

System Validation

Prior to the assessment, the system was verified to be within $\pm 10\%$ of the specifications by using the system validation kit. The system validation procedure tests the system against reference SAR values and the performance of probe, readout electronics and software. The test setup utilizes a phantom and reference dipole.

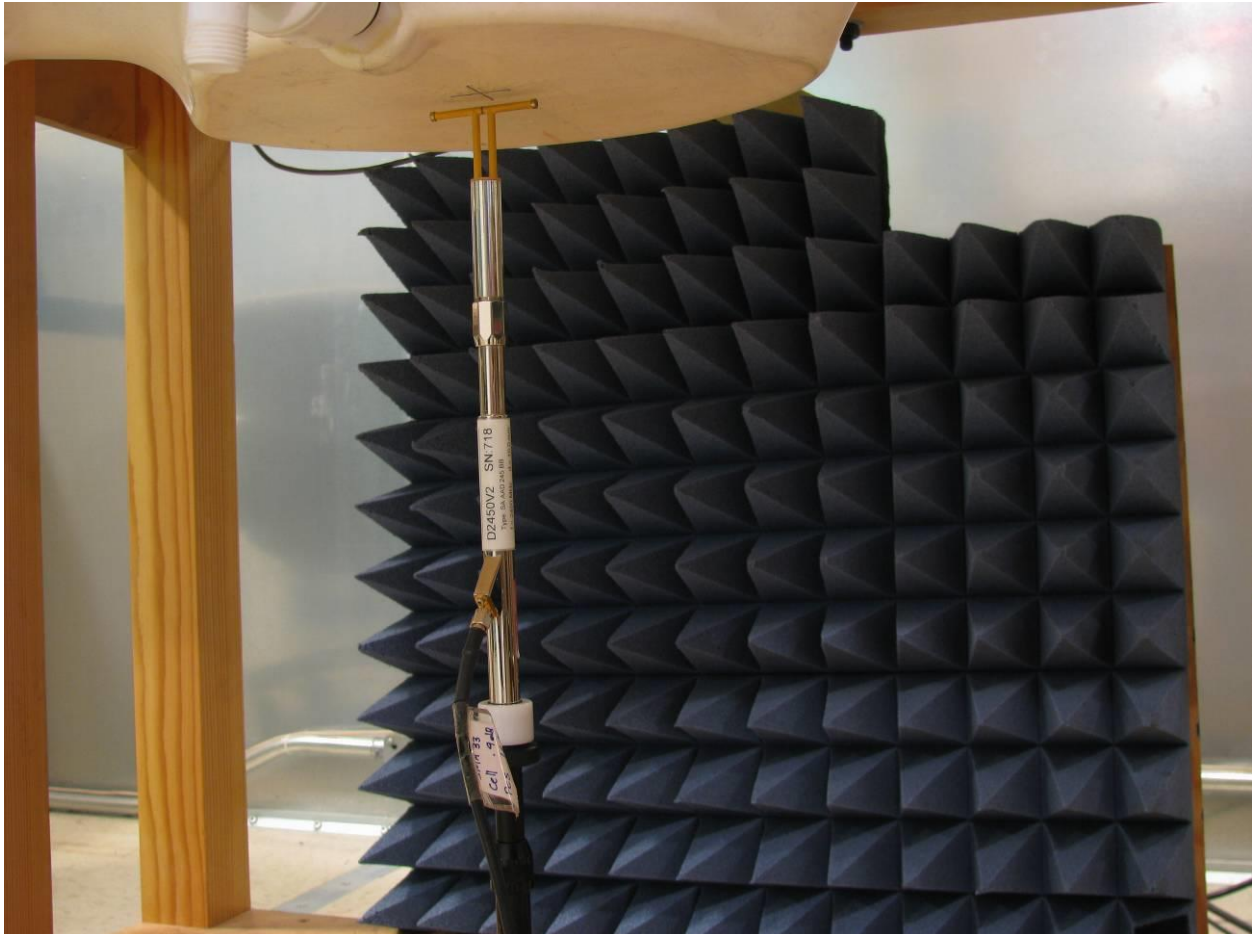


Figure 2: System Verification Setup



Table 5: Dipole Validations (1g)

Reference Dipole Validation									
Ambient Temp (°C)	Fluid Temp (°C)	Frequency (MHz)	Dipole	Fluid Type	Dipole Power Input	Cal. Lab SAR (1g)	Measured SAR (1g)	% Error SAR (1g)	Date
23.2	23.1	1800	D1800V2	MSL1800	1W	39.7	41.1	3.53	1/24/2020
23.2	23.1	1800	D1800V2	MSL1800	1W	39.7	41	3.27	1/27/2020
23.2	23.1	1900	D1900V2	MSL1900	1W	40.3	39.7	1.49	1/23/2020
23.2	23.1	1900	D1900V2	MSL1900	1W	40.3	40.7	0.99	1/24/2020
23.2	23.1	750	D750V3	MSL750	1W	8.75	7.98	8.80	1/31/2020
23.2	23.1	750	D750V3	MSL750	1W	8.75	8.09	7.54	2/3/2020

Table 6: Dipole Validations (10g)

Reference Dipole Validation									
Ambient Temp (°C)	Fluid Temp (°C)	Frequency (MHz)	Dipole	Fluid Type	Dipole Power Input	Cal. Lab SAR (10g)	Measured SAR (10g)	% Error SAR (10g)	Date
23.2	23.1	1800	D1800V2	MSL1800	1W	20.8	21.6	3.85	1/24/2020
23.2	23.1	1800	D1800V2	MSL1800	1W	20.8	21.6	3.85	1/27/2020
23.2	23.1	1900	D1900V2	MSL1900	1W	21.2	20.5	3.30	1/23/2020
23.2	23.1	1900	D1900V2	MSL1900	1W	21.2	21	0.94	1/24/2020
23.2	23.1	750	D750V3	MSL750	1W	5.8	5.37	7.41	1/31/2020
23.2	23.1	750	D750V3	MSL750	1W	5.8	5.45	6.03	2/3/2020



SAR Test Report

Measurement Uncertainty for System Validation

Source of Uncertainty	Value(dB)	Probability Distribution	Divisor	c _i	u _i (y)	(u _i (y))^2
Measurement System						
Probe Calibration	5.50	n1	1	1	5.50	30.250
Axial Isotropy	4.70	r	1.732	0.7	2.71	7.364
Hemispherical Isotropy	9.60	r	1.732	0.7	5.54	30.722
Boundary Effect	1.00	r	1.732	1	0.58	0.333
Linearity	4.70	r	1.732	1	2.71	7.364
System Detection Limits	1.00	r	1.732	1	0.58	0.333
Readout Electronics	0.30	n1	1	1	0.30	0.090
Response Time	0.80	r	1.732	1	0.46	0.213
Integration Time	2.60	r	1.732	1	1.50	2.253
RF Ambient Noise	3.00	r	1.732	1	1.73	3.000
RF Ambient Reflections	3.00	r	1.732	1	1.73	3.000
Probe Positioner	0.40	r	1.732	1	0.23	0.053
Probe Positioning	2.90	r	1.732	1	1.67	2.803
Max. SAR Eval.	1.00	r	1.732	1	0.58	0.333
Dipole / Generator / Power Meter Related						
Dipole positioning	2.90	n1	1	1	2.90	8.410
Dipole Calibration Uncertainty	0.68	r	1.732	1	0.39	0.154
Power Meter 1 Uncertainty (+20C to +25C)	0.13	n1	1	2	0.13	0.017
Power Meter 2 Uncertainty (+20C to +25C)	0.04	n1	1	3	0.04	0.002
Sig Gen VSWR Mismatch Error	1.80	n1	1	5	1.80	3.240
Sig Gen Resolution Error	0.01	n1	1	6	0.01	0.000
Sig Gen Level Error	0.90	n1	1	1	0.90	0.810
Phantom and Setup						
Phantom Uncertainty	4.00	r	1.732	1	2.31	5.334
Liquid Conductivity (target)	5.00	r	1.732	0.43	2.89	8.334
Liquid Conductivity (meas.)	2.50	n1	1	0.43	2.50	6.250
Liquid Permittivity (target)	5.00	r	1.732	0.49	2.89	8.334
Liquid Permittivity (meas.)	2.50	n1	1	0.49	2.50	6.250
Combined Standard Uncertainty		N1	1	1	11.63	135.247
Expanded Uncertainty		Normal k=	2		23.26	
Expanded Uncertainty	is	23.3	for	Normal	k=	2

**Tissue Simulating Liquid Description and Validation**

The dielectric parameters were verified to be within 5% of the target values prior to assessment. The dielectric parameters (ϵ_r, σ) are shown in Table 7. A recipe for the tissue simulating fluid used is shown in Table 8.

Table 7: Dielectric Parameter Validations

Tissue Type	Frequency Measure (MHz)	Dielectric Constant Target	Conductivity Target	Dielectric Constant Measure	Imaginary Part	Conductivity Measure	Dielectric % Deviation	Conductivity % Deviation	Date
1750 MSL	1710	55.33	1.46	53.12	15.8	1.50	3.99	2.88	1/24/2020
	1732	54.12	1.48	53.08	15.7	1.5118	1.92	2.15	1/24/2020
	1755	53.87	1.49	53.01	15.7	1.5319	1.60	2.81	1/24/2020
Measured Tissue Properties									
Tissue Type	Frequency Measure (MHz)	Dielectric Constant Target	Conductivity Target	Dielectric Constant Measure	Imaginary Part	Conductivity Measure	Dielectric % Deviation	Conductivity % Deviation	Date
750MSL	699	55.72	0.96	53.9	24.13	0.94	3.27	2.32	1/31/2020
	710	55.68	0.96	53.6	24.08	0.9505	3.74	0.99	1/31/2021
	720	55.65	0.96	53.3	23.97	0.9595	4.22	0.05	1/31/2022
Measured Tissue Properties									
Tissue Type	Frequency Measure (MHz)	Dielectric Constant Target	Conductivity Target	Dielectric Constant Measure	Imaginary Part	Conductivity Measure	Dielectric % Deviation	Conductivity % Deviation	Date
1800 MSL	1800	53.3	1.52	54.21	15.2	1.52	1.71	0.07	1/23/2020
	1850	53.3	1.52	54.14	15.1	1.5531	1.58	2.18	1/23/2020
	1880	53.3	1.52	54.03	15.1	1.5783	1.37	3.83	1/23/2020
	1910	53.3	1.52	53.87	14.89	1.5811	1.07	4.02	1/23/2020



