

SAR Test Report - New Certification

Applicant:

REXON
REXON TECHNOLOGY CO., LTD.

Rexon Technology Co., LTD
No. 261, Jen Hwa Road, Tali, Taichung, Taiwan

Maximum Reported 1g SAR			
FCC	FACE	0.34	W/kg
	BODY	0.29	
Occupational Limit:		8.00	

FCC ID:

I70PJ2

Product Model Number / HVIN

PJ2

Product Name / PMN

PJ2

In Accordance With:

FCC 47 CFR §2.1093

Radiofrequency Radiation Exposure Evaluation: Portable Devices

Approved By:



Ben Hewson, President

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Test Lab Certificate: 2470.01



FCC Registration: 714830

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1.0 DOCUMENT CONTROL

Samples Tested By:	Trevor Whillock		
Report Prepared By:	Art Voss		
Report Reviewed By:	Ben Hewson		
Report Issue Number	Description	By	Report Issue Date
R0.0	Draft Release	Trevor Whillock	17 September 2019
	Revised Company Name Pg.1,8, and 29		23 September 2019
	Revised Model Name Throughout Report		
	Revised Battery Accessory P2 Rating, Added Accessory P/N's & Notes Related to Evaluation of Accessories Section 9.0		
R1.0	Initial Release	Trevor Whillock	25 October 2019

2.0 CLIENT AND DEVICE INFORMATION

Client Information	
Applicant Name	Rexon Technology CO., LTD
Applicant Address	No. 261, Jen Hwa Road, Tali, Taichung, Taiwan
Manufacturer Name	Rexon Technology CO., LTD
Manufacturer Address	No. 261, Jen Hwa Road, Tali, Taichung, Taiwan
DUT Information	
Device Identifier(s):	FCC ID: I70PJ2
Type of Equipment:	Licensed Non-Broadcast Transmitter Held to Face (TNF) FCC Part 90
Device Model(s) / HVIN:	PJ2
Device Marketing Name / PMN:	PJ2
Test Sample Serial No.:	T/A Sample - Identical Prototype
Transmit Frequency Range:	VHF Band: 118-136.975 MHz
Number of Channels:	Programmable
Manuf. Max. Rated Output Power:	VHF Band: 1.5W +/- 20%
Modulation:	AMFM
Duty Cycle:	50% PTT Duty Cycle
DUT Power Source:	See Section 9.0
Deviation(s) from standard/procedure:	None
Modification of DUT:	None

3.0 SCOPE OF EVALUATION

The PJ2, FCC ID: I7OPJ2, is a Portable Hand Held PTT Radio Transceiver that operates in the 108-136.975 MHz VHF frequency band with transmission channel range from 118MHz to 136.975MHz. The device is intended for Occupational Use. The product operates from a battery pack that accepts Alkaline primary AA batteries. Additionally the device may be powered and operate via USB-C cable connected to a USB interface port, AC or DC adapter. Test samples provided by the manufacturer were capable of transmitting at select frequencies and power levels preset by the manufacturer. Test equipment was connected via the antenna port for conducted power analysis. The DUT was evaluated for SAR at the maximum conducted output power level, preset by the manufacturer and in accordance with the procedures described in IEEE 1528, IEC 62209-2, FCC KDB 865646, 447498, 643646. A description of the device, operating configuration, detailed summary of the test results, methodology and procedures used in the evaluation, equipment used and the various provisions of the rules are included within this test report.

4.0 NORMATIVE REFERENCES

Normative References*	
ANSI / ISO 17025:2017	General Requirements for competence of testing and calibration laboratories
FCC CFR Title 47 Part 2	Code of Federal Regulations
Title 47:	Telecommunication
Part 2.1093:	Radiofrequency Radiation Exposure Evaluation: Portable Devices
IEEE International Committee on Electromagnetic Safety	
IEEE 1528-2013:	IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
IEC International Standard	
IEC 62209-2 2010	Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Part 2
FCC KDB	
KDB 865664 D01v01r04	SAR Measurement Requirements for 100MHz to 6GHz
FCC KDB	
KDB 447498 D01v06	Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies
FCC KDB	
KDB 643646 D01v01r03	SAR Test Reduction Considerations for Occupational PTT Radios
* When the issue number or issue date is omitted, the latest version is assumed.	


5.0 STATEMENT OF COMPLIANCE

This measurement report demonstrates that samples of the product model(s) were evaluated for Specific Absorption Rate (SAR) on the date(s) shown, in accordance with the Measurement Procedures cited and were found to comply with the Standard(s) Applied based on the Exposure Limits of the Use Group indicated for which the product is intended to be used.

Applicant: Rexon Technology CO., LTD		Product / PMN PJ2	
Standard(s) Applied: FCC 47 CFR §2.1093		Measurement Procedure(s): FCC KDB 865664, FCC KDB 447498, FCC KDB 643646 IEEE Standard 1528-2013, IEC 62209-2	
Reason For Issue: <input checked="" type="checkbox"/> New Certification <input type="checkbox"/> Class I Permissive Change <input type="checkbox"/> Class II Permissive Change		Use Group: <input type="checkbox"/> General Population / Uncontrolled <input checked="" type="checkbox"/> Occupational / Controlled	
Reason for Change: Original Filing		Limits Applied: <input type="checkbox"/> 1.6W/kg - 1g Volume <input checked="" type="checkbox"/> 8.0W/kg - 1g Volume <input type="checkbox"/> 4.0W/kg - 10g Volume	
		Date(s) Evaluated: Aug 13th-14th & Sept 16th-17th	

The results of this investigation are based solely on the test sample(s) provided by the applicant which was not adjusted, modified or altered in any manner whatsoever except as required to carry out specific tests or measurements. A description of the device, operating configuration, detailed summary of the test results, methodologies and procedures used during this evaluation, the equipment used and the various provisions of the rules are included in this test report.

I attest that the data reported herein is true and accurate within the tolerance of the Measurement Instrument Uncertainty; that all tests and measurements were performed in accordance with accepted practices or procedures; and that all tests and measurements were performed by me or by trained personnel under my direct supervision. The results of this investigation are based solely on the test sample(s) provided by the client which were not adjusted, modified or altered in any manner whatsoever, except as required to carry out specific tests or measurements. This test report has been completed in accordance with ISO/IEC 17025.


Trevor Whillock
 Test Lab Engineer
 Celltech Labs Inc.
 25 October 2019
 Date

6.0 SAR MEASUREMENT SYSTEM

SAR Measurement System

Celltech Labs Inc. SAR measurement facility employs a Dosimetric Assessment System (DASY™) manufactured by Schmid & Partner Engineering AG (SPEAG™) of Zurich, Switzerland. The DASY6 measurement system is comprised of the measurement server, a robot controller, a computer, a near-field probe, a probe alignment sensor, an Elliptical Planar Phantom (ELI) phantom and a specific anthropomorphic mannequin (SAM) phantom for Head and/or Body SAR evaluations. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF). A cell controller system contains the power supply, robot controller and a teach pendant (Joystick) to control the robot's servo motors. The Staubli robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical form the DAE to digital electronic signal and transfers data to the DASY6 measurement server. The DAE4 utilizes a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16-bit AD-converter, a command decoder and a control logic unit. Transmission to the DASY6 measurement server is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe-mounting device includes two different sensor systems for frontal and sidewise probe contacts. The sensor systems are also used for mechanical surface detection and probe collision detection. The robot utilizes a controller with built in VM-bus computer.



DASY 6 SAR System with SAM Phantom



DASY 6 Measurement Controller

7.0 RF CONDUCTED POWER MEASUREMENT

Table 7.0 Conducted Power Measurements

Conducted Power Measurements- (P1) Alkaline AA						
Channel	Frequency (MHz)	Measured Power (dBm)	Rated Power (dBm)	Rated Power (W)	Delta (dBm)	SAR Test Channel (Y/N)
1	118.000	31.68	32.55	1.80	-0.87	Y
2	122.700	31.57	32.55	1.80	-0.98	Y
3	127.400	31.7	32.55	1.80	-0.85	Y
4	132.100	31.76	32.55	1.80	-0.79	Y
5	136.800	31.75	32.55	1.80	-0.80	Y

Table 7.1 Conducted Power Measurements

Conducted Power Measurements- (P2) USB-C w/ AC/DC Power Supply						
Channel	Frequency (MHz)	Measured Power (dBm)	Rated Power (dBm)	Rated Power (W)	Delta (dBm)	SAR Test Channel (Y/N)
1	118	32.42	32.55	1.80	0.17	Y
2	122.7	32.47	32.55	1.80	0.15	Y
3	127.4	32.52	32.55	1.80	0.29	Y
4	132.1	32.55	32.55	1.80	0.35	Y
5	136.8	32.53	32.55	1.80	0.31	Y

The rated power and tolerance are stated for typical transmission modes. Some modes may produce lower than rated conducted power levels. Power measurements taken across the various channels did not produce levels in excess of the Rated Power. SAR was evaluated using AM mode with the default battery type and alternative USB-C power option. SAR was evaluated at the level specified by the manufacture to be the max output power and produce the most conservative SAR. SAR was evaluated at the maximum tune up tolerance. See section 2.0 Client and Device Information for details. The reported SAR was not scaled down.

8.0 NUMBER OF TEST CHANNELS (N_C)

Table 8.0 Number of Required Test Channels

Number of Required Test Channels						
Frequency			Number of Channels		Spacing	
f_{LOW} (MHz)	f_{HIGH} (MHz)	f_c (MHz)	KDB 447498 (N_c)	IEC 62209 (N_c)	KDB 447498 (MHz)	IEC 62209 (MHz)
118	136.975	127.4875	5	5	4.7	4.7
<p>KDB 447498: $N_c = \text{RoundUp} \{ [100 (F_{\text{HIGH}} - F_{\text{LOW}}) / F_c]^{0.5} \times (F_c / 100)^{0.2} \}$</p> <p>IEC 62209-1: $N_c = 2 \times \{ \text{RoundUp} [10 (F_{\text{HIGH}} - F_{\text{LOW}}) / F_c] \} + 1$</p>						
Notes:						
<p>Per FCC KDB 643646 D01v01r03 (A1)(A2)</p> <p>1) When the Head/Body SAR of an antenna tested in A) is:</p> <p>a) ≤ 3.5 W/kg, testing of all other required channels is not necessary for that antenna</p> <p>b) > 3.5 W/kg and ≤ 4.0 W/kg, testing of the required immediately adjacent channel(s) is not necessary; 3 testing of the other required channels may still be required</p> <p>c) > 4.0 W/kg and ≤ 6.0 W/kg, Head/Body SAR should be measured for that antenna on the required immediately adjacent channels; testing of the other required channels still needs consideration</p> <p>d) > 6.0 W/kg, test all required channels for that antenna</p>						

9.0 ACCESSORIES EVALUATED

Table 9.0 Manufacturer's Accessory List

Manufacturer's Accessory List				
Test Report ID Number	Manufacturer's Part Number	Description	SAR Evaluated	SAR Tested
Audio Accessory				
A1	Rexon Testing Cable*	Standard Audio Accessory	Y	Y
Antenna Accessory				
T1	801-00132-200	Rubber Antenna	Y	Y
Battery Accessory				
P1	770-00028-00000	Battery Pack (AA 1.5V) Alkaline Non Rechargeable	Y	Y
P2	—	USB-C Cable with AC/DC Power Supply Output Rating: 5.0V, 3.0A Max	Y	Y
Body-Worn Accessory				
B1	395-00125-000	Plastic Belt-Clip Fastened with Metal Screws	Y	Y

A1 - * The manufacturer has stated they do not offer or market Headset units or an Audio Accessory for use with this device; however, they have provided a standard input Audio Accessory in place, which was evaluated during the course of this investigation.

