Test Report Serial Number:	45461442 R2.0
Test Report Date:	20 July 2018
Project Number:	1407

SAR Test Report - New Certification

Applicant:

Garmin International Inc.
1200 East 151 St.
Olathe, KS, 66062
USA

Maximum Reported 10g SAR			
FCC	Extremity	0.30	W/kg
	Simultaneous	0.34	
General Pop. Limit:		4.00	

FCC ID:

IPH-03547

Product Model Number / HVIN

A03547

In Accordance With:

FCC 47 CFR §2.1093

Radiofrequency Radiation Exposure Evaluation: Portable Devices

Approved By:

Ben Hewson, President
Celltech Labs Inc.
21-364 Lougheed Rd.
Kelowna, BC, V1X 7R8
Canada

Test Lab Certificate: 2470.01

IC Registration 3874A-1

FCC Registration: CA3874

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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	Art Voss	13 June 2018
R1.0	Initial Release - Revised Max SAR to Display Extremity and Simultaneous as separate on Cover Page and in Table 10.0.	Art Voss	26 June 2018
R2.0	Revised Modulation from FM to GFSK Throughout	Art Voss	20 July2018

2.0 CLIENT AND DEVICE INFORMATION

Client Information	
Applicant Name	**Garmin International Inc.**
Applicant Address	1200 East 151 St.
	Olathe, KS,66062
	USA
DUT Information	
Device Identifier(s):	**FCC ID:** **IPH-03547**
Type of Equipment:	Licensed Non-Broadcast Station Transmitter
Device Model(s) / HVIN:	A03547
Device Marketing Name / PMN:	A03547
Test Sample Serial No.:	T/A Sample - Identical Prototype
Transmit Frequency Range:	VHF: 151.82-154.60 MHz
	BLE/ANT+: 2402 - 2480 MHz
Number of Channels:	See Section 7.0
Manuf. Max. Avg Rated Output Power:	VHF: 33dBm, 2.0 W
	BLE/ANT+: 4.0dBm, 0.003W
Modulation:	BLE/ANT+: GFSK, PI/4, DQSK, 8-DPSK
	VHF: GFSK
Duty Cycle:	100.0%
DUT Power Source:	See Section 8.0
Deviation(s) from standard/procedure:	None
Modification of DUT:	None

3.0 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
Health Canada	
Safety Code 6 (2015)	Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3kHz to 300GHz
Industry Canada Spectrum Management & Telecommunications Policy	
RSS-102 Issue 5:	Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
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

* When the issue number or issue date is omitted, the latest version is assumed.

4.0 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:	Model / HVIN:	
Garmin International Inc.	A03547	
Standard(s) Applied:	**Measurement Procedure(s):**	
FCC 47 CFR §2.1093	FCC KDB 865664, FCC KDB 447498 IEEE Standard 1528-2013, IEC 62209-2	
Reason For Issue:	**Use Group:**	**Limits Applied:**
[x] New Certification	[x] General Population / Uncontrolled	[ ] 1.6W/kg - 1g Volume
[ ] Class I Permissive Change		[ ] 8.0W/kg - 1g Volume
[ ] Class II Permissive Change	[ ] Occupational / Controlled	[x] 4.0W/kg - 10g Volume
Reason for Change:		**Date(s) Evaluated:**
Original Filing		June 1-7, 2018

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.

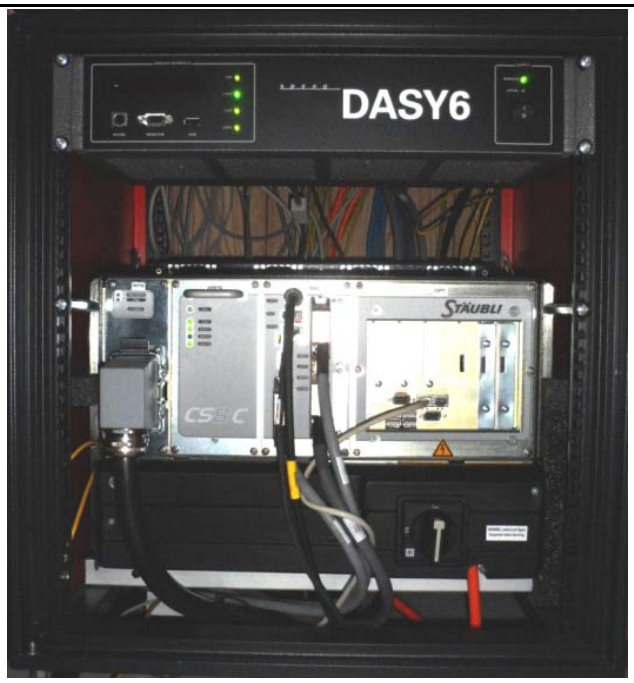
Art Voss, P.Eng.
Technical Manager
Celltech Labs Inc.
11 June 2018
Date

5.0 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 VME-bus computer.