Table 8: Tissue Simulating Fluid Recipe

Composition of Ingredients for Liquid Tissue Phantoms (450MHz to 2450 MHz data only)												
Ingredient (% by weight)	f (MHz)											
	450		835		915		1900		2450		5500	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56	54.9	70.45	62.7	68.64	65.53	78.67
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.36	0.5	0	0	0
Sugar	56.32	46.78	56	45	56.5	41.76	0	0	0	0	0	0
HEC	0.98	0.52	1	1	1	1.21	0	0	0	0	0	0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0	0	0	0	0	0
Triton X-100	0	0	0	0	0	0	0	0	36.8	0	17.235	10.665
DGBE	0	0	0	0	0	0	44.92	29.18	0	31.37	0	0
DGHE	0	0	0	0	0	0	0	0	0	0	17.235	10.665
Dielectric Constant	43.42	58	42.54	56.1	42	56.8	39.9	53.3	39.8	52.7		
Conductivity (S/m)	0.85	0.83	0.91	0.95	1	1.07	1.42	1.52	1.88	1.95		

Tissue Simulating Liquid for 5GHz, MBBL3500-5800V5 Manufactured by SPEAG (proprietary mixture)

Ingredients	(% by weight)
Water	78
Mineral oil	11
Emulsifiers	9
Additives and Salt	2



5 EVALUATION PROCEDURES

Prior to any testing, the appropriate fluid was used to fill the phantom to a depth of 15 cm \pm 0.2cm. The fluid parameters were verified and the dipole validation was performed as described in the previous sections.

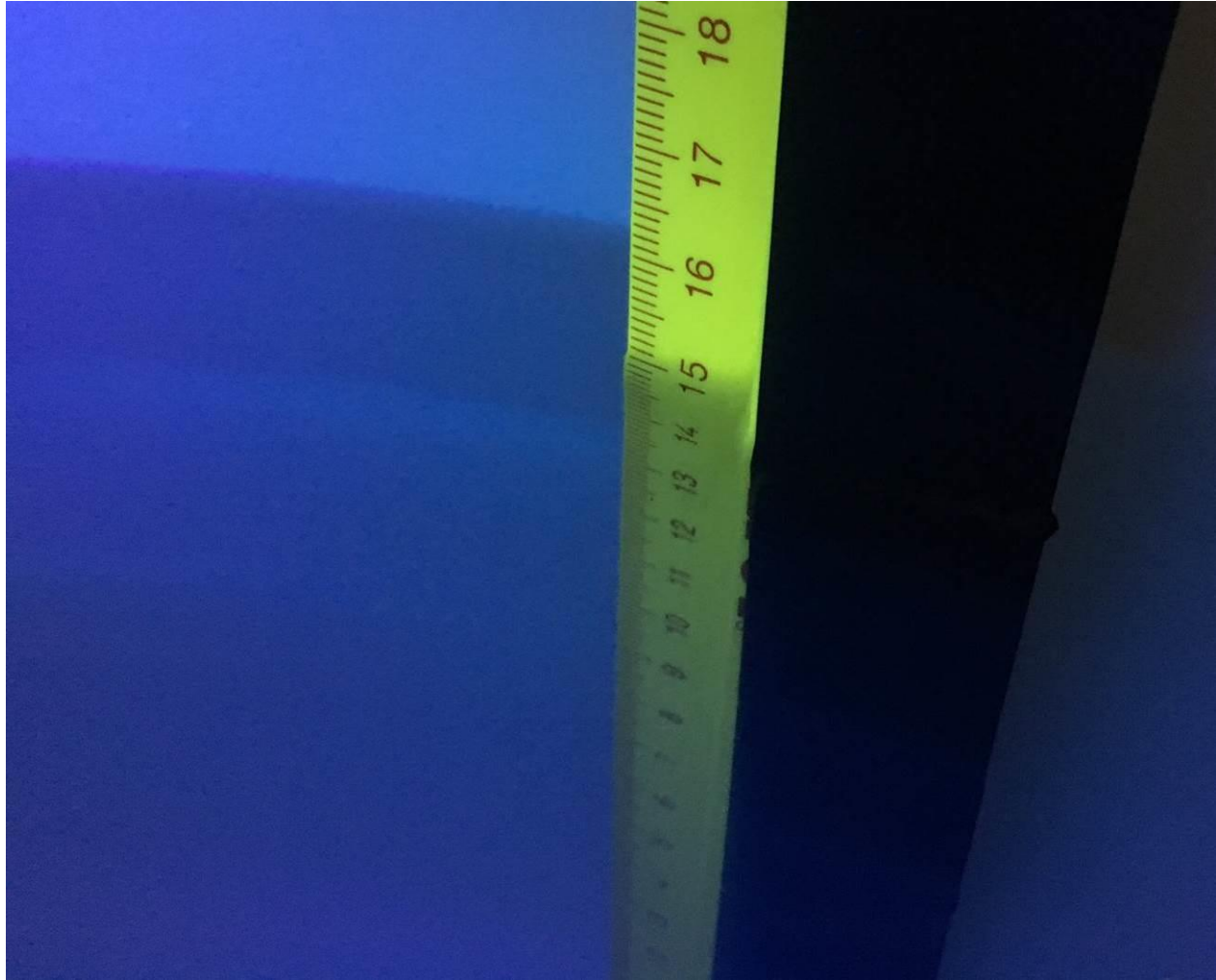


Figure 3: Fluid Depth 15cm

**Test Positions:**

The Device was positioned against the SAM and flat phantom using the exact procedure described in IEEE Std 1528:2013, IEC62209-2:2010, and the Office of Engineering and Technology KDB 447498.

Reference Power Measurement:

The measurement probe was positioned at a fixed location above the reference point. A power measurement was made with the probe above this reference position so it could be used for assessing the power drift later in the test procedure.

Area Scan:

A coarse area scan was performed in order to find the approximate location of the peak SAR value. This scan was performed with the measurement probe at a constant height in the simulating fluid. A two dimensional spline interpolation algorithm was then used to determine the peaks and gradients within the scanned area. The area scan resolution conformed to the requirements of KDB 865664 as shown in Table 9.

Zoom Scan:

A zoom scan was performed around the approximate location of the peak SAR as determined from the area scan. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure. The zoom scan resolution conformed to the requirements of KDB 865664 as shown in Table 9.



Table 9: SAR Area and Zoom Scan Resolutions

		≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface		5 ± 1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location		30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: $\Delta x_{Area}, \Delta y_{Area}$		≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
		When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	
Maximum zoom scan spatial resolution: $\Delta x_{Zoom}, \Delta y_{Zoom}$		≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$	≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1 st two points closest to phantom surface	≤ 4 mm 3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ 1.5 · $\Delta z_{Zoom}(n-1)$
Minimum zoom scan volume	x, y, z	≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm
<p>Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.</p> <p>* When zoom scan is required and the <i>reported</i> SAR from the <i>area scan based 1-g SAR estimation</i> procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</p>			



Interpolation, Extrapolation and Detection of Maxima:

The probe is calibrated at the center of the dipole sensors which is located 1 to 2.7 mm away from the probe tip. During measurements, the probe stops shortly above the phantom surface, depending on the probe and the surface detecting system. Both distances are included as parameters in the probe configuration file. The software always knows exactly how far away the measured point is from the surface. As the probe cannot directly measure at the surface, the values between the deepest measured point and the surface must be extrapolated.

In DASYS5, the choice of the coordinate system defining the location of the measurement points has no influence on the uncertainty of the interpolation, Maxima Search and extrapolation routines. The interpolation, extrapolation and maximum search routines are all based on the modified Quadratic Shepard's method.

Thereby, the interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation. The DASYS5 routines construct a once-continuously differentiable function that interpolates the measurement values as follows:

- For each measurement point a trivariate (3-D) / bivariate (2-D) quadratic is computed. It interpolates the measurement values at the data point and forms a least-square fit to neighboring measurement values.
- The spatial location of the quadratic with respect to the measurement values is attenuated by an inverse distance weighting. This is performed since the calculated quadratic will fit measurement values at nearby points more accurate than at points located further away.
- After the quadratics are calculated for at all measurement points, the interpolating function is calculated as a weighted average of the quadratics.

There are two control parameters that govern the behavior of the interpolation method. One specifies the number of measurement points to be used in computing the least-square fits for the local quadratics. These measurement points are the ones nearest the input point for which the quadratic is being computed. The second parameter specifies the number of measurement points that will be used in calculating the weights for the quadratics to produce the final function. The input data points used there are the ones nearest the point at which the interpolation is desired. Appropriate defaults are chosen for each of the control parameters.

The trivariate quadratics that have been previously computed for the 3-D interpolation and whose input data are at the closest distance from the phantom surface, are used in order to extrapolate the fields to the surface of the phantom.

In order to determine all the field maxima in 2-D (Area Scan) and 3-D (Zoom Scan), the measurement grid is refined by a default factor of 10 and the interpolation function is used to evaluate all field values between corresponding measurement points. Subsequently, a linear search is applied to find all the candidate maxima. In a last step, non-physical maxima are removed and only those maxima which are within 2 dB of the global maximum value are retained.



Averaging and Determination of Spatial Peak SAR

The interpolated data is used to average the SAR over the 1g and 10g cubes by spatially discretizing the entire measured volume. The resolution of this spatial grid used to calculate the averaged SAR is 1mm or about 42875 interpolated points. The resulting volumes are defined as cubical volumes containing the appropriate tissue parameters that are centered at the location. The location is defined as the center of the incremental volume.

The spatial-peak SAR must be evaluated in cubical volumes containing a mass that is within 5% of the required mass. The cubical volume centered at each location, as defined above, should be expanded in all directions until the desired value for the mass is reached, with no surface boundaries of the averaging volume extending beyond the outermost surface of the considered region. In addition, the cubical volume should not consist of more than 10% of air. If these conditions are not satisfied then the center of the averaging volume is moved to the next location. Otherwise, the exact size of the final sampling cube is found using an inverse polynomial approximation algorithm, leading to results with improved accuracy. If one boundary of the averaging volume reaches the boundary of the measured volume during its expansion, it will not be evaluated at all. Reference is kept of all locations used and those not used for averaging the SAR. All average SAR values are finally assigned to the centered location in each valid averaging volume.