Per FCC KDB 447498:

For third-party accessories that do not contain transmitters, the accessory suppliers should consult with the host equipment manufacturer to determine accessory approval options; for example, through a Class I or Class II permissive change submitted by the host grantee. If applicable, a change of FCC ID followed by a Class II permissive change by the third-party accessory supplier may be considered.

T1 - The Antenna is the standard (default) antenna and only this antenna was evaluated during the course of this investigation.

P1 - This battery pack is fill-able by the user with AA batteries (x6); the manufacturer asserts that "only Alkaline batteries" will be used and "will be specified in their user manual". As such only Alkaline AA batteries were evaluated in the battery pack.

P2 - The device may be powered and operate via this USB-C cable connected to the USB port with an AC/DC power adapter. The manufacturer asserts that there are no re-chargeable battery packs for this device, and the USB-C cable and port is not intended for charging purposes. Therefore the device was also evaluated for SAR using this alternative power option without any battery pack.

B1 - The Plastic Belt-Clip is fastened by metal screws and is not easily removable; therefore the accessory was evaluated in both Face and body Configuration.

10.0 SAR MEASUREMENT SUMMARY

Table 10.0: Measured Results

Measured SAR Results (1g) - BODY/FACE Configuration (FCC)															
Date	Plot ID	Test Type	DUT Model	Test Frequency (MHz)	Modulation	Accessories				DUT Spacing		Conducted Power (dBm)	Measured SAR (10g)		SAR Drift (dB)
						Antenna ID	Battery ID	Body ID	Audio ID	DUT (mm)	Antenna (mm)		100% DC (W/kg)	50% DC (W/kg)	
FACE															
14 Aug 2019	F1	PTT	PJ2	132.100	AM	T1	P1	B1	n/a	25	35	31.72	0.480	0.379	-0.730
17 Aug 2019	F2	PTT	PJ2	132.100	AM	T1	P2	B1	n/a	25	35	32.55	0.370	0.296	-0.380
BODY															
17 Aug 2019	B1	PTT	PJ2	132.100	AM	T1	P1	B1	A1	0	40	31.72	0.441	0.225	-0.330
17 Aug 2019	B2	PTT	PJ2	132.100	AM	T1	P2	B1	A1	0	40	32.55	0.289	0.170	-0.550
SAR Limit							Spatial Peak			Head/Body		RF Exposure Category			
FCC 47 CFR 2.1093							1 Gram Average			8.0 W/kg		Occupational			

Per FCC KDB 643646 D01v01r03 (A1)(A2)

When the Head/Body SAR of an antenna tested in A) is:

a) ≤ 3.5 W/kg, testing of all other required channels is not necessary for that antenna

11.0 SCALING OF MAXIMUM MEASURE SAR

Table 11.0 SAR Scaling

Scaling of Maximum Measured SAR ⁽¹⁾							
Plot ID	Configuration	Freq	Measured Fluid Deviation		Measured Conducted Power	Measured Drift	Measured SAR (1g)
		(MHz)	Permittivity	Conductivity	(dBm)	(dB)	(W/kg)
F1	FACE	132.1	-2.57%	-1.33%	31.8	-0.730	0.240
B1	BODY	132.1	-0.10%	-7.09%	31.8	-0.330	0.221
Step 1							
Fluid Sensitivity Adjustment							
Plot ID	Scale Factor		X	Measured SAR		=	Step 1 Adjusted SAR (1g)
	(%)			(W/kg)			(W/kg)
F1	-0.510%		X	0.240		=	0.240
B1	-5.550%		X	0.221		=	0.221
Step 2							
Manufacturer's Tune-Up Tolerance							
Plot ID	Measured Conducted Power	Rated Power		Delta	+	Step 1 Adjusted SAR	Step 2 Adjusted SAR (1g)
	(dBm)	(dBm)		(dB)		(W/kg)	(W/kg)
F1	31.8	32.6		-0.8	+	0.240	0.289
B1	31.8	32.6		-0.8	+	0.221	0.266
Step 3							
Drift Adjustment							
Plot ID	Measured Drift		+	Step 2 Adjusted SAR		=	Step 3 Adjusted SAR (1g)
	(dB)			(W/kg)			(W/kg)
F1	-0.730		+	0.289		=	0.342
B1	-0.330		+	0.266		=	0.286
Step 4							
Simultaneous Transmission - Bluetooth and/or WiFi							
Plot ID	Rated Output Power (Pmax)	Freq	Separation Distance	Estimated SAR	+	Step 3 Adjusted SAR	Step 4 Adjusted SAR (1g)
	(mW)	(MHz)	(mm)	(W/kg)		(W/kg)	(W/kg)
F1	n/a	n/a	n/a	n/a	+	0.342	0.342
B1	n/a	n/a	n/a	n/a	+	0.286	0.286
Step 5							
Reported SAR							
Plot ID	FCC			ISED			
	From Steps 1 through 3			From Steps 1 through 4			
	1g SAR (W/kg)			1g SAR (W/kg)			
F1	0.34			n/a			
B1	0.29			n/a			

NOTES to Table 11.0

(1) Scaling of the Maximum Measured SAR is based on the highest, 100% duty cycle for Face, Body and/or Head including ALL test channels, configurations and accessories used during THIS evaluation. The Measured Fluid Deviation parameters apply only to deviation of the tissue equivalent fluids used at the frequencies which produced the highest measured SAR. The Measured Conducted Power applies to the Conducted Power measured at the frequencies producing the highest Face and Body SAR. The Measured Drift is the SAR drift associated with that specific SAR measurement. The Reported SAR is the accumulation of all SAR Adjustments from the applicable Steps 1 through 4. The Plot ID is for identification of the SAR Measurement Plots in Annex A of this report.

NOTE: Some of the scaling factors in Steps 1 through 4 may not apply and are identified by light gray text.

Step 1

Per IEC-62209-1 and FCC KDB 865664. Scaling required only when Measured Fluid Deviation is greater than 5%. If the Measured Fluid Deviation is greater than 5%, Table 10.1 will be shown and will indicate the SAR scaling factor in percent (%). SAR is MULTIPLIED by this scaling factor only when the scaling factor is positive (+).

Step 2

Per KDB 447498. Scaling required only when the difference (Delta) between the Measured Conducted Power and the Manufacturer's Rated Conducted Power is (-) Negative. The absolute value of Delta is ADDED to the SAR.

Step 3

Per IEC 62209-1. Scaling required only when Measured Drift is (-) Negative. The absolute value of Measured Drift is added to Reported or Simultaneous Reported SAR.

Step 4

Per KDB 447498 4.3.2. The SAR, either measured or calculated, of ANY and ALL simultaneous transmitters must be added together and includes all contributors.

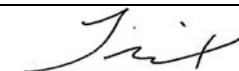
Step 5

The Reported SAR is the Maximum Final Adjusted Cumulative SAR from the applicable Steps 1 through 4 and are reported on Page 1 of this report.

Table 11.1: Fluid Sensitivity Calculation

Fluid Sensitivity Calculation (1g)				
Delta SAR = Ce * Δe + Cσ*Δσ				
Ce = (-0.0007854*F ³) + (0.009402*F ²) - (0.02742*F) - 0.2026				
Cσ = (0.009804*F ³) - (0.08661*F ²) + (0.02981*F) + 0.7829				
Attribute	Plot ID	Freq. [F] (GHz)	Plot ID	Freq. [F] (GHz)
	F1	0.1321	B1	0.1321
Ce	-0.2061		-0.2061	
Cσ	0.7853		0.7853	
Δe	-2.57%		-0.10%	
Δσ	-1.33%		-7.09%	
ΔSAR	-0.51%		-5.55%	
Scaling of SAR only required for Positive ΔSAR				

I attest that the data reported herein is true and accurate within the tolerance of the Measurement Instrument Uncertainty; that all tests and measurements were performed in accordance with accepted practices or procedures; and that all tests and measurements were performed by me. The results of this investigation are based solely on the test sample(s) provided by the client which were not adjusted, modified or altered in any manner whatsoever, except as required to carry out specific tests or measurements. This test report has been completed in accordance with ISO/IEC 17025.



Trevor Whillock
Test Lab Engineer
Celltech Labs Inc.

25 October 2019
Date

12.0 SAR EXPOSURE LIMITS

Table 12.0 Exposure Limits

SAR RF EXPOSURE LIMITS			
FCC 47 CFR§2.1093	Health Canada Safety Code 6	General Population / Uncontrolled Exposure ⁽⁴⁾	Occupational / Controlled Exposure ⁽⁵⁾
Spatial Average⁽¹⁾ (averaged over the whole body)		0.08 W/kg	0.4 W/kg
Spatial Peak⁽²⁾ (Head and Trunk averaged over any 1 g of tissue)		1.6 W/kg	8.0 W/kg
Spatial Peak⁽³⁾ (Hands/Wrists/Feet/Ankles averaged over 10 g)		4.0 W/kg	20.0 W/kg
(1) The Spatial Average value of the SAR averaged over the whole body.			
(2) The Spatial Peak value of the SAR averaged over any 1 gram of tissue, defined as a tissue volume in the shape of a cube and over the appropriate averaging time.			
(3) The Spatial Peak value of the SAR averaged over any 10 grams of tissue, defined as a tissue volume in the shape of a cube and over the appropriate averaging time.			
(4) Uncontrolled environments are defined as locations where there is potential exposure to individuals who have no knowledge or control of their potential exposure.			
(5) Controlled environments are defined as locations where there is potential exposure to individuals who have knowledge of their potential exposure and can exercise control over their exposure.			

13.0 DETAILS OF SAR EVALUATION

13.0 Day Log

DAY LOG					Fluid Dielectric	SPC	Test	Task
Date	Ambient Temp (°C)	Fluid Temp (°C)	Relative Humidity (%)	Barometric Pressure (kPa)				
13 Aug 2019	24.0	24.3	35%	101.9	X	X		Fluid Parameters, SPC & Prescan
14 Aug 2019	23.0	24.3	44%	102.1			X	VHF Test-Face Config
16 Sept 2019	24.0	24.0	33%	100.8	X	X		Fluid Parameters, SPC & Prescan
17 Sept 2019	24.0	23.6	42%	101.0			X	VHF Test-Body/Face Config

*Per IEEE 1528 2013, test series was started within 24 hours of Fluid Parameter Measurement and was completed within a 48hr period

13.1 DUT Setup and Configuration

DUT Setup and Configuration	
Overview	<p>The DUT was evaluated for <i>Face</i> SAR at the maximum conducted output power level, preset by the manufacturer, with a fully charged battery in unmodulated continuous transmit operation (FM mode at 100% duty cycle) with the transmit key continuously depressed. For a Push-To-Talk (PTT) device with a manually operated transmit pushbutton, a 50% duty cycle compensation for the <u>reported SAR</u> was used, as per FCC KDB 447498 (6.1). The manufacturer does not manufacture, offer or market any Audio Accessories to be used with this device. Therefore, Audio Accessories were not evaluated during the course of this investigation. Since the nature of the device does not inhibit the ability to transmit while worn on the body; the DUT was tested in <i>Face</i> configuration only.</p> <p>The test procedures outlined in FCC KDB 447498 " General SAR Test Reduction Considerations for " as well as FCC KDB 865664, and IEEE 1528 were used throughout the evaluation of this device.</p>

13.2 DUT Positioning

DUT Positioning	
Positioning	<p>The DUT Positioner was securely fastened to the Phantom Platform. Registration marks were placed on the DUT and the Positioner to ensure consistent positioning of the DUT for each test evaluation.</p>
FACE Configuration	<p>The DUT was securely clamped into the device holder with the surface of the DUT normally held to the user's face facing the phantom. The device holder was adjusted to ensure that the horizontal axis of the DUT was parallel to the bottom of the phantom. A 25mm spacer block was used to set the separation distance between the DUT and the phantom to 25mm. When applicable and unless by design, the antenna of the DUT was prevented from sagging away from the phantom. The spacer block was removed before testing.</p>
BODY Configuration	<p>Body-Worn and Audio Accessories were affixed to the DUT in the manner in which they are intended to be used. The DUT, with its accessories, were securely clamped into the device holder with the surface of the DUT normally in contact with the body in direct contact with the bottom of the phantom, or 0mm separation from the DUT's accessory to the phantom. Body-Worn Accessory straps, linkages, etc. were positioned in a fashion resembling that for which they were intended to be used. Audio Accessory cables, etc., were positioned in a fashion resembling that for which they were intended to be used.</p>
HEAD Configuration	<p>This device is not intended to be held to the ear and was not tested in the HEAD configuration.</p>

13.3 General Procedures and Report

General Procedures and Reporting	
General Procedures	<p>The fluid dielectric parameters of the Active Tissue Simulating Liquid (TSL) were measured as described in this Section, recorded and entered into the DASY Measurement Server. Active meaning the TSL used during the SAR evaluation of the DUT. The temperature of the Active TSL was measured and recorded prior to performing a System Performance Check (SPC). An SPC was performed with the Active TSL prior to the start of the test series. The temperature of the Active TSL was measured throughout the day and the Active TSL temperature was maintained to $\pm 0.5^{\circ}\text{C}$. The Active TSL temperature was maintained to within $\pm 2.0^{\circ}\text{C}$ throughout the test series. The liquid parameters shall be measured within 24 hours before the start of a test series and if it takes longer than 48 hours, the liquid parameters shall also be measured at the end of the test series.</p> <p>An Area Scan exceeding the length and width of the DUT projection was performed and the locations of all maximas within 2dB of the Peak SAR recorded. A Zoom Scan centered over the Peak SAR location(s) was performed and the 1g and 10g SAR values recorded. The resolutions of the Area Scan and Zoom Scan are described in the Scan Resolution table(s) in this Section. A Power Reference Measurement was taken at the phantom reference point immediately prior to the Area Scan. A Power Drift measurement was taken at the phantom reference point immediately following the Zoom Scan to determine the power drift. A Z-Scan from the <u>Maximum Distance to Phantom Surface</u> to the fluid surface was performed following the power drift measurement.</p>
Reporting	<p>The 1g SAR, 10g SAR and power drift measurements are recorded in the SAR Measurement Summary tables in the SAR Measurement Summary Section of this report. The SAR values shown in the 100% DC (Duty Cycle) column are the SAR values reported by the SAR Measurement Server with the DUT operating at 100% transmit duty cycle. These tables also include other information such as transmit channel and frequency, modulation, accessories tested and DUT-phantom separation distance.</p> <p>In the Scaling of Maximum Measured SAR Section of this report, the highest measured SAR in the BODY configuration, within the entire scope of this assessment, are, when applicable, scaled for Fluid Sensitivity, Manufacturer's Tune-Up Tolerance, Simultaneous Transmission and Drift. With the exception of Duty Cycle correction/compensation, SAR values are <u>ONLY</u> scaled up, not down. The final results of this scaling is the <u>reported SAR</u> which appears on the Cover Page of this report.</p>

13.4 Fluid Dielectric and Systems Performance Check

Fluid Dielectric and Systems Performance Check	
Fluid Dielectric Measurement Procedure	
<p>The fluid dielectric parameters of the Tissue Simulating Liquid (TSL) are measured using the Open-Ended Coax Method connected to an Agilent 8753ET Network Analyzer connected to a measurement server running April Dielectric Property Measurement System. A frequency range of $\pm 100\text{MHz}$ for frequencies $> 300\text{MHz}$ and $\pm 50\text{MHz}$ for frequencies $\leq 300\text{MHz}$ with frequency step size of 10MHz is used. The center frequency is centered around the SAR measurement probe's calibration point for that TSL frequency range. A calibration of the setup is performed using a short-open-deionized water (at 23°C in a 300ml beaker) method. A sample of the TSL is placed in a 300ml beaker and the open-ended coax is submerged approximately 8mm below the fluid surface in the approximate center of the beaker. A check of the setup is made to ensure no air is trapped under the open-ended coax. The sample of TSL is measured and compared to the FCC KDB 865664 targets for HEAD or BODY for the entire fluid measurement range. Fluid adjustment are made if the dielectric parameters are $> 5\%$ in range that the DUT is to be tested. If the adjustments fail to bring the parameters to $\leq 5\%$ but are $< 10\%$, the SAR Fluid Sensitivity as per IEC 62201-1 and FCC KDB 865664 are applied to the highest measured SAR. A TSL with dielectric parameters $> 10\%$ in the DUT test frequency range are not used.</p>	
Systems Performance Check	
<p>The fluid dielectric parameters of the Active TSL are entered into the DASY Measurement Server at each of the 10MHz step size intervals. Active meaning the TSL used during the SAR evaluation of the DUT. The DASY Measurement System will automatically interpolate the dielectric parameters for DUT test frequencies that fall between the 10MHz step intervals.</p> <p>A Systems Performance Check (SPC) is performed in accordance with IEEE 1528 "System Check" and FCC KDB 865664 "System Verification". A validation source, dipole or Confined Loop Antenna (CLA), is placed under the geometric center of the phantom and separated from the phantom in accordance to the validation source's Calibration Certificate data. A CW signal set to the frequency of the validate source's and SAR measurement probe's calibration frequency with a forward power set to the validation source's Calibration Certificate data power setting is applied to the validation source. An Area Scan is centered over the projection of the validation source's feed point and an Area Scan is taken. A Zoom Scan centered over the Peak SAR measurement of the Area Scan and the 1g and 10g SAR is measured. The measured 1g and 10g SAR is compared to the 1g and 10g SAR measurements from the validation source's Calibration Certificate. When required, the measured SAR is normalized to 1.0W and compared to the normalized SAR indicated on the validation source's Calibration Certificate. The SPC is considered valid when the measured and normalized SAR is $\leq 10\%$ of the measured and normalize SAR of the validation source's Calibration Certificate.</p> <p>The fluid dielectric parameters of the Active TSL and SPC are repeated when the Active TSL has been in use for greater than 84 hours or if the Active TSL temperature has exceed $\pm 1^\circ\text{C}$ of the initial fluid analysis.</p>	

13.5 Scan Resolution 100MHz to 2GHz

Scan Resolution 100MHz to 2GHz	
Maximum distance from the closest measurement point to phantom surface: (Geometric Center of Probe Center)	$4 \pm 1 \text{ mm}$
Maximum probe angle normal to phantom surface. (Flat Section ELI Phantom)	$5^\circ \pm 1^\circ$
Area Scan Spatial Resolution $\Delta X, \Delta Y$	15 mm
Zoom Scan Spatial Resolution $\Delta X, \Delta Y$	7.5 mm
Zoom Scan Spatial Resolution ΔZ (Uniform Grid)	5 mm
Zoom Scan Volume X, Y, Z	30 mm
Phantom	ELI
Fluid Depth	$150 \pm 5 \text{ mm}$
An Area Scan with an area extending beyond the device was used to locate the candidate maximas within 2dB of the global maxima.	
A Zoom Scan centered over the peak SAR location(s) determined by the Area Scan was used to determine the 1-gram and 10-gram peak spatial-average SAR	

13.6 Scan Resolution 2GHz to 3GHz

Scan Resolution 2GHz to 3GHz	
Maximum distance from the closest measurement point to phantom surface: (Geometric Center of Probe Center)	4 ± 1 mm
Maximum probe angle normal to phantom surface. (Flat Section ELI Phantom)	5° ± 1°
Area Scan Spatial Resolution $\Delta X, \Delta Y$	12 mm
Zoom Scan Spatial Resolution $\Delta X, \Delta Y$	5 mm
Zoom Scan Spatial Resolution ΔZ (Uniform Grid)	5 mm
Zoom Scan Volume X, Y, Z	30 mm
Phantom	ELI
Fluid Depth	150 ± 5 mm
An Area Scan with an area extending beyond the device was used to locate the candidate maximas within 2dB of the global maxima.	
A Zoom Scan centered over the peak SAR location(s) determined by the Area Scan was used to determine the 1-gram and 10-gram peak spatial-average SAR	

13.7 Scan Resolution 5GHz to 6GHz

Scan Resolution 5GHz to 6GHz	
Maximum distance from the closest measurement point to phantom surface: (Geometric Center of Probe Center)	4 ± 1 mm
Maximum probe angle normal to phantom surface. (Flat Section ELI Phantom)	5° ± 1°
Area Scan Spatial Resolution $\Delta X, \Delta Y$	10 mm
Zoom Scan Spatial Resolution $\Delta X, \Delta Y$	4 mm
Zoom Scan Spatial Resolution ΔZ (Uniform Grid)	2 mm
Zoom Scan Volume X, Y, Z	22 mm
Phantom	ELI
Fluid Depth	100 ± 5 mm
An Area Scan with an area extending beyond the device was used to locate the candidate maximas within 2dB of the global maxima.	
A Zoom Scan centered over the peak SAR location(s) determined by the Area Scan was used to determine the 1-gram and 10-gram peak spatial-average SAR	