All locations included in an averaging volume are marked to indicate that they have been used at least once. If a location has been marked as used, but has never been assigned to the center of a cube, the highest averaged SAR value of all other cubical volumes which have used this location for averaging is assigned to this location. Only those locations that are not part of any valid averaging volume should be marked as unused. For the case of an unused location, a new averaging volume must be constructed which will have the unused location centered at one surface of the cube. The remaining five surfaces are expanded evenly in all directions until the required mass is enclosed, regardless of the amount of included air. Of the six possible cubes with one surface centered on the unused location, the smallest cube is used, which still contains the required mass.

If the final cube containing the highest averaged SAR touches the surface of the measured volume, an appropriate warning is issued within the post processing engine.

Power Drift Measurement:

The probe was positioned at precisely the same reference point and the reference power measurement was repeated. The difference between the initial reference power and the final one is referred to as the power drift. This value should not exceed 5%. The power drift measurement was used to assess the output power stability of the test sample throughout the SAR scan.

RF Ambient Activity:

During the entire SAR evaluation, the RF ambient activity was monitored using a spectrum analyzer with an antenna connected to it. The spectrum analyzer was tuned to the frequency of measurement and with one trace set to max hold mode. In this way, it was possible to determine if at any point during the SAR measurement there was an interfering ambient signal. If an ambient signal was detected, then the SAR measurement was repeated.



6 CRITERIA

The following ANSI/IEEE C95.1 – 1992 limits for SAR apply to portable devices operating in the General Population/Uncontrolled Exposure environment. Uncontrolled environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

Exposure Type (General Population/Uncontrolled Exposure environment)	SAR Limit (W/kg or mW/g)
Average over the whole body	0.08
Spatial Peak (1g)	1.60
Spatial Peak for hands, wrists, feet and ankles (10g)	4.00

7 TEST CONFIGURATION

The SAVI could be used against the body or hand held. According to the manufacturer there are no against the head usage conditions. Therefore, it was evaluated in body and extremity (hand held) positions. Due to the curved nature of the device the testing on the inside was performed against a curved section of the phantom that matched the curvature of the device.

The device was evaluated according to the specific requirements found in the following KDBs and Standards:

- FCC KDB 447498D01 v06, General RF Exposure Guidance
- FCC KDB 865664D01 v01r04, SAR Measurement Requirements for 100MHz to 6GHz
- FCC KDB 941225 D05, SAR for LTE Devices v02r05
- RSS-102 Issue 5, Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)



7.1 Setup Photos (Back Side Exposure, 0mm spacing)



7.2 Setup Photos (Front Side Exposure, 0mm spacing)





8 TEST RESULTS

The worst case 1g SAR value for body exposure was less than the 1.6W/kg limit. The worst case 10g SAR value for extremity exposure was less than the 4W/kg limit.

9 SAR DATA:

The results on the following page(s) were obtained when the device was transmitting at maximum output power. The worst case plots, which reveal information about the location of the maximum SAR with respect to the device, are referenced are shown in APPENDIX B – Worst Case SAR Plots. The measured conducted output power was compared to the power declared by the manufacturer and used for scaling the measured SAR values.



Table 10: Extremity SAR Results, (LTE Band 2)

US / Canada Extremity SAR Results Using 1900MHz MSL									
TX Mode	Spacing	RB	Position	RB Offset	Power Drift (dB)	Measured SAR 10g (W/kg)	Reported SAR 10g (W/kg)	Measured Conducted Output Power (dBm)	Maximum Conducted Output Power (dBm)
LTE, Band 2, QPSK, Channel 18900	0mm	1	Back	low	-0.17	0.5280	0.6865	23.86	25.00
				mid	-0.17	0.4960	0.6449	23.86	25.00
				high	-0.17	0.5010	0.6514	23.86	25.00
			Front	low	0.40	0.0342	0.0445	23.86	25.00
				mid	0.40	0.3730	0.4850	23.86	25.00
				high	0.40	0.0335	0.0436	23.86	25.00
LTE, Band 2, QPSK, Channel 18900	0mm	50%	Back	low	-0.17	0.4300	0.5591	23.86	25.00
				mid	-0.19	0.4370	0.5682	23.86	25.00
				high	-0.19	0.4360	0.5669	23.86	25.00
			Front	low	0.40	0.0336	0.0437	23.86	25.00
				mid	0.40	0.2920	0.3796	23.86	25.00
				high	0.40	0.2930	0.3809	23.86	25.00

10g SAR Limit (Extremity) = 4W/kg

Test Personnel:	Bryan Taylor	Test Date:	1/23/2020 – 1/24/2020
Supervising/Reviewing Engineer:	NA	Tissue Depth:	15cm
Signal Setup:	Base Station Simulator	Ambient Temperature:	23.1C
Power Method:	Fully Charged Battery	Relative Humidity:	38.7%
Pretest Dipole Verification:	Yes	Atmospheric Pressure:	988.7mbar

Deviations, Additions, or Exclusions:

- (1) Test reduction was applied. Per KDB941225D05 v02r05 Section 5.2.3, testing with 100% RB allocation is not required when the highest maximum output power is less than that which was measured in 50% and 1RB allocations and the highest reported SAR for 1RB and 50%RB allocation are $\leq 1.45W/kg$.
- (2) Test reduction was applied. Per KDB941225D05 v02r05 Section 5.2.4 SAR for higher order modulations is only required when the maximum output power for the configuration with the higher order modulation is $>1/2dB$ higher than the same configuration in QPSK or when the reported SAR for QPSK is $>1.45W/kg$.
- (3) Test reduction was applied. Per KDB447498 D01v06 when the mid channel is more than 3dB below the limit testing at the remaining channels is not required.



Table 11: Body Mode SAR Results, (LTE Band 2)

US / Canada Body SAR Results Using 1900MHz MSL									
TX Mode	Spacing	RB	Position	RB Offset	Power Drift (dB)	Measured SAR 1g (W/kg)	Reported SAR 1g (W/kg)	Measured Conducted Output Power (dBm)	Maximum Conducted Output Power (dBm)
LTE, Band 2, QPSK, Channel 18900	5mm	1	Back	low	0.06	0.2500	0.3250	23.86	25.00
				mid	0.06	0.2360	0.3068	23.86	25.00
				high	0.16	0.2540	0.3302	23.86	25.00
			Front	low	0.40	0.0565	0.0735	23.86	25.00
				mid	0.40	0.0613	0.0797	23.86	25.00
				high	0.40	0.0556	0.0723	23.86	25.00
LTE, Band 2, QPSK, Channel 18900	5mm	50%	Back	low	0.15	0.1860	0.2418	23.86	25.00
				mid	-0.14	0.1780	0.2314	23.86	25.00
				high	0.16	0.1900	0.2470	23.86	25.00
			Front	low	0.40	0.0555	0.0722	23.86	25.00
				mid	0.40	0.4810	0.6254	23.86	25.00
				high	0.40	0.4840	0.6293	23.86	25.00
LTE, Band 2, QPSK, Channel 18900	5mm	100%	Back	Mid	Reduced				
			Front	Mid					
1g SAR Limit (Head & Body) = 1.6W/kg									

Test Personnel:	Bryan Taylor	Test Date:	1/23/2020 – 1/24/2020
Supervising/Reviewing Engineer:	NA	Tissue Depth:	15cm
Signal Setup:	Base Station Simulator	Ambient Temperature:	23.1C
Power Method:	Fully Charged Battery	Relative Humidity:	38.7%
Pretest Dipole Verification:	Yes	Atmospheric Pressure:	988.7mbar

Deviations, Additions, or Exclusions:

- (1) Test reduction was applied. Per KDB941225D05 v02r05 Section 5.2.3, testing with 100% RB allocation is not required when the highest maximum output power is less than that which was measured in 50% and 1RB allocations and the highest reported SAR for 1RB and 50%RB allocation are $\leq 1.45W/kg$.
- (2) Test reduction was applied. Per KDB941225D05 v02r05 Section 5.2.4 SAR for higher order modulations is only required when the maximum output power for the configuration with the higher order modulation is $>1/2dB$ higher than the same configuration in QPSK or when the reported SAR for QPSK is $>1.45W/kg$.
- (3) Test reduction was applied. Per KDB447498 D01v06 when the mid channel is more than 3dB below the limit testing at the remaining channels is not required.



Table 12: Extremity SAR Results, (LTE Band 4)

US / Canada Extremity SAR Results Using 1750MHz MSL									
TX Mode	Spacing	RB	Position	RB Offset	Power Drift (dB)	Measured SAR 10g (W/kg)	Reported SAR 10g (W/kg)	Measured Conducted Output Power (dBm)	Maximum Conducted Output Power (dBm)
LTE, Band 4, QPSK, Channel 20175	0mm	1	Back	low	-0.04	1.1700	1.6300	23.56	25.00
				mid	-0.04	1.0800	1.5046	23.56	25.00
				high	-0.04	1.0800	1.5046	23.56	25.00
			Front	low	1.22	0.0762	0.1062	23.56	25.00
				mid	1.22	0.0852	0.1187	23.56	25.00
				high	1.22	0.0881	0.1227	23.56	25.00
LTE, Band 4, QPSK, Channel 20175	0mm	50%	Back	low	0.09	1.0100	1.4071	23.56	25.00
				mid	0.09	1.0200	1.4210	23.56	25.00
				high	0.09	1.0300	1.4350	23.56	25.00
			Front	low	1.22	0.0643	0.0896	23.56	25.00
				mid	1.22	0.0646	0.0900	23.56	25.00
				high	1.22	0.0646	0.0900	23.56	25.00

10g SAR Limit (Extremity) = 4W/kg

Test Personnel:	Bryan Taylor	Test Date:	1/24/2020 – 1/27/2020
Supervising/Reviewing Engineer:	NA	Tissue Depth:	15cm
Signal Setup:	Base Station Simulator	Ambient Temperature:	23.1C
Power Method:	Fully Charged Battery	Relative Humidity:	38.7%
Pretest Dipole Verification:	Yes	Atmospheric Pressure:	988.7mbar

Deviations, Additions, or Exclusions:

- (1) Test reduction was applied. Per KDB941225D05 v02r05 Section 5.2.3, testing with 100% RB allocation is not required when the highest maximum output power is less than that which was measured in 50% and 1RB allocations and the highest reported SAR for 1RB and 50%RB allocation are $\leq 1.45W/kg$.
- (2) Test reduction was applied. Per KDB941225D05 v02r05 Section 5.2.4 SAR for higher order modulations is only required when the maximum output power for the configuration with the higher order modulation is $>1/2dB$ higher than the same configuration in QPSK or when the reported SAR for QPSK is $>1.45W/kg$.
- (3) Test reduction was applied. Per KDB447498 D01v06 when the mid channel is more than 3dB below the limit testing at the remaining channels is not required.



Table 13: Body Mode SAR Results, (LTE Band 4)

US / Canada Body SAR Results Using 1750MHz MSL									
TX Mode	Spacing	RB	Position	RB Offset	Power Drift (dB)	Measured SAR 1g (W/kg)	Reported SAR 1g (W/kg)	Measured Conducted Output Power (dBm)	Maximum Conducted Output Power (dBm)
LTE, Band 4, QPSK, Channel 20175	5mm	1	Back	low	-0.02	0.7230	1.0017	23.56	25.00
				mid	-0.02	0.7190	0.9404	23.56	25.00
				high	-0.02	0.6750	0.9404	23.56	25.00
			Front	low	1.22	0.1150	0.1602	23.56	25.00
				mid	1.22	0.1240	0.1728	23.56	25.00
				high	1.22	0.1300	0.1811	23.56	25.00
LTE, Band 4, QPSK, Channel 20175	5mm	50%	Back	low	-0.02	0.5600	0.7802	23.56	25.00
				mid	-0.14	0.0570	0.0794	23.56	25.00
				high	-0.02	0.7220	1.0059	23.56	25.00
			Front	low	1.22	0.0926	0.1290	23.56	25.00
				mid	1.22	0.0945	0.1317	23.56	25.00
				high	1.22	0.6460	0.9000	23.56	25.00
LTE, Band 4, QPSK, Channel 20175	5mm	100%	Back	Mid	0.00	0.7580	1.0560	23.56	25.00
			Front	Reduced					
1g SAR Limit (Head & Body) = 1.6W/kg									

Test Personnel:	Bryan Taylor	Test Date:	1/24/2020 – 1/27/2020
Supervising/Reviewing Engineer:	NA	Tissue Depth:	15cm
Signal Setup:	Base Station Simulator	Ambient Temperature:	23.1C
Power Method:	Fully Charged Battery	Relative Humidity:	38.7%
Pretest Dipole Verification:	Yes	Atmospheric Pressure:	988.7mbar

Deviations, Additions, or Exclusions:

- (1) Test reduction was applied. Per KDB941225D05 v02r05 Section 5.2.3, testing with 100% RB allocation is not required when the highest maximum output power is less than that which was measured in 50% and 1RB allocations and the highest reported SAR for 1RB and 50%RB allocation are $\leq 1.45W/kg$.
- (2) Test reduction was applied. Per KDB941225D05 v02r05 Section 5.2.4 SAR for higher order modulations is only required when the maximum output power for the configuration with the higher order modulation is $>1/2dB$ higher than the same configuration in QPSK or when the reported SAR for QPSK is $>1.45W/kg$.
- (3) Test reduction was applied. Per KDB447498 D01v06 when the mid channel is more than 3dB below the limit testing at the remaining channels is not required.



Table 14: Extremity SAR Results, (LTE Band 12)

US / Canada Extremity SAR Results Using 750MHz MSL									
TX Mode	Spacing	RB	Position	RB Offset	Power Drift (dB)	Measured SAR 10g (W/kg)	Reported SAR 10g (W/kg)	Measured Conducted Output Power (dBm)	Maximum Conducted Output Power (dBm)
LTE, Band 12, QPSK, Channel 23095	0mm	1	Back	low	0.01	0.4470	0.6156	23.61	25.00
				mid	0.01	0.4620	0.6363	23.61	25.00
				high	0.01	0.4650	0.6404	23.61	25.00
			Front	low	-0.08	0.0016	0.0022	23.61	25.00
				mid	-0.08	0.0016	0.0023	23.61	25.00
				high	-0.08	0.0017	0.0024	23.61	25.00
LTE, Band 12, QPSK, Channel 23095	0mm	50%	Back	low	0.01	0.3560	0.4903	23.61	25.00
				mid	0.01	0.3610	0.4972	23.61	25.00
				high	0.01	0.3550	0.4889	23.61	25.00
			Front	low	-0.08	0.0015	0.0021	23.61	25.00
				mid	-0.08	0.0014	0.0019	23.61	25.00
				high	-0.08	0.0014	0.0020	23.61	25.00

10g SAR Limit (Extremity) = 4W/kg

Test Personnel:	Bryan Taylor	Test Date:	1/31/2020 – 2/3/2020
Supervising/Reviewing Engineer:	NA	Tissue Depth:	15cm
Signal Setup:	Base Station Simulator	Ambient Temperature:	23.1C
Power Method:	Fully Charged Battery	Relative Humidity:	38.7%
Pretest Dipole Verification:	Yes	Atmospheric Pressure:	988.7mbar

Deviations, Additions, or Exclusions:

- (1) Test reduction was applied. Per KDB941225D05 v02r05 Section 5.2.3, testing with 100% RB allocation is not required when the highest maximum output power is less than that which was measured in 50% and 1RB allocations and the highest reported SAR for 1RB and 50%RB allocation are $\leq 1.45W/kg$.
- (2) Test reduction was applied. Per KDB941225D05 v02r05 Section 5.2.4 SAR for higher order modulations is only required when the maximum output power for the configuration with the higher order modulation is $>1/2dB$ higher than the same configuration in QPSK or when the reported SAR for QPSK is $>1.45W/kg$.
- (3) Test reduction was applied. Per KDB447498 D01v06 when the mid channel is more than 3dB below the limit testing at the remaining channels is not required.



Table 15: Body Mode SAR Results, (LTE Band 12)

US / Canada Body SAR Results Using 750MHz MSL									
TX Mode	Spacing	RB	Position	RB Offset	Power Drift (dB)	Measured SAR 1g (W/kg)	Reported SAR 1g (W/kg)	Measured Conducted Output Power (dBm)	Maximum Conducted Output Power (dBm)
LTE, Band 12, QPSK, Channel 23095	5mm	1	Back	low	0.50	0.1770	0.2438	23.61	25.00
				mid	0.50	0.1670	0.2300	23.61	25.00
				high	0.50	0.1740	0.2396	23.61	25.00
			Front	low	-0.08	0.0021	0.0029	23.61	25.00
				mid	-0.08	0.0023	0.0031	23.61	25.00
				high	-0.08	0.0025	0.0034	23.61	25.00
LTE, Band 12, QPSK, Channel 23095	5mm	50%	Back	low	0.50	0.1350	0.1859	23.61	25.00
				mid	0.50	0.1360	0.1873	23.61	25.00
				high	0.50	0.1350	0.1859	23.61	25.00
			Front	low	-0.08	0.0019	0.0026	23.61	25.00
				mid	-0.08	0.0019	0.0026	23.61	25.00
				high	-0.08	0.0020	0.0027	23.61	25.00
LTE, Band 12, QPSK, Channel 23095	5mm	100%	Back	low					
				mid					
				high					
			Front	low					
				mid					
				high					

1g SAR Limit (Head and Body) = 1.6W/kg

Test Personnel:	Bryan Taylor	Test Date:	1/31/2020 – 2/3/2020
Supervising/Reviewing Engineer:	NA	Tissue Depth:	15cm
Signal Setup:	Base Station Simulator	Ambient Temperature:	23.1C
Power Method:	Fully Charged Battery	Relative Humidity:	38.7%
Pretest Dipole Verification:	Yes	Atmospheric Pressure:	988.7mbar

Deviations, Additions, or Exclusions:

- (1) Test reduction was applied. Per KDB941225D05 v02r05 Section 5.2.3, testing with 100% RB allocation is not required when the highest maximum output power is less than that which was measured in 50% and 1RB allocations and the highest reported SAR for 1RB and 50%RB allocation are $\leq 1.45W/kg$.
- (2) Test reduction was applied. Per KDB941225D05 v02r05 Section 5.2.4 SAR for higher order modulations is only required when the maximum output power for the configuration with the higher order modulation is $>1/2dB$ higher than the same configuration in QPSK or when the reported SAR for QPSK is $>1.45W/kg$.
- (3) Test reduction was applied. Per KDB447498 D01v06 when the mid channel is more than 3dB below the limit testing at the remaining channels is not required.



1.0 REFERENCES

- [1]ANSI, ANSI/IEEE C95.1-1992: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 GHz, The Institute of electrical and Electronics Engineers, Inc., New York, NY 10017, 1992
- [2]Federal Communications Commission, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 97-01), FCC, Washington, D.C. 20554, 1997
- [3]Thomas Schmid, Oliver Egger, and Niels Kuster, "Automated E-field scanning system for dosimetric assessments", *IEEE Transaction on Microwave Theory and Techniques*, vol. 44, pp. 105-113, Jan. 1996.
- [4]Niels Kuster, Ralph Kastle, and Thomas Schmid, "Dosimetric evaluation of mobile communications equipment with know precision", *IEICE Transactions on Communications*, vol. E80-B, no. 5, pp.645-652, May 1997.
- [5]NIS81, NAMAS, "The treatment of uncertainty in EMC measurement", Tech. Rep., NAMAS Executive, National Physical Laboratory, Teddinton, Middlesex, England, 1994.
- [6]Barry N. Taylor and Chris E. Kuyatt, "Guidelines for evaluating and expressing the uncertainty of NIST measurement results", Tech. Rep., National Institute of Standards and Technology, 1994.
- [7]Federal Communications Commission, KDB 248227 - "SAR Measurement Procedures for 802.11 a/b/g Transmitters"
- [8] Federal Communications Commission, KDB 648474 – "SAR Evaluation Considerations for Handsets with Multiple Transmitters and Antennas".
- [9] Federal Communications Commission, KDB 447498 – "Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies".
- [10] Federal Communications Commission, KDB 616217 – "SAR Evaluation Considerations for Laptop Computers with Antennas Built-in on Display Screens".
- [11] Federal Communications Commission, KDB 450824 – "SAR Probe Calibration and System Verification Considerations for Measurements at 150MHz – 3GHz".
- [12] Federal Communications Commission, KDB 865664 – "SAR Measurement Requirements for 3-6GHz".
- [13] Federal Communications Commission, KDB 941225 – "SAR Measurement Procedures for 3G Devices".
- [14] ANSI, ANSI/IEEE C63.10-2009: American National Standard for Testing Unlicensed Wireless Devices.