14.0 MEASUREMENT UNCERTAINTIES

Table 14.0 Measurement Uncertainty

UNCERTAINTY BUDGET FOR DEVICE EVALUATION (IEEE 1528-2013 Table 9)									
Source of Uncertainty	IEEE 1528 Section	Toler ±%	Prob Dist	Div	c _i	c _i	Stand Unct ±%	Stand Unct ±%	V _i or V _{eff}
Measurement System					(1g)	(10g)	(1g)	(10g)	
EX3DV4 Probe Calibration** (k=1)	E.2.1	6.7	N	1	1	1	6.7	6.7	∞
Axial Isotropy** (k=1)	E.2.2	0.6	R	√3	0.7	0.7	0.2	0.2	∞
Hemispherical Isotropy** (k=1)	E.2.2	3.2	R	√3	0.7	0.7	1.3	1.3	∞
Boundary Effect*	E.2.3	1.0	R	√3	1	1	0.6	0.6	∞
Linearity** (k=1)	E.2.4	0.5	R	√3	1	1	0.3	0.3	∞
System Detection Limits*	E.2.4	1.0	R	√3	1	1	0.6	0.6	∞
Modulation Response** (k=1)	E.2.5	8.3	R	√3	1	1	4.8	4.8	∞
Readout Electronics*	E.2.6	0.3	N	1	1	1	0.3	0.3	∞
Response Time*	E.2.7	0.8	R	√3	1	1	0.5	0.5	∞
Integration Time*	E.2.8	2.6	R	√3	1	1	1.5	1.5	∞
RF Ambient Conditions - Noise	E.6.1	0.0	R	√3	1	1	0.0	0.0	10
RF Ambient Conditions - Reflection	E.6.1	0.0	R	√3	1	1	0.0	0.0	10
Probe Positioner Mechanical Tolerance*	E.6.2	0.0	R	√3	1	1	0.0	0.0	∞
Probe Positioning wrt Phantom Shell*	E.6.3	0.4	R	√3	1	1	0.2	0.2	∞
Post-processing*	E.5	2.0	R	√3	1	1	1.2	1.2	∞
Test Sample Related									
Test Sample Positioning	E.4.2	2.2	N	1	1	1	2.2	2.2	5
Device Holder Uncertainty*	E.4.1	3.6	N	1	1	1	3.6	3.6	∞
SAR Drift Measurement ⁽²⁾	E.2.9	0.0	R	√3	1	1	0.0	0.0	∞
SAR Power Scaling ⁽³⁾	E.6.5	0.0	R	√3	1	1	0.0	0.0	∞
Phantom and Tissue Parameters									
Phantom Uncertainty*	E.3.1	6.1	R	√3	1	1	3.5	3.5	∞
SAR Correction Uncertainty	E.3.2	1.6	N	1	1	0.84	1.6	1.3	∞
Liquid Conductivity (measurement)	E.3.3	5.0	N	1	0.78	0.71	3.9	3.6	10
Liquid Permittivity (measurement)	E.3.3	5.0	N	1	0.23	0.26	1.2	1.3	10
Liquid Conductivity (Temperature)	E.3.2	0.4	R	√3	0.78	0.71	0.2	0.2	10
Liquid Permittivity Temperature)	E.3.2	0.2	R	√3	0.23	0.26	0.0	0.0	10
Effective Degrees of Freedom⁽¹⁾								V_{eff} =	1141
Combined Standard Uncertainty			RSS				11.1	11.0	
Expanded Uncertainty (95% Confidence Interval)			k=2				22.2	21.9	
Measurement Uncertainty Table in accordance with IEEE Standard 1528-2003									

(1) The Effective Degrees of Freedom is > 30

Therefore a coverage factor of k=2 represents an approximate confidence level of 95%.

(2) The SAR Value is compensated for Drift

(3) SAR Power Scaling not Required

* Provided by SPEAG for DASY4

Table 14.1 Calculation of Degrees of Freedom

Calculation of the Degrees and Effective Degrees of Freedom	
$v_i = n - 1$	$v_{\text{eff}} = \frac{u_c^4}{m \sum_{i=1} \frac{c_i^4 u_i^4}{v_i}}$

15.0 FLUID DIELECTRIC PARAMETERS

Note: Effective February 19, 2019 TCB Workshop: FCC has permitted the use of single head-tissue simulating liquid specified in IEC 62209-1 for all SAR tests.

Table 15.0 Fluid Dielectric Parameters 150MHz HEAD TSL

Aprel Laboratory
Test Result for UIM Dielectric Parameter
Tue 13/Aug/2019 13:52:26
Freq Frequency(GHz)
FCC_eHFCC OET 65 Supplement C (June 2001) Limits for Head Epsilon
FCC_sHFCC OET 65 Supplement C (June 2001) Limits for Head Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM

Freq	FCC_eHFCC_sH	Test_e	Test_s
0.1000	54.63	0.72	60.24
0.1100	54.17	0.73	57.33
0.1200	53.70	0.74	54.52
0.1300	53.23	0.75	51.28
0.1400	52.77	0.75	53.60
0.1500	52.30	0.76	52.79
0.1600	51.83	0.77	53.81
0.1700	51.37	0.77	52.80
0.1800	50.90	0.78	49.74
0.1900	50.43	0.79	51.48
0.2000	49.97	0.80	50.49

FLUID DIELECTRIC PARAMETERS							
Date:	13 Aug 2019	Fluid Temp:	24.3	Frequency:	150MHz	Tissue:	Head
Freq (MHz)	Test_e	Test_s	Target_e	Target_s	Deviation Permittivity	Deviation Conductivity	
100.0000		60.2400	0.7200	54.6300	0.72	10.27%	0.00%
110.0000		57.3300	0.7300	54.1700	0.73	5.83%	0.00%
118.0000	*	55.0820	0.7220	53.7940	0.74	2.39%	-2.17%
120.0000		54.5200	0.7200	53.7000	0.74	1.53%	-2.70%
122.7000	*	53.6452	0.7254	53.5731	0.74	0.13%	-2.33%
127.4000	*	52.1224	0.7348	53.3522	0.75	-2.31%	-1.69%
130.0000		51.2800	0.7400	53.2300	0.75	-3.66%	-1.33%
132.1000	*	51.7672	0.7400	53.1334	0.75	-2.57%	-1.33%
136.8000	*	52.8576	0.7400	52.9172	0.75	-0.11%	-1.33%
140.0000		53.6000	0.7400	52.7700	0.75	1.57%	-1.33%
150.0000		52.7900	0.7600	52.3000	0.76	0.94%	0.00%
160.0000		53.8100	0.7700	51.8300	0.77	3.82%	0.00%
170.0000		52.8000	0.7700	51.3700	0.77	2.78%	0.00%
180.0000		49.7400	0.7800	50.9000	0.78	-2.28%	0.00%
190.0000		51.4800	0.7800	50.4300	0.79	2.08%	-1.27%
200.0000		50.4900	0.8000	49.9700	0.80	1.04%	0.00%

*Channel Frequency Tested

Table 15.1 Fluid Dielectric Parameters 150MHz HEAD TSL

Aprel Laboratory
Test Result for UIM Dielectric Parameter
Mon 16/Sep/2019 13:35:51
Freq Frequency(GHz)
FCC_eHFCC OET 65 Supplement C (June 2001) Limits for Head Epsilon
FCC_sHFCC OET 65 Supplement C (June 2001) Limits for Head Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM

Freq	FCC_eHFCC	sHFCC	Test_e	Test_s
0.1000	54.63	0.72	51.23	0.67
0.1100	54.17	0.73	54.26	0.67
0.1200	53.70	0.74	52.23	0.69
0.1300	53.23	0.75	53.74	0.69
0.1400	52.77	0.75	50.61	0.70
0.1500	52.30	0.76	52.07	0.72
0.1600	51.83	0.77	49.39	0.71
0.1700	51.37	0.77	48.94	0.73
0.1800	50.90	0.78	49.03	0.74
0.1900	50.43	0.79	48.29	0.76
0.2000	49.97	0.80	49.04	0.76

FLUID DIELECTRIC PARAMETERS								
Date:	16 Sep 2019	Fluid Temp:		24	Frequency:	150MHz	Tissue:	Head
Freq (MHz)		Test_e	Test_s	Target_e	Target_s	Deviation Permittivity	Deviation Conductivity	
100.0000		51.2300	0.6700	54.6300	0.72	-6.22%	-6.94%	
110.0000		54.2600	0.6700	54.1700	0.73	0.17%	-8.22%	
118.0000	*	52.6360	0.6860	53.7940	0.74	-2.15%	-7.05%	
120.0000		52.2300	0.6900	53.7000	0.74	-2.74%	-6.76%	
122.7000	*	52.6377	0.6900	53.5731	0.74	-1.75%	-7.10%	
127.4000	*	53.3474	0.6900	53.3522	0.75	-0.01%	-7.68%	
130.0000		53.7400	0.6900	53.2300	0.75	0.96%	-8.00%	
132.1000	*	53.0827	0.6921	53.1334	0.75	-0.10%	-7.72%	
136.8000	*	51.6116	0.6968	52.9172	0.75	-2.47%	-7.09%	
140.0000		50.6100	0.7000	52.7700	0.75	-4.09%	-6.67%	
150.0000		52.0700	0.7200	52.3000	0.76	-0.44%	-5.26%	
160.0000		49.3900	0.7100	51.8300	0.77	-4.71%	-7.79%	
170.0000		48.9400	0.7300	51.3700	0.77	-4.73%	-5.19%	
180.0000		49.0300	0.7400	50.9000	0.78	-3.67%	-5.13%	
190.0000		48.2900	0.7600	50.4300	0.79	-4.24%	-3.80%	
200.0000		49.0400	0.7600	49.9700	0.80	-1.86%	-5.00%	

*Channel Frequency Tested

16.0 SYSTEM VERIFICATION TEST RESULTS

Table 16.0 System Verification Results 150MHz HEAD TSL

System Verification Test Results					
Date		Frequency (MHz)	Validation Source		
			P/N	S/N	
13 Aug 2019		150	CLA-150	4007	
Fluid Type	Fluid Temp °C	Ambient Temp °C	Ambient Humidity (%)	Forward Power (mW)	Source Spacing (mm)
Head	24.3	24	35%	1000	0
Fluid Parameters					
Permittivity			Conductivity		
Measured	Target	Deviation	Measured	Target	Deviation
52.79	52.30	0.94%	0.76	0.76	0.00%
Measured SAR					
1 gram			10 gram		
Measured	Target	Deviation	Measured	Target	Deviation
3.80	3.90	-2.56%	2.51	2.58	-2.71%
Measured SAR Normalized to 1.0W					
1 gram			10 gram		
Normalized	Target	Deviation	Normalized	Target	Deviation
3.80	3.87	-1.81%	2.51	2.56	-1.95%
<p>Prior to the SAR evaluations, system checks were performed on the planar section of the phantom and a SPEAG validation dipole in accordance with the procedures described in IEEE 1528-2013, FCC KDB 846224 and IEC 62209-1.</p> <p>The dielectric parameters of the simulated tissue mixture were measured prior to the system performance check using a Dielectric Probe Kit and a Network Analyzer.</p> <p>The forward power was applied to the dipole and the system was verified to a tolerance of +10% from the system manufacturer's dipole calibration target SAR value.</p> <p>The forward power applied was same forward power applied by the calibration lab during the calibration of this validation source.</p>					

Table 16.1 System Verification Results 150MHz HEAD TSL

System Verification Test Results					
Date		Frequency (MHz)	Validation Source		
			P/N	S/N	
16 Sept 2019		150	CLA-150	4007	
Fluid Type	Fluid Temp °C	Ambient Temp °C	Ambient Humidity (%)	Forward Power (mW)	Source Spacing (mm)
Head	24.0	24	33%	1000	0
Fluid Parameters					
Permittivity			Conductivity		
Measured	Target	Deviation	Measured	Target	Deviation
52.07	52.30	-0.44%	0.72	0.76	-5.26%
Measured SAR					
1 gram			10 gram		
Measured	Target	Deviation	Measured	Target	Deviation
3.90	3.90	0.00%	2.58	2.58	0.00%
Measured SAR Normalized to 1.0W					
1 gram			10 gram		
Normalized	Target	Deviation	Normalized	Target	Deviation
3.90	3.87	0.78%	2.58	2.56	0.78%
<p>Prior to the SAR evaluations, system checks were performed on the planar section of the phantom and a SPEAG validation dipole in accordance with the procedures described in IEEE 1528-2013, FCC KDB 846224 and IEC 62209-1.</p> <p>The dielectric parameters of the simulated tissue mixture were measured prior to the system performance check using a Dielectric Probe Kit and a Network Analyzer.</p> <p>The forward power was applied to the dipole and the system was verified to a tolerance of +10% from the system manufacturer's dipole calibration target SAR value.</p> <p>The forward power applied was same forward power applied by the calibration lab during the calibration of this validation source.</p>					

17.0 SYSTEM VALIDATION SUMMARY




Table 17.0 System Validation Summary

System Validation Summary											
Frequency (MHz)	Validation Date	Probe Model	Probe S/N	Validation Source	Source S/N	Tissue	Tissue Dielectrics		Validation Results		
							Permittivity	Conductivity	Sensitivity	Linearity	Isotropy
30	31-May-19	EX3DV4	3600	CLA-30	1005	Head	52.40	0.75	Pass	Pass	Pass
150	27-Jun-18	EX3DV4	3600	CLA-150	4007	Body	66.48	0.79	Pass	Pass	Pass
150	12-Aug-19	EX3DV4	3600	CLA-150	4007	Head	49.46	0.79	Pass	Pass	Pass
450	08-May-17	EX3DV4	3600	D450V3	1068	Body	54.65	0.95	Pass	Pass	Pass
450	16-May-17	EX3DV4	3600	D450V3	1068	Head	43.70	0.83	Pass	Pass	Pass
750	20-Jun-19	EX3DV4	3600	D750V3	1061	Head	44.27	0.83	Pass	Pass	Pass
835	03-May-18	EX3DV4	3600	D835V2	4d075	Body	53.31	1.00	Pass	Pass	Pass
835	19-May-17	EX3DV4	3600	D835V2	4d075	Head	42.01	0.89	Pass	Pass	Pass
900	08-May-18	EX3DV4	3600	D900V2	045	Body	54.46	1.10	Pass	Pass	Pass
900	02-Aug-17	EX3DV4	3600	D900V2	045	Head	39.10	0.93	Pass	Pass	Pass
1640	06-May-18	EX3DV4	3600	1620-S-2	207-00102	Body	39.87	1.27	Pass	Pass	Pass
1640	07-May-18	EX3DV4	3600	1620-S-2	207-00102	Head	39.87	1.27	Pass	Pass	Pass
1800	21-Jul-17	EX3DV4	3600	D1800V2	247	Body	54.77	1.53	Pass	Pass	Pass
1800	18-Jun-19	EX3DV4	3600	D1800V2	247	Head	41.20	1.39	Pass	Pass	Pass
2450	05-Apr-19	EX3DV4	3600	D2450V2	825	Body	51.55	1.90	Pass	Pass	Pass
2450	02-Apr-19	EX3DV4	3600	D2450V2	825	Head	36.58	1.85	Pass	Pass	Pass
5250	24-Jul-18	EX3DV4	3600	D5GHzV2	1031	Body	46.42	5.69	Pass	Pass	Pass
5250	24-Jul-18	EX3DV4	3600	D5GHzV2	1031	Head	35.96	4.99	Pass	Pass	Pass

18.0 MEASUREMENT SYSTEM SPECIFICATIONS

Table 18.0 Measurement System Specifications

Measurement System Specification	
Specifications	
Positioner	Stäubli Unimation Corp. Robot Model: TX90XL
Repeatability	+/- 0.035 mm
No. of axis	6.0
Data Acquisition Electronic (DAE) System	
Cell Controller	
Processor	Intel(R) Core(TM) i7-7700
Clock Speed	3.60 GHz
Operating System	Windows 10 Professional
Data Converter	
Features	Signal Amplifier, multiplexer, A/D converter, and control logic
Software	Measurement Software: DASY6, V 6.4.0.12171 / DASY52 V52.10.0.1446
	Postprocessing Software: SEMCAD X, V14.6.10(Deployment Build)
Connecting Lines	Optical downlink for data and status info., Optical uplink for commands and clock
DASY Measurement Server	
Function	Real-time data evaluation for field measurements and surface detection
Hardware	Intel ULV Celeron CPU 400 MHz; 128 MB chip disk; 128 MB RAM
Connections	COM1, COM2, DAE, Robot, Ethernet, Service Interface
E-Field Probe	
Model	EX3DV4
Serial No.	3600
Construction	Triangular core fiber optic detection system
Frequency	10 MHz to 6 GHz
Linearity	±0.2 dB (30 MHz to 3 GHz)
Phantom	
Type	ELI Elliptical Planar Phantom
Shell Material	Fiberglass
Thickness	2mm +/- .2mm
Volume	> 30 Liter

Measurement System Specification		
Probe Specification		
Construction:	Symmetrical design with triangular core; Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, glycol)	
Calibration:	In air from 10 MHz to 2.5 GHz In head simulating tissue at frequencies of 900 MHz and 1.8 GHz (accuracy $\pm 8\%$)	
Frequency:	10 MHz to > 6 GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)	
Directivity:	± 0.2 dB in head tissue (rotation around probe axis) ± 0.4 dB in head tissue (rotation normal to probe axis)	
Dynamic Range:	5 μ W/g to > 100 mW/g; Linearity: ± 0.2 dB	
Surface Detect:	± 0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces	
Dimensions:	Overall length: 330 mm; Tip length: 16 mm; Body diameter: 12 mm; Tip diameter: 6.8 mm Distance from probe tip to dipole centers: 2.7 mm	
Application:	General dosimetry up to 3 GHz; Compliance tests of mobile phone	EX3DV4 E-Field Probe
Phantom Specification		
The ELI V5.0 phantom is an elliptical planar fiberglass shell phantom with a shell thickness of 2.0mm +/- .2mm at the planar area. This phantom conforms to OET Bulletin 65, Supplement C, IEEE 1528-2013, IEC 62209-1 and IEC 62209-2.		
		ELI Phantom
Device Positioner Specification		
The DASY device positioner has two scales for device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear openings). The plane between the ear openings and the mouth tip has a rotation angle of 65° . The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections.		
		Device Positioner

19.0 TEST EQUIPMENT LIST

Table 19.0 Equipment List and Calibration

Test Equipment List				
DESCRIPTION	ASSET NO.	SERIAL NO.	DATE CALIBRATED	CALIBRATION DUE
Schmid & Partner DASY 6 System	-	-	-	-
-DASY Measurement Server	00158	1078	CNR	CNR
-Robot	00046	599396-01	CNR	CNR
-DAE4	00019	353	19-Mar-19	19-Mar-20
-EX3DV4 E-Field Probe	00213	3600	26-Mar-19	26-Mar-20
-CLA 30 Validation Dipole	00300	1005	23-Nov-17	23-Nov-20
-CLA 150 Validation Dipole	00251	4007	27-Apr-17	27-Apr-20
-D450V3 Validation Dipole	00221	1068	23-Apr-18	23-Apr-21
-D750V3 Validation Dipole	00238	1061	19-Mar-19	19-Mar-22
-D835V2 Validation Dipole	00217	4D075	20-Apr-18	20-Apr-21
-D900V2 Validation Dipole	00020	54	24-Apr-17	24-Apr-20
-D1640/1620-S-2 Validation Dipole	00299	207-00102	07-Nov-17	07-Nov-20
-D2450V2 Validation Dipole*	00219	825	24-Apr-18	24-Apr-21
-D5GHzV2 Validation Dipole	00126	1031	26-Apr-18	26-Apr-21
ELI Phantom	00247	1234	CNR	CNR
SAM Phantom	00154	1033	CNR	CNR
HP 85070C Dielectric Probe Kit	00033	none	CNR	CNR
Gigatronics 8652A Power Meter	00007	1835801	26-Mar-19	26-Mar-22
Gigatronics 80701A Power Sensor	00248	1833687	26-Mar-19	26-Mar-22
Gigatronics 80334A Power Sensor	00237	1837001	26-Mar-19	26-Mar-22
HP 8753ET Network Analyzer	00134	US39170292	29-Dec-17	29-Dec-20
Rohde & Schwarz SMR20 Signal Generator	00006	100104	29-May-17	29-May-20
Amplifier Research 10W1000C Power Amplifier	00041	27887	CNR	CNR
Amplifier Research 5S1G4 Power Amplifier	00106	26235	CNR	CNR
Narda Directional Coupler 3020A	00064	-	CNR	CNR
Traceable VWR Thermometer	00291	-	19-Nov-16	19-Nov-19
Traceable VWR Jumbo Humidity/Thermometer	00295	170120555	17-Feb-17	17-Feb-20
Digital Multi Meter DMR-1800	00250	TE182	6-22-17	6-22-20
Bipolar Power Supply 6299A	00086	1144A02155	COU	COU
DC-18G 10W 30db Attenuator	00102	-	COU	COU
R&S FSP40 Spectrum Analyzer	00241	100500	15-May-18	15-May-21
RF Cable-SMA	00311	-	CNR	CNR
HP Calibration Kit	00145	-	10-Feb-17	10-Feb-20

CNR = Calibration Not Required

SB=Stand By

COU = Calibrate on Use

* Per KDB 865664 3.2.2; Supporting documentation is included in the report for validation dipoles exceeding the recommended annual calibration cycle.

When applicable, reference Appendix F

20.0 FLUID COMPOSITION

Table 20.0 Fluid Composition 150MHz HEAD TSL

150		150MHz Head		
Tissue Simulating Liquid (TSL) Composition				
Component by Percent Weight				
Water	Sugar	Salt ⁽¹⁾	HEC ⁽²⁾	Bacteriacide ⁽³⁾
38.35	55.5	5.15	0.9	0.1

(1) Non-Iodinized

(2) HydroxyEthyl-Cellulose: Sigma-Aldrich P/N 54290-500g

(3) Dow Chemical DOWICIL 75 Antimicrobial Preservative

Note: Effective February 19, 2019 TCB Workshop: FCC has permitted the use of single head-tissue simulating liquid specified in IEC 62209-1 for all SAR tests.

APPENDIX A – SYSTEM VERIFICATION PLOTS

Date/Time: 8/13/2019 2:23:06 PM

Test Laboratory: Celltech Labs

SPC-150H Aug 13 2019

DUT: CLA-150; Type: CLA-150; Serial: 4007

Communication System: UID 0, CW (0); Communication System Band: FullSpan (0.0 - 6000.0 MHz); Frequency: 150 MHz; Communication System PAR: 0 dB; PMF: 1

Medium: TSL_150H[09AU19]

Medium parameters used: $f = 150$ MHz; $\sigma = 0.78$ S/m; $\epsilon_r = 50.15$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: EX3DV4 - SN3600; ConvF(9.72, 9.72, 9.72); Calibrated: 3/26/2019, ConvF(9.72, 9.72, 9.72); Calibrated: 3/26/2019, ConvF(9.72, 9.72, 9.72); Calibrated: 3/26/2019;
 - Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection), $z = 16.0, 31.0, 151.0$
- Electronics: DAE4 Sn353; Calibrated: 3/19/2019
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax;
- DASY52 52.10.1(1476);

Frequency: 150 MHz

SPC/SPC 150H Input=1.0W, Target=[3.90W/kg][2.58W/kg]/Area Scan (9x9x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 4.02 W/kg

SPC/SPC 150H Input=1.0W, Target=[3.90W/kg][2.58W/kg]/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 71.66 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 5.89 W/kg