APPENDIX A – SYSTEM VALIDATION SUMMARY

Per FCC KDB 865664, a tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters have been included in the summary table below. The validation was performed with reference dipoles using the required tissue equivalent media for system validation according to KDB 865664. Each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point. All measurements were performed using probes calibrated for CW signals. Modulations in the table above represent test configurations for which the SAR system has been validated. The SAR system was also validated with modulated signals per KDB 865664.

Table 16: SAR System Validation Summary

Frequency (MHz)	Date	Probe (SN#)	Probe (Model #)	Probe Calibration Point		Dielectric Properties		CW Validation			Modulation Validation		
				Frequency (MHz)	Fluid Type	σ	ϵ_r	Sensitivity	Probe Linearity	Probe Isotropy	Mod. Type	Duty Factor	PAR
2450	1/6/2020	3516	EX3DV3	2450	Body	50.65	2.02	Pass	Pass	Pass	OFDM	N/A	Pass
5200	1/6/2020	3516	EX3DV3	5200	Body	48.71	5.54	Pass	Pass	Pass	OFDM	N/A	Pass
5500	1/6/2020	3516	EX3DV3	5500	Body	47.68	6.29	Pass	Pass	Pass	OFDM	N/A	Pass
5800	1/6/2020	3516	EX3DV3	5800	Body	48.71	5.54	Pass	Pass	Pass	OFDM	N/A	Pass
Frequency (MHz)	Date	Probe (SN#)	Probe (Model #)	Probe Calibration Point		Dielectric Properties		CW Validation			Modulation Validation		
				Frequency (MHz)	Fluid Type	σ	ϵ_r	Sensitivity	Probe Linearity	Probe Isotropy	Mod. Type	Duty Factor	PAR
835	1/6/2020	3516	EX3DV3	835	Body	54.2	0.98	Pass	Pass	Pass	GMSK	Pass	N/A
900	1/6/2020	3516	EX3DV3	900	Body	54	1.02	Pass	Pass	Pass	GMSK	Pass	N/A
1750	1/6/2020	3516	EX3DV3	1800	Body	52.9	1.41	Pass	Pass	Pass	GMSK	Pass	N/A
1900	1/6/2020	3516	EX3DV3	1900	Body	52.7	1.48	Pass	Pass	Pass	GMSK	Pass	N/A



APPENDIX B – WORST CASE SAR PLOTS

SAR_LTE Band 4 (Body Mode)

DUT: eNeura SAVI;

Communication System: UID 0, Generic LTE 20 MHz Bandwidth (0); Communication System Band: Band 4; Frequency: 1732.5 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): $f = 1732.5$ MHz; $\sigma = 1.459$ S/m; $\epsilon_r = 53.239$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: EX3DV3 - SN3516; ConvF(9.08, 9.08, 9.08); Calibrated: 11/19/2019;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 11/13/2019
- Phantom: SAM 2 with CRP v5.0; Type: QD000P40CD; Serial: TP:1663
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

WWAN Flat-Section MSL Testing/Back Side 5mm Spacing, Band 4 2/Area Scan 2 (51x71x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.14 W/kg

WWAN Flat-Section MSL Testing/Back Side 5mm Spacing, Band 4 2/mid zoom scan 100RB (9x9x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 21.493 V/m; Power Drift = 0.00 dB

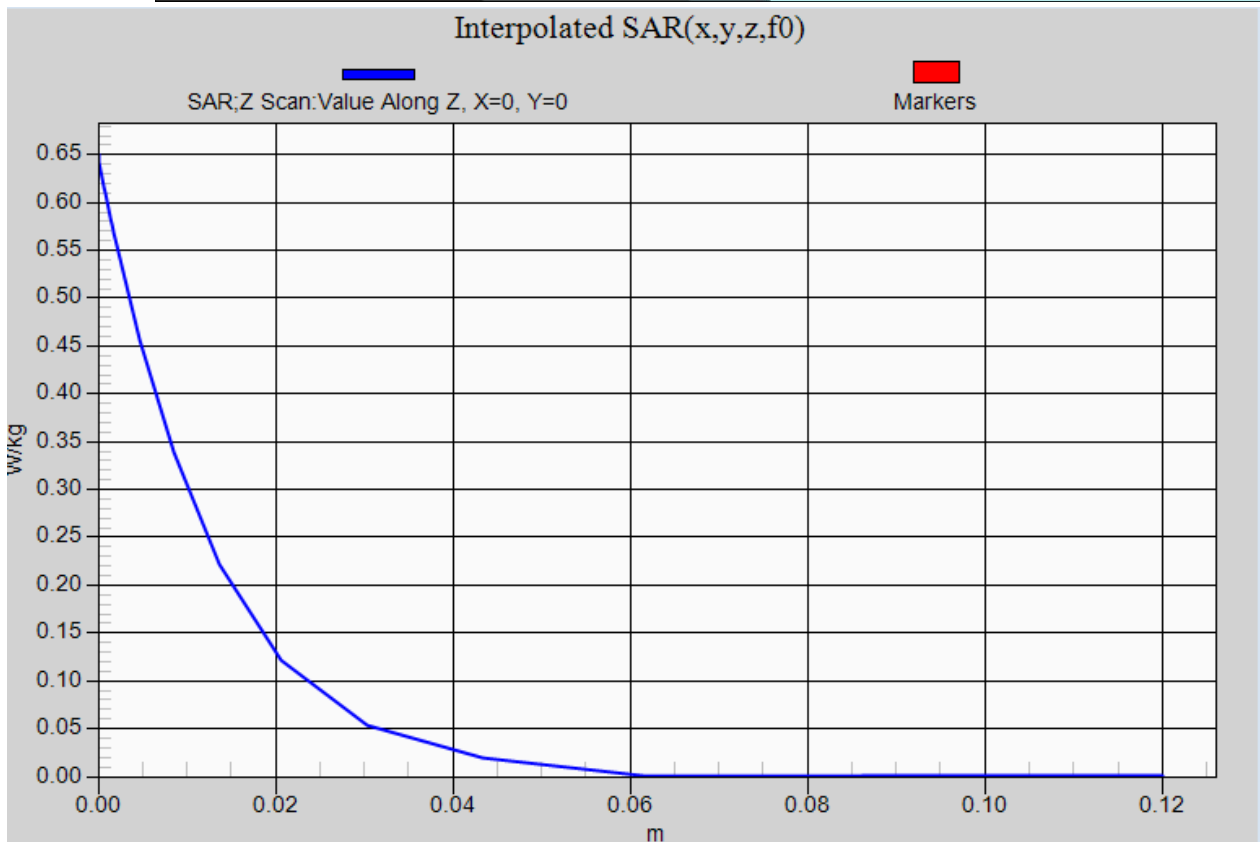
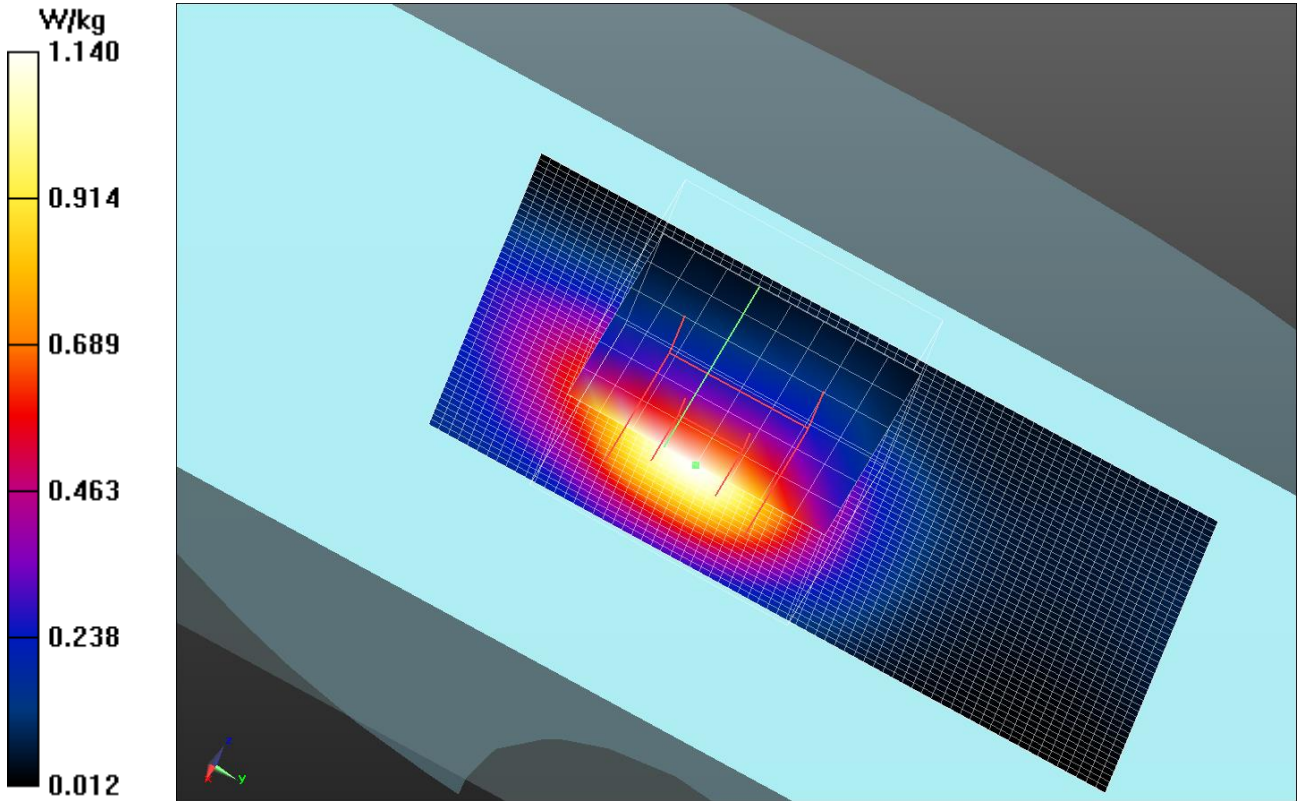
Peak SAR (extrapolated) = 1.33 W/kg

SAR(1 g) = 0.758 W/kg; SAR(10 g) = 0.449 W/kg

Maximum value of SAR (measured) = 1.11 W/kg



SAR Test Report





SAR Test Report

SAR_LTE Band 4 (Extremity Mode)