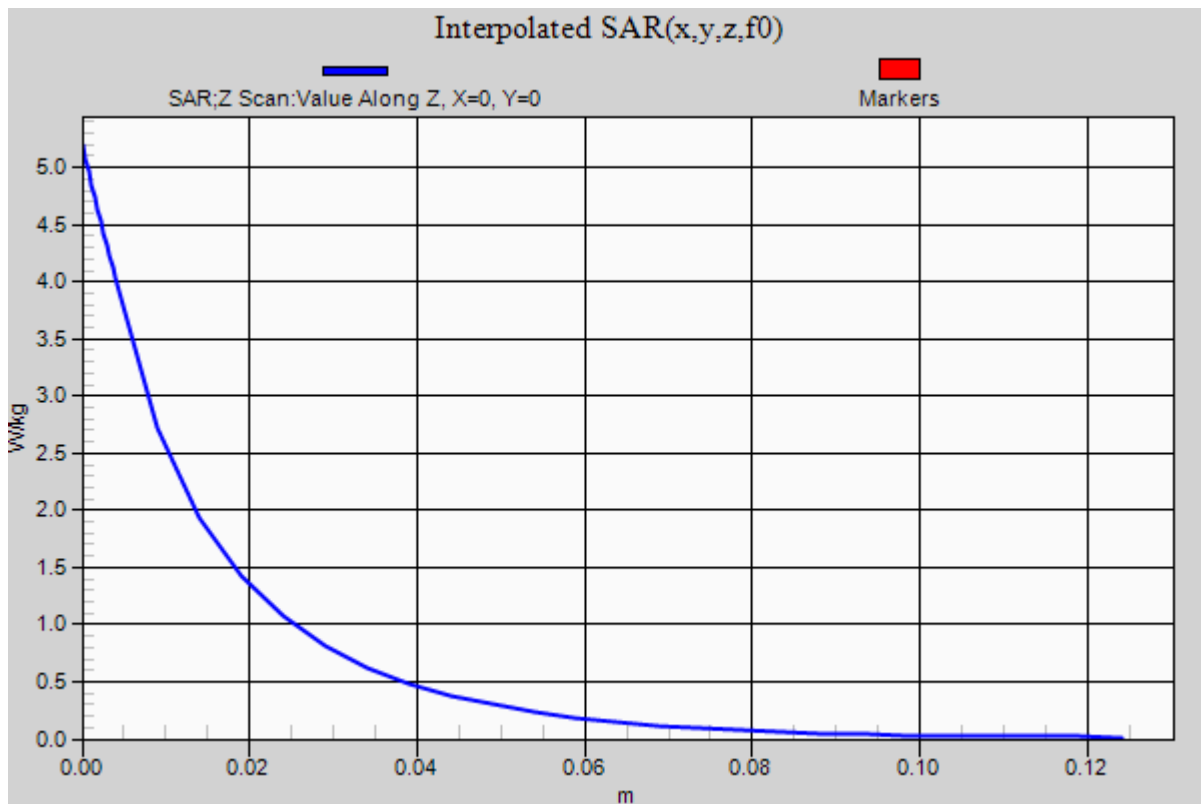
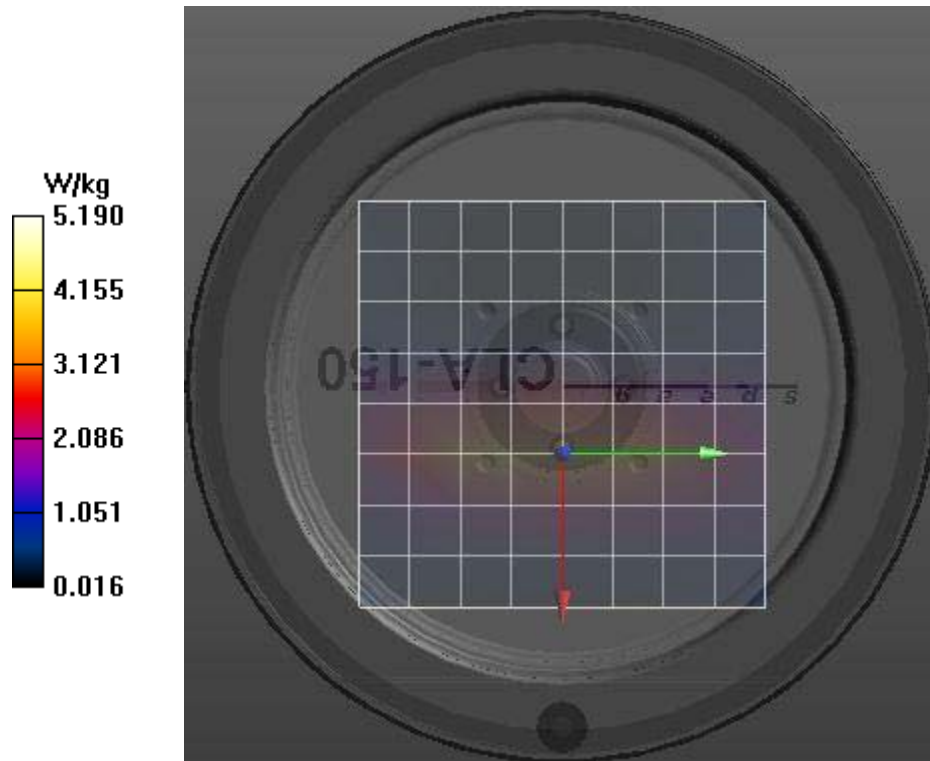
SAR(1 g) = 3.8 W/kg; SAR(10 g) = 2.51 W/kg

Maximum value of SAR (measured) = 4.07 W/kg

SPC/SPC 150H Input=1.0W, Target=[3.90W/kg][2.58W/kg]/Z Scan (1x1x36): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Penetration depth = 14.65 (12.72, 16.26) [mm]

Maximum value of SAR (interpolated) = 5.19 W/kg



Date/Time: 9/16/2019 3:08:50 PM

Test Laboratory: Celltech Labs

SPC-150H Sep 16 2019

DUT: CLA-150; Type: CLA-150; Serial: 4007

Communication System: UID 0, CW (0); Communication System Band: FullSpan (0.0 - 6000.0 MHz); Frequency: 150 MHz; Communication System PAR: 0 dB; PMF: 1

Medium parameters used: $f = 150$ MHz; $\sigma = 0.72$ S/m; $\epsilon_r = 52.07$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: EX3DV4 - SN3600; ConvF(9.72, 9.72, 9.72) @ 150 MHz; Calibrated: 3/26/2019
 - Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection), $z = 16.0, 31.0, 151.0$
- Electronics: DAE4 Sn353; Calibrated: 3/19/2019
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax; Serial: 1234
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

SPC/SPC 150H Input=1.0W, Target=3.90W/kg 2/Area Scan (9x9x1): Measurement grid: $dx=15$ mm, $dy=15$ mm

Maximum value of SAR (measured) = 4.21 W/kg

SPC/SPC 150H Input=1.0W, Target=3.90W/kg 2/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=7.5$ mm, $dy=7.5$ mm, $dz=5$ mm

Reference Value = 77.91 V/m; Power Drift = -0.01dB

Peak SAR (extrapolated) = 6.01 W/kg

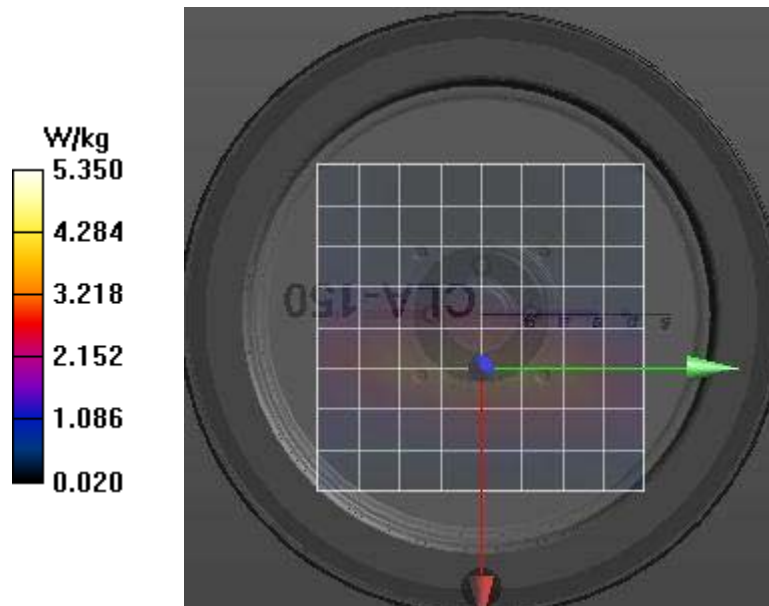
SAR(1 g) = 3.9 W/kg; SAR(10 g) = 2.58 W/kg

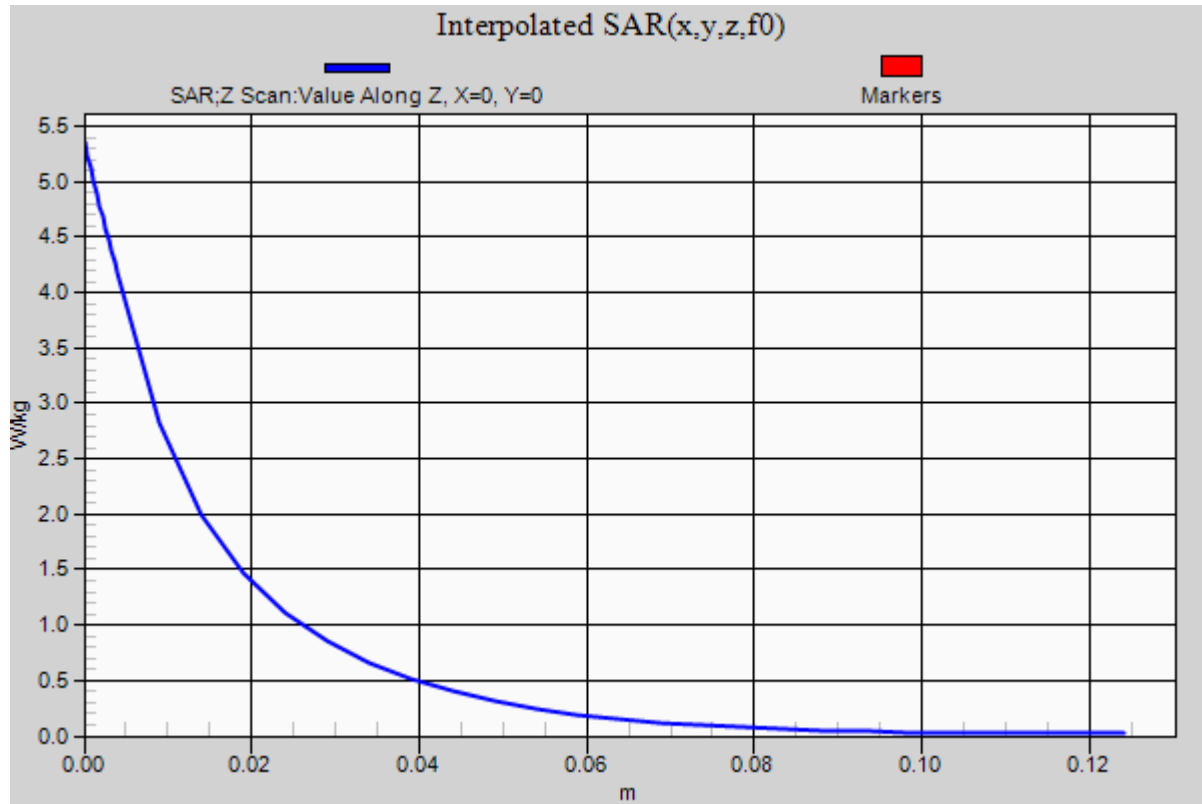
Maximum value of SAR (measured) = 4.18 W/kg