Procedure Notes:

DUT: eNeura SAVI;

Communication System: UID 0, Generic LTE 20 MHz Bandwidth (0); Communication System Band: Band 4; Frequency: 1732.5 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): $f = 1732.5$ MHz; $\sigma = 1.459$ S/m; $\epsilon_r = 53.239$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASYS Configuration:

- Probe: EX3DV3 - SN3516; ConvF(9.08, 9.08, 9.08); Calibrated: 11/19/2019;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 11/13/2019
- Phantom: SAM 2 with CRP v5.0; Type: QD000P40CD; Serial: TP:1663
- DASYS2 52.8.7(1137); SEMCAD X 14.6.10(7164)

WWAN Flat-Section MSL Testing/Extremity LTE Band 4, Back Side, Direct Contact/Area Scan 2 (51x71x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 3.19 W/kg

WWAN Flat-Section MSL Testing/Extremity LTE Band 4, Back Side, Direct Contact/low zoom scan 1RB 2 (9x8x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 43.800 V/m; Power Drift = -0.04

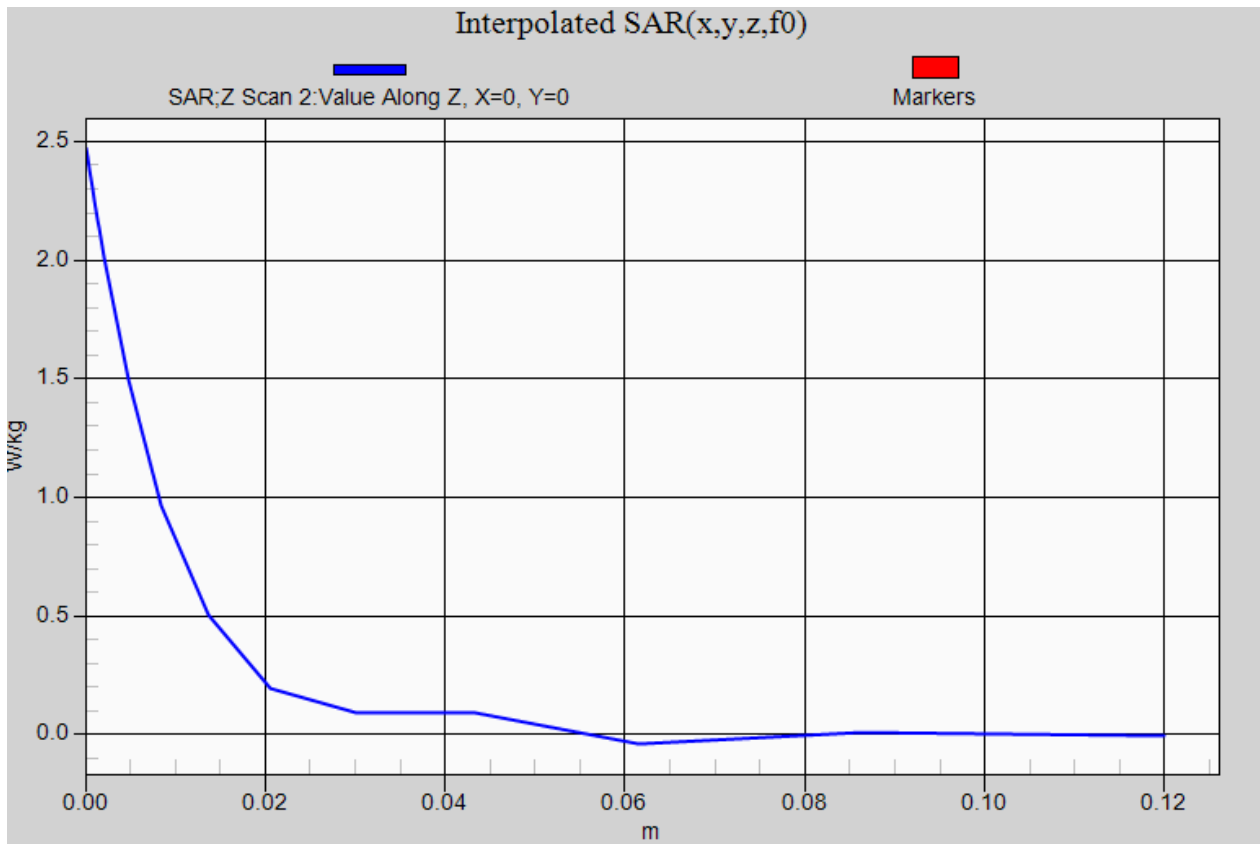
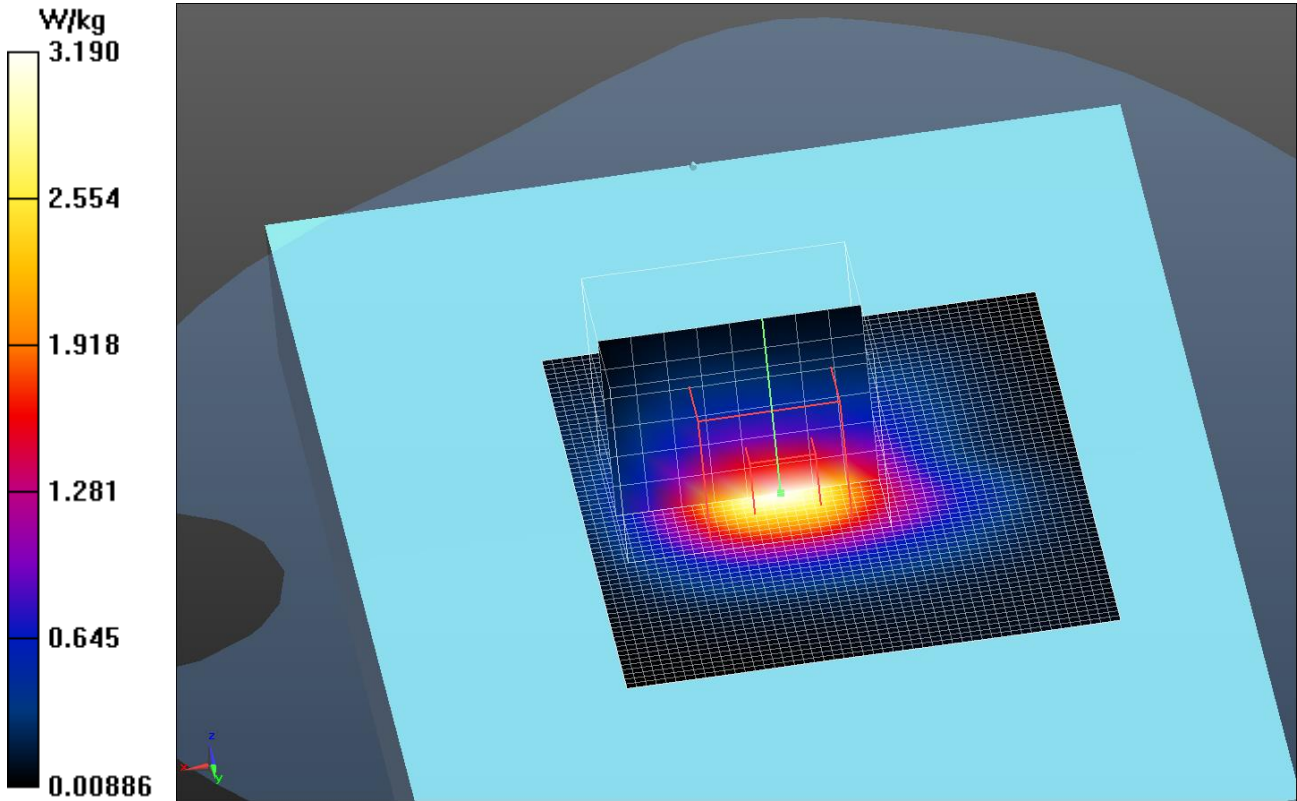
Peak SAR (extrapolated) = 4.03 W/kg

SAR(1 g) = 2.1 W/kg; SAR(10 g) = 1.17 W/kg

Maximum value of SAR (measured) = 3.23 W/kg



SAR Test Report





APPENDIX C – DIPOLE VALIDATION PLOTS

Dipole 1900

Medium parameters used (interpolated): $f = 1900$ MHz; $\sigma = 1.532$ S/m; $\epsilon_r = 53.28$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASYS Configuration:

- Probe: EX3DV3 - SN3516; ConvF(8.78, 8.78, 8.78); Calibrated: 11/19/2019;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 11/13/2019
- Phantom: SAM 2 with CRP v5.0; Type: QD000P40CD; Serial: TP:1663
- DASYS2 52.8.7(1137); SEMCAD X 14.6.10(7164)

WWAN Flat-Section MSL Testing/1900MHz Dipole/Area Scan 2 (41x71x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.648 W/kg

WWAN Flat-Section MSL Testing/1900MHz Dipole/Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

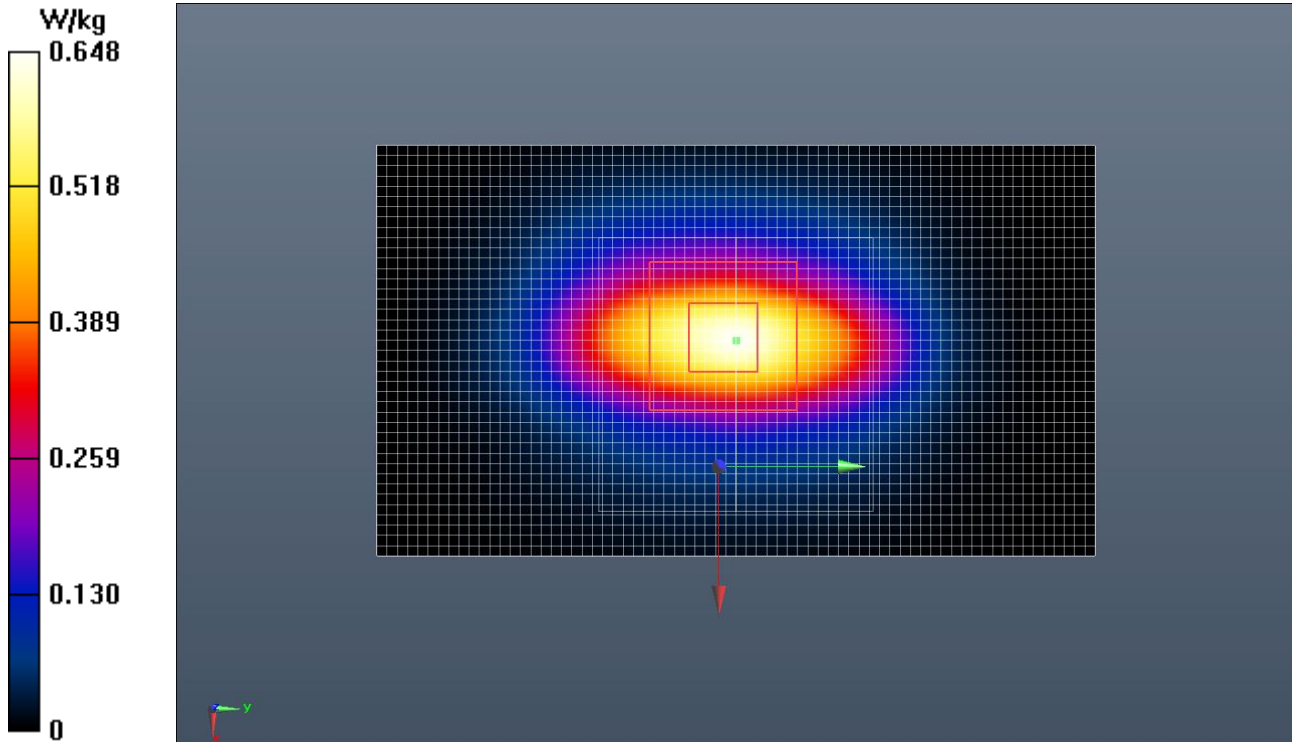
Reference Value = 15.737 V/m; Power Drift = -0.23 dB

Peak SAR (extrapolated) = 73.4 W/kg

SAR(1 g) = 39.7 W/kg; SAR(10 g) = 20.5 W/kg

Normalized to target power = 1 W and actual power = 0.01 W

Maximum value of SAR (measured) = 61.5 W/kg



Date/Time: 1/28/2020 2:30:58 PM



SAR Test Report

Dipole 1900

Medium parameters used (interpolated): $f = 1900$ MHz; $\sigma = 1.532$ S/m; $\epsilon_r = 53.28$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: EX3DV3 - SN3516; ConvF(8.78, 8.78, 8.78); Calibrated: 11/19/2019;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 11/13/2019
- Phantom: SAM 2 with CRP v5.0; Type: QD000P40CD; Serial: TP:1663
- DASYS2 52.8.7(1137); SEMCAD X 14.6.10(7164)

WWAN Flat-Section MSL Testing/1900MHz Dipole/Area Scan 2 (41x71x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm

Maximum value of SAR (interpolated) = 0.648 W/kg

WWAN Flat-Section MSL Testing/1900MHz Dipole/Zoom Scan 2 (9x9x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

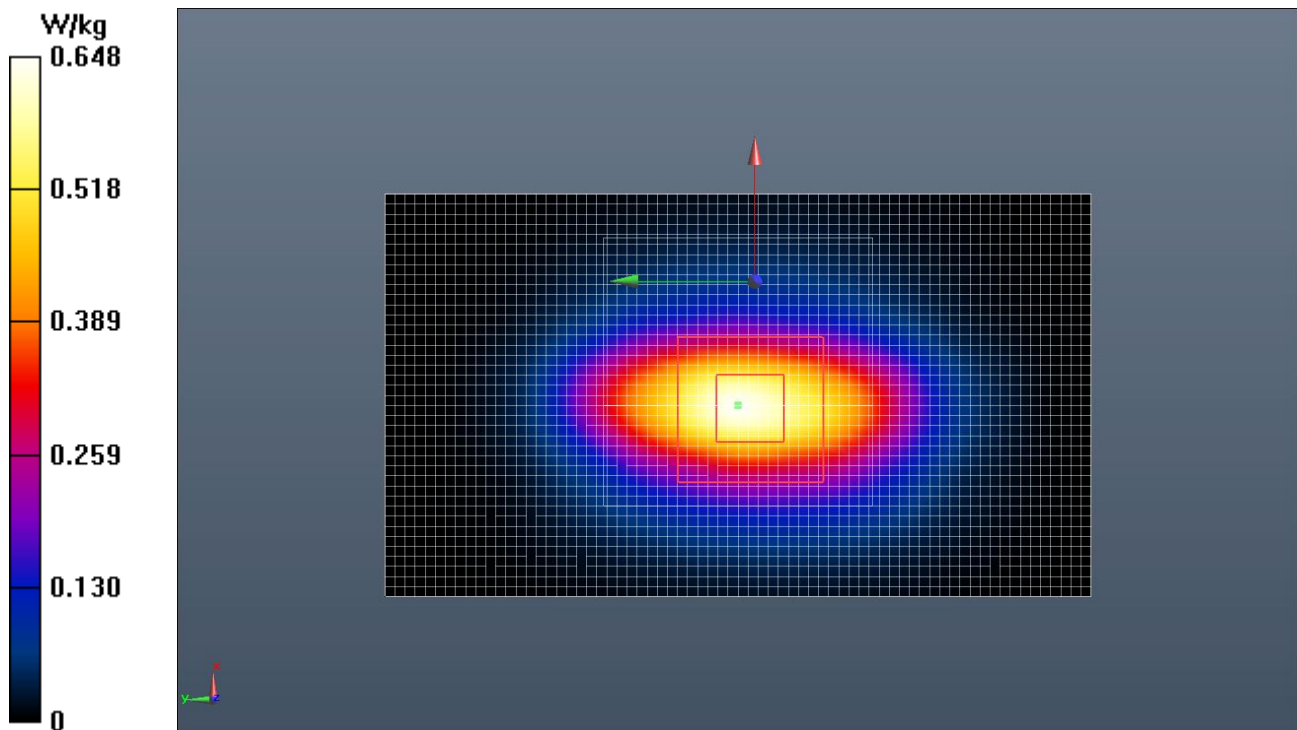
Reference Value = 15.737 V/m; Power Drift = -0.13 dB

Peak SAR (extrapolated) = 75.2 W/kg

SAR(1 g) = 40.7 W/kg; SAR(10 g) = 21 W/kg

Normalized to target power = 1 W and actual power = 0.01 W

Maximum value of SAR (measured) = 62.8 W/kg





SAR Test Report

Dipole 1800

Medium parameters used: $f = 1800$ MHz; $\sigma = 1.53$ S/m; $\epsilon_r = 52.89$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: EX3DV3 - SN3516; ConvF(9.08, 9.08, 9.08); Calibrated: 11/19/2019;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 11/13/2019
- Phantom: SAM 2 with CRP v5.0; Type: QD000P40CD; Serial: TP:1663
- DASYS2 52.8.7(1137); SEMCAD X 14.6.10(7164)

WWAN Flat-Section MSL Testing/1800MHz Dipole/Area Scan 2 (41x71x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm

Maximum value of SAR (interpolated) = 0.648 W/kg

WWAN Flat-Section MSL Testing/1800MHz Dipole/Zoom Scan (9x9x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

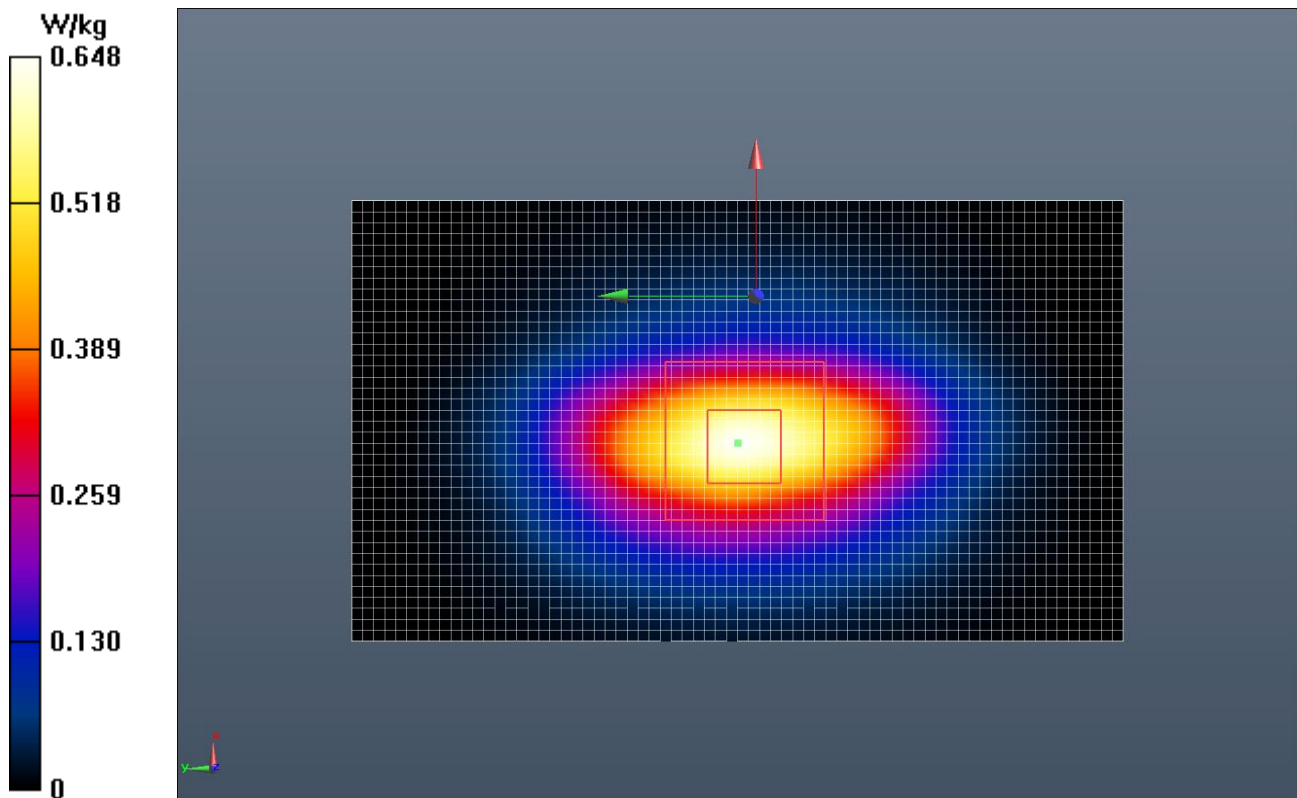
Reference Value = 8.170 V/m; Power Drift = -0.30 dB