SPC/SPC 150H Input=1.0W, Target=3.90W/kg 2/Z Scan (1x1x36): Measurement grid: $dx=20$ mm, $dy=20$ mm, $dz=5$ mm

Penetration depth = 14.62 (12.70, 16.32) [mm]

Maximum value of SAR (interpolated) = 5.35 W/kg





APPENDIX B – MEASUREMENT PLOTS OF MAXIMUM MEASURED SAR

Plot F1

Date/Time: 8/14/2019 10:46:25 AM

Test Laboratory: Celltech Labs

Rexon-PJ2 150H Aug 14 2019

DUT: PJ2; Type: Sample; Serial: IMEI Number

Communication System: UID 0, AM (0); Communication System Band: VHF; Frequency: 132.1 MHz; Communication System PAR: 0 dB; PMF: 1
Medium parameters used (interpolated): $f = 132.1$ MHz; $\sigma = 0.74$ S/m; $\epsilon_r = 51.767$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: EX3DV4 - SN3600; ConvF(9.72, 9.72, 9.72) @ 132.1 MHz; Calibrated: 3/26/2019
 - Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection), $z = -1.5, 31.0, 151.0$
- Electronics: DAE4 Sn353; Calibrated: 3/19/2019
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax; Serial: 1234
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

150H/F1-PJ2,Face Config- Front Side(25mm),Accessory B1, Ant T1,Bat P1,132.1MHz/Area Scan (8x25x1): Measurement grid: $dx=15$ mm, $dy=15$ mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.501 W/kg

150H/F1-PJ2,Face Config- Front Side(25mm),Accessory B1, Ant T1,Bat P1,132.1MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=7.5$ mm, $dy=7.5$ mm, $dz=5$ mm

Reference Value = 24.68 V/m; Power Drift = -0.73 dB

Peak SAR (extrapolated) = 0.605 W/kg

SAR(1 g) = 0.480 W/kg; SAR(10 g) = 0.379 W/kg

[Info: Interpolated medium parameters used for SAR evaluation.](#)

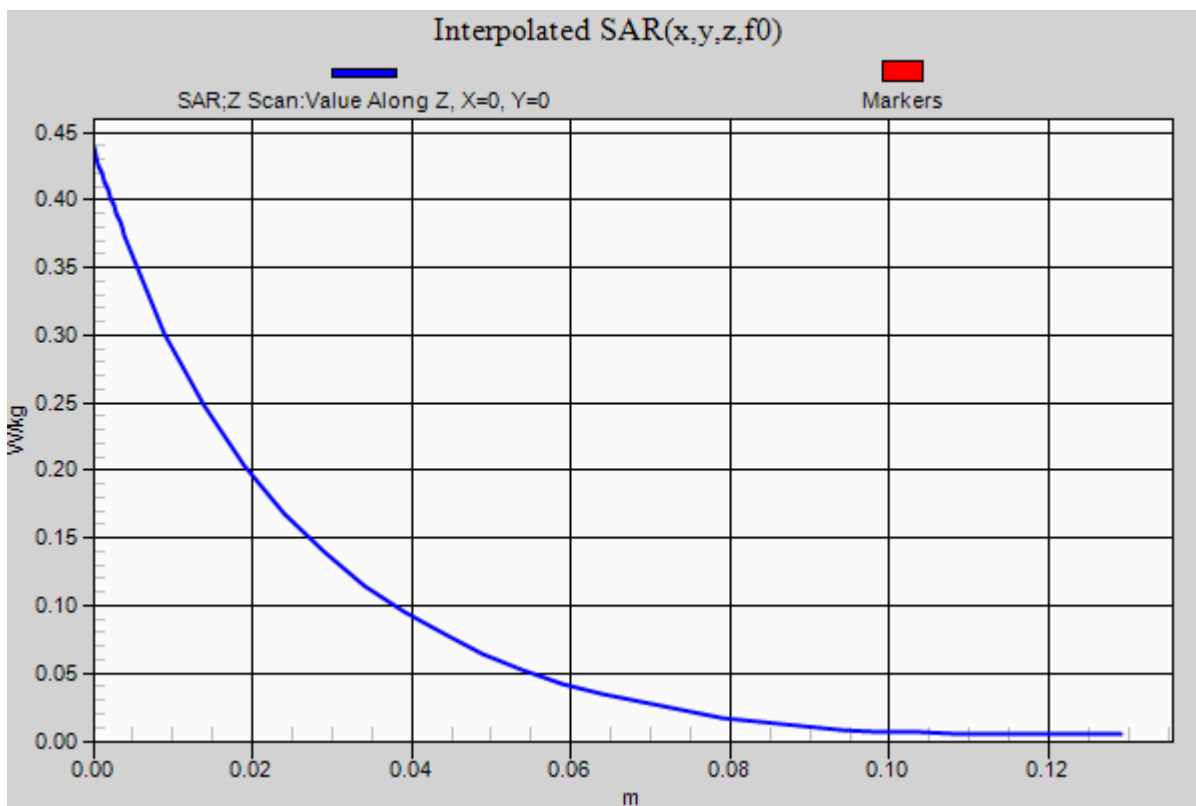
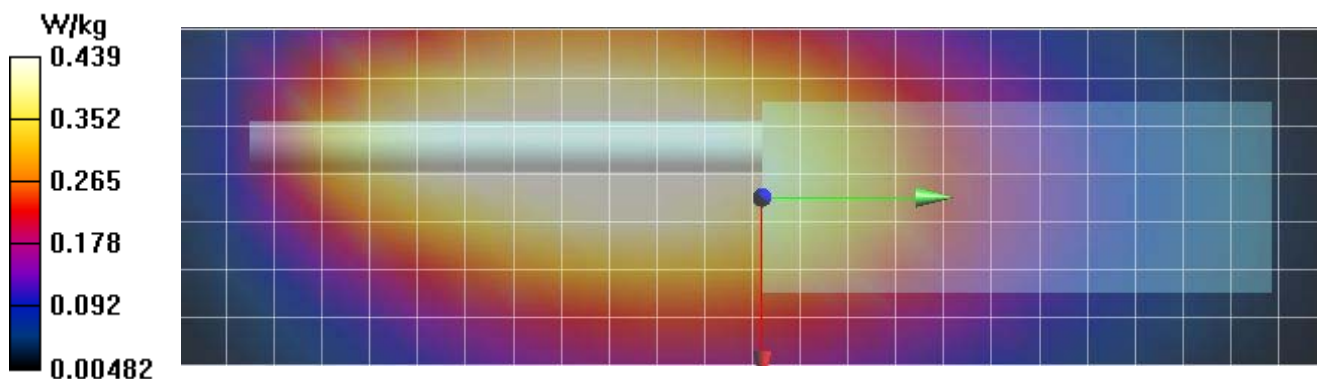
Maximum value of SAR (measured) = 0.500 W/kg

150H/F1-PJ2,Face Config- Front Side(25mm),Accessory B1, Ant T1,Bat P1,132.1MHz/Z Scan (1x1x37): Measurement grid: $dx=20$ mm, $dy=20$ mm, $dz=5$ mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Penetration depth = 25.28 (23.33, 25.69) [mm]

Maximum value of SAR (interpolated) = 0.439 W/kg



Plot F2

Date/Time: 9/17/2019 11:00:20 AM

Test Laboratory: Celltech Labs

Rexon-PJ2 150H Sept 17 2019-2

DUT: PJ2; Type: Sample; Serial: IMEI Number

Communication System: UID 0, AM (0); Communication System Band: VHF; Frequency: 132.1 MHz; Communication System PAR: 0 dB; PMF: 1
Medium parameters used (interpolated): $f = 132.1$ MHz; $\sigma = 0.692$ S/m; $\epsilon_r = 53.083$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: EX3DV4 - SN3600; ConvF(9.72, 9.72, 9.72) @ 132.1 MHz; Calibrated: 3/26/2019
 - Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection), $z = -1.5, 31.0, 151.0$
- Electronics: DAE4 Sn353; Calibrated: 3/19/2019
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax; Serial: 1234
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

150H/F2-PJ2,Face Config- Front Side(25mm), Accessory B1, Ant T1,P2-PS,132.1MHz/Area Scan (8x25x1): Measurement grid: $dx=15$ mm, $dy=15$ mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.406 W/kg

150H/F2-PJ2,Face Config- Front Side(25mm), Accessory B1, Ant T1,P2-PS,132.1MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=7.5$ mm, $dy=7.5$ mm, $dz=5$ mm

Reference Value = 23.74 V/m; Power Drift = -0.38 dB

Peak SAR (extrapolated) = 0.461 W/kg

SAR(1 g) = 0.370 W/kg; SAR(10 g) = 0.296 W/kg

[Info: Interpolated medium parameters used for SAR evaluation.](#)

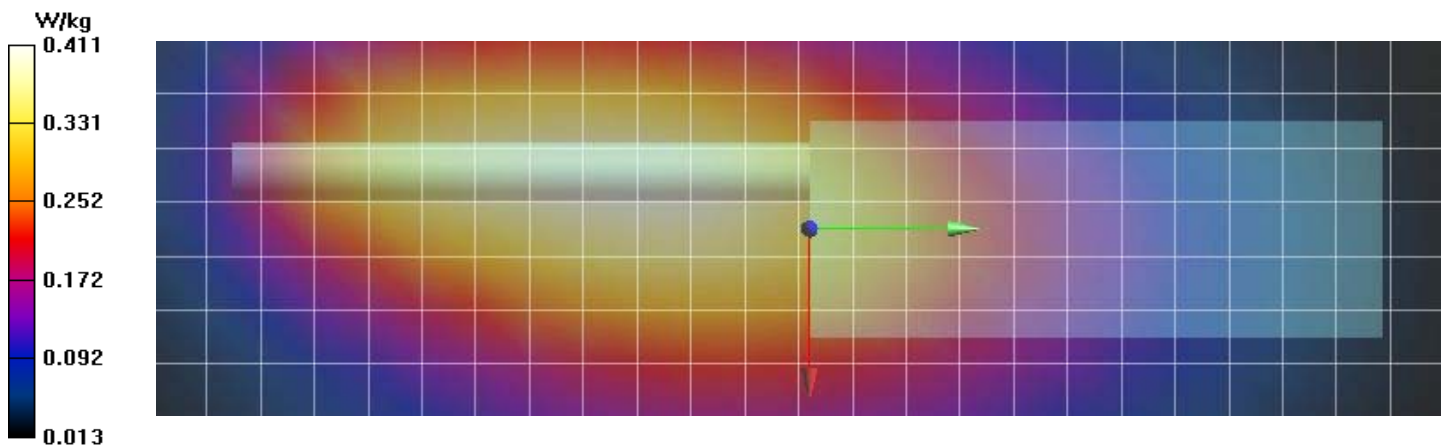
Maximum value of SAR (measured) = 0.384 W/kg