Peak SAR (extrapolated) = 74.5 W/kg

SAR(1 g) = 41.1 W/kg; SAR(10 g) = 21.6 W/kg

Normalized to target power = 1 W and actual power = 0.01 W

Maximum value of SAR (measured) = 62.9 W/kg





SAR Test Report

Dipole 1800

DUT: Dipole 1800 MHz D1800V2; Serial: D1800V2 - SN:xxx

Medium parameters used: $f = 1800$ MHz; $\sigma = 1.53$ S/m; $\epsilon_r = 52.89$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASYS Configuration:

- Probe: EX3DV3 - SN3516; ConvF(9.08, 9.08, 9.08); Calibrated: 11/19/2019;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 11/13/2019
- Phantom: SAM 2 with CRP v5.0; Type: QD000P40CD; Serial: TP:1663
- DASYS2 52.8.7(1137); SEMCAD X 14.6.10(7164)

WWAN Flat-Section MSL Testing/1800MHz Dipole/Area Scan 2 (41x71x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.648 W/kg

WWAN Flat-Section MSL Testing/1800MHz Dipole/Zoom Scan 2 (9x9x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

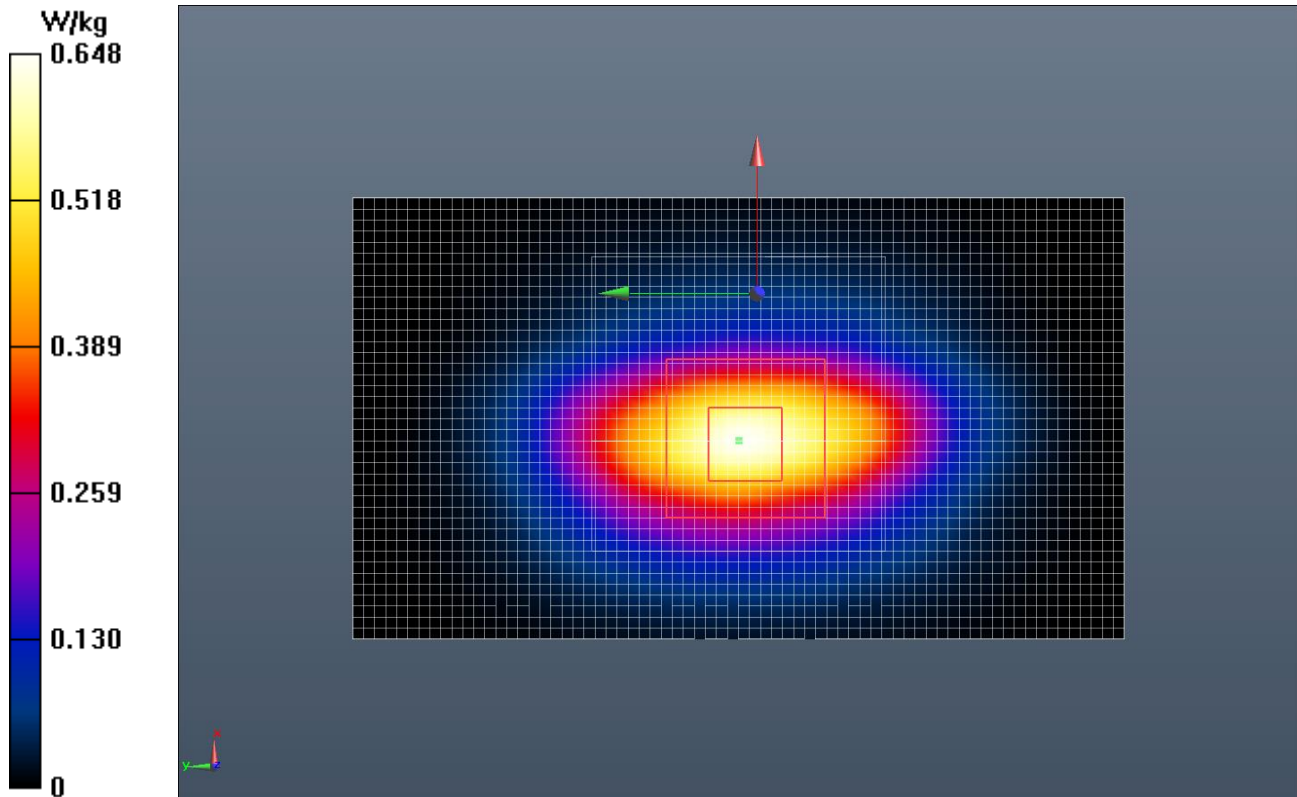
Reference Value = 8.170 V/m; Power Drift = -0.20 dB

Peak SAR (extrapolated) = 74.3 W/kg

SAR(1 g) = 41 W/kg; SAR(10 g) = 21.6 W/kg

Normalized to target power = 1 W and actual power = 0.01 W

Maximum value of SAR (measured) = 62.8 W/kg





SAR Test Report

Dipole 750

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.9 \text{ S/m}$; $\epsilon_r = 41.86$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: EX3DV3 - SN3516; ConvF(11.41, 11.41, 11.41); Calibrated: 11/19/2019;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 11/13/2019
- Phantom: SAM 2 with CRP v5.0; Type: QD000P40CD; Serial: TP:1663
- DASYS2 52.8.7(1137); SEMCAD X 14.6.10(7164)

WWAN Flat-Section MSL Testing/750MHz Dipole/Area Scan 2 (41x71x1): Interpolated grid: $dx=1.500 \text{ mm}$, $dy=1.500 \text{ mm}$
Maximum value of SAR (interpolated) = 0.0990 W/kg

WWAN Flat-Section MSL Testing/750MHz Dipole/Zoom Scan 2 (9x9x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

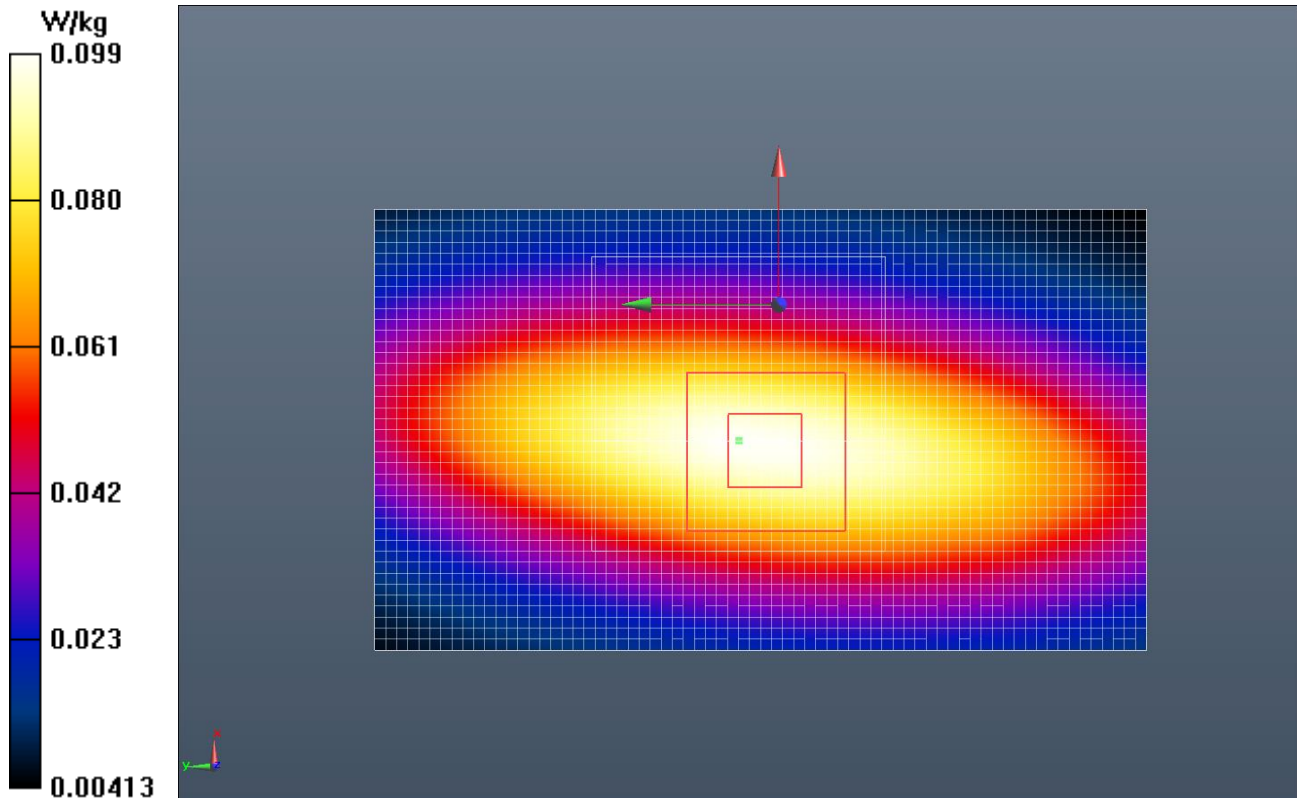
Reference Value = 10.464 V/m; Power Drift = 0.02

Peak SAR (extrapolated) = 11.7 W/kg

SAR(1 g) = 8.09 W/kg; SAR(10 g) = 5.45 W/kg

Normalized to target power = 1 W and actual power = 0.01 W

Maximum value of SAR (measured) = 10.5 W/kg





SAR Test Report

Dipole 750

Medium parameters used: $f = 750$ MHz; $\sigma = 0.9$ S/m; $\epsilon_r = 41.86$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: EX3DV3 - SN3516; ConvF(11.41, 11.41, 11.41); Calibrated: 11/19/2019;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 11/13/2019
- Phantom: SAM 2 with CRP v5.0; Type: QD000P40CD; Serial: TP:1663
- DASYS2 52.8.7(1137); SEMCAD X 14.6.10(7164)

WWAN Flat-Section MSL Testing/750MHz Dipole/Area Scan 2 (41x71x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.0990 W/kg

WWAN Flat-Section MSL Testing/750MHz Dipole/Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 10.464 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 11.0 W/kg

SAR(1 g) = 7.98 W/kg; SAR(10 g) = 5.37 W/kg

Normalized to target power = 1 W and actual power = 0.01 W

Maximum value of SAR (measured) = 9.97 W/kg