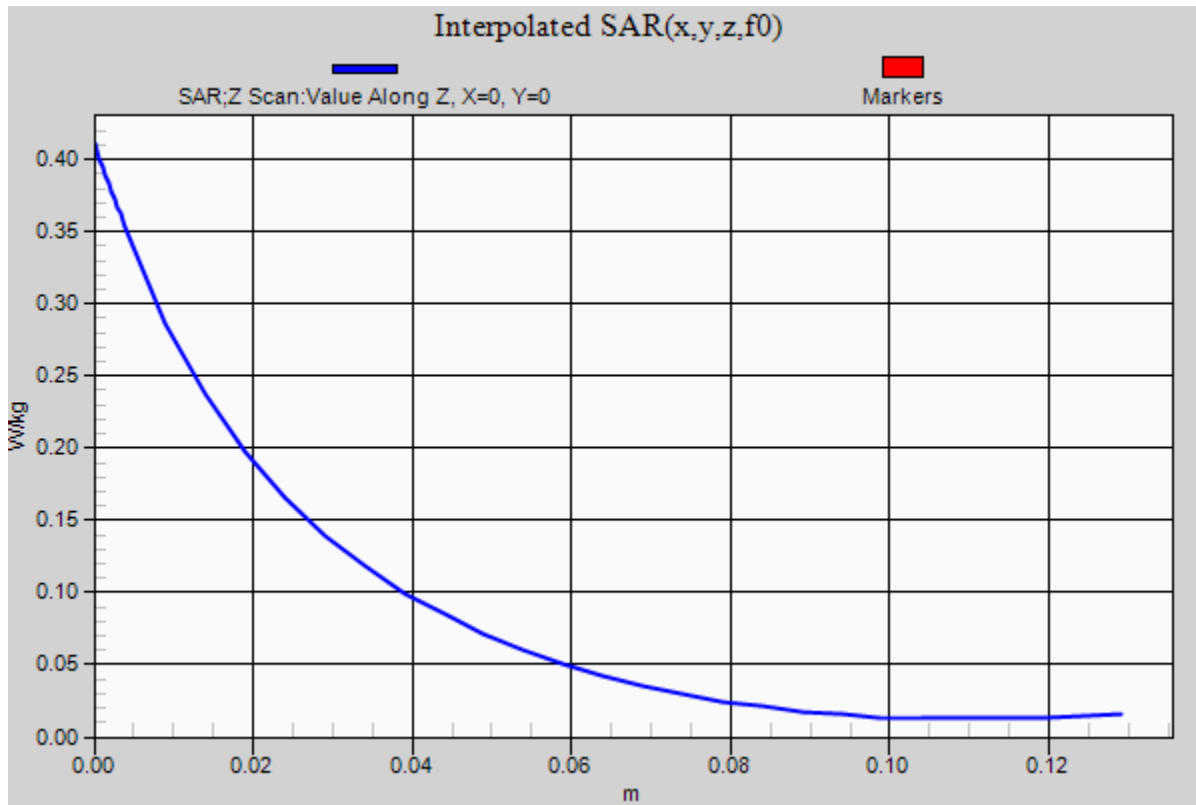
150H/F2-PJ2,Face Config- Front Side(25mm), Accessory B1, Ant T1,P2-PS,132.1MHz/Z Scan (1x1x37): Measurement grid: $dx=20$ mm, $dy=20$ mm, $dz=5$ mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Penetration depth = 26.62 (24.12, 27.70) [mm]

Maximum value of SAR (interpolated) = 0.411 W/kg





PlotB1

Date/Time: 9/17/2019 9:04:42 AM

Test Laboratory: Celltech Labs

Rexon-PJ2 150H Sept 17 2019

DUT: PJ2; Type: Sample; Serial: IMEI Number

Communication System: UID 0, AM (0); Communication System Band: VHF; Frequency: 132.1 MHz; Communication System PAR: 0 dB; PMF: 1
Medium parameters used (interpolated): $f = 132.1$ MHz; $\sigma = 0.692$ S/m; $\epsilon_r = 53.083$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: EX3DV4 - SN3600; ConvF(9.72, 9.72, 9.72) @ 132.1 MHz; Calibrated: 3/26/2019
 - Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection), $z = -1.5, 31.0, 151.0$
- Electronics: DAE4 Sn353; Calibrated: 3/19/2019
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax; Serial: 1234
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

150H/B1-PJ2,Body Config- Back Side, Accessory B1, Ant T1,Audio A1,Bat P1,132.1MHz/Area Scan (8x25x1): Measurement grid: dx=15mm, dy=15mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.349 W/kg

150H/B1-PJ2,Body Config- Back Side, Accessory B1, Ant T1,Audio A1,Bat P1,132.1MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 15.98 V/m; Power Drift = -0.33 dB

Peak SAR (extrapolated) = 1.13 W/kg

SAR(1 g) = 0.441 W/kg; SAR(10 g) = 0.225 W/kg

[Info: Interpolated medium parameters used for SAR evaluation.](#)

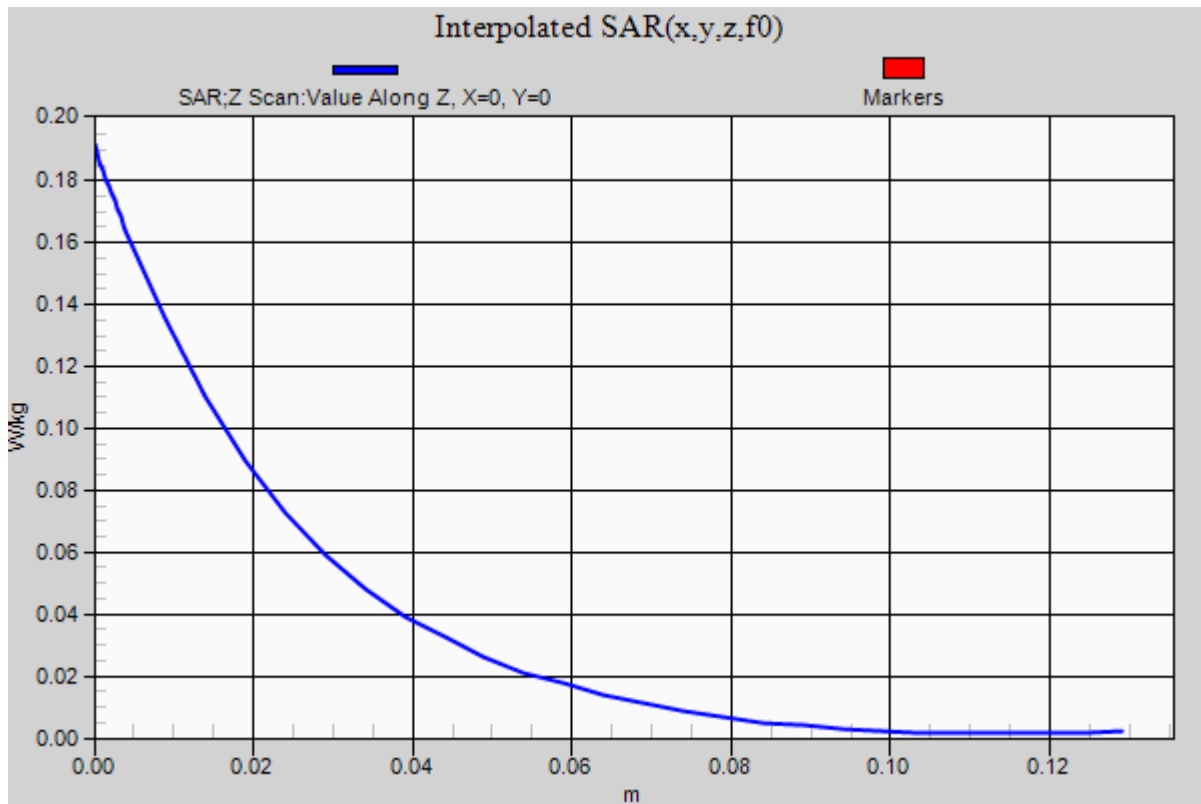
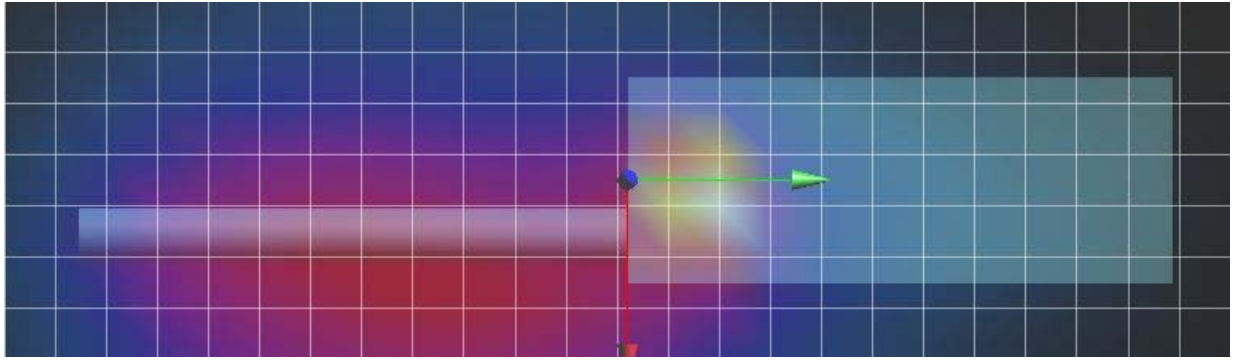
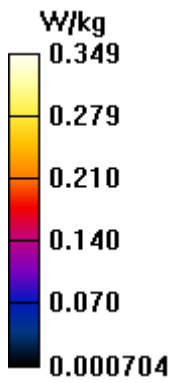
Maximum value of SAR (measured) = 0.483 W/kg

150H/B1-PJ2,Body Config- Back Side, Accessory B1, Ant T1,Audio A1,Bat P1,132.1MHz/Z Scan (1x1x37): Measurement grid: dx=20mm, dy=20mm, dz=5mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Penetration depth = 24.33 (26.46, 23.97) [mm]

Maximum value of SAR (interpolated) = 0.192 W/kg



Plot B2

Date/Time: 9/17/2019 11:38:59 AM

Test Laboratory: Celltech Labs

Rexon-PJ2 150H Sept 17 2019-2

DUT: PJ2; Type: Sample; Serial: IMEI Number

Communication System: UID 0, AM (0); Communication System Band: VHF; Frequency: 132.1 MHz; Communication System PAR: 0 dB; PMF: 1
Medium parameters used (interpolated): $f = 132.1$ MHz; $\sigma = 0.692$ S/m; $\epsilon_r = 53.083$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: EX3DV4 - SN3600; ConvF(9.72, 9.72, 9.72) @ 132.1 MHz; Calibrated: 3/26/2019
 - Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection), $z = -1.5, 31.0, 151.0$
- Electronics: DAE4 Sn353; Calibrated: 3/19/2019
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax; Serial: 1234
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

150H/B2-PJ2,Body Config- Back Side, Accessory B1, Ant T1,Audio A1,P2-PS,132.1MHz/Area Scan (8x25x1): Measurement grid: dx=15mm, dy=15mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.356 W/kg

150H/B2-PJ2,Body Config- Back Side, Accessory B1, Ant T1,Audio A1,P2-PS,132.1MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 16.40 V/m; Power Drift = -0.55 dB

Peak SAR (extrapolated) = 0.630 W/kg

SAR(1 g) = 0.289 W/kg; SAR(10 g) = 0.170 W/kg

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.312 W/kg

150H/B2-PJ2,Body Config- Back Side, Accessory B1, Ant T1,Audio A1,P2-PS,132.1MHz/Z Scan (1x1x37): Measurement grid: dx=20mm, dy=20mm, dz=5mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Penetration depth = 30.27 (28.42, 28.55) [mm]

Maximum value of SAR (interpolated) = 0.184 W/kg