DASY 6 SAR System with SAM Phantom



DASY 6 Measurement Controller

6.0 RF CONDUCTED POWER MEASUREMENT

Table 6.0 Conducted Power Measurements

Conducted Power Measurements							
Channel	**Frequency** ***(MHz)***	**Measured Power** ***(dBm)***	**Rated Power** ***(dBm)***	**Rated Power** ***(W)***	**Delta** ***(dBm)***	**SAR Test Channel** ***(Y/N)***	**Modulation**
1	151.82	32.67	33.00	2.00	-0.33	**Y**	**GFSK**
2	151.88	32.65	33.00	2.00	-0.35	–	**GFSK**
3	151.94	32.63	33.00	2.00	-0.37	–	**GFSK**
4	154.57	32.65	33.00	2.00	-0.35	–	**GFSK**
5	154.6	32.73	33.00	2.00	-0.27	**Y**	**GFSK**
2	2402	3.75	4.00	0.003	-0.25	**Y**	**CW**
40	2440	3.73	4.00	0.003	-0.27	–	**CW**
80	2480	3.75	4.00	0.003	-0.25	–	**CW**

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 Average Power .Power measurements were found to be the highest on channel 5 than any other mode or data-rate. SAR was evaluated using FM mode with the default battery type 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 average* tune up tolerance. See section 2.0 Client and Device Information for details. The *reported* SAR was not scaled down

7.0 NUMBER OF TEST CHANNELS (N_C) AND CONFIGURATIONS

Table 7.0 Number of Test Channels and Configurations

Table 7.0

Number of Required Test Channels						
Transmit 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*)
151.82	154.6	**153.21**	**2**	**3**	**2.8**	**1.4**

KDB 447498: $N_C = \text{RoundUp} \{ [100 (F_{HIGH} - F_{LOW})/Fc]^{0.5} \text{ X } (F_C/100)^{0.2} \}$

IEC 62209-1: $N_C = 2 \text{ X } \{ \text{RoundUp} [10 (F_{HIGH} - F_{LOW}) / F_C] \} + 1$

8.0 ACCESSORIES EVALUATED

Table 8.0 Accessories Evaluated

Manufacturer's Accessory List						
Test Report ID Number	**Manufacturer's Part Number**	**Description**	**UDC Group(1)**	**Type II Group(2)**	**SAR(3) Evaluated**	**SAR(4) Tested**
P1	-	Rechargeable, Replaceable Lithium-Ion	**n/a**	**n/a**	**Y**	**Y**
P2	362-00069-06	AC Adapter,5.0V,2A,Mini-B Repl. Plug Base Unit with Ferrite	**n/a**	**n/a**	**n/a**	**n/a**
T1	700-00021-00	VHF Antenna, D Series	**n/a**	**n/a**	**Y**	**Y**
T2	700-00042-00	VHF Antenna, Astro, Extended Range	**n/a**	**n/a**	**Y**	**Y**

9.0 SAR MEASUREMENT SUMMARY

Table 9.0: Measured Results

Measured SAR Results (10g) - EXTREMITY (FCC)														
Date	Plot ID #	DUT Model	Test Type	Test Freq. (MHz)	Modulation	Accessories				DUT Spacing		Meas. Cond. Power (dBm)	Measured SAR 10g (W/kg)	SAR Drift (dB)
						Antenna ID	Battery ID	Body ID	Audio ID	DUT (mm)	Antenna (mm)			
BODY SAR														
01 June 2018	B1	A03547	Touch/Back	151.82	CW	T1	P1	n/a	n/a	0	42	32.67	0.212	-1.050
04 June 2018	B2	A03547	Touch/Left	151.82	CW	T1	P1	n/a	n/a	0	35	32.67	0.220	-0.270
04 June 2018	B3	A03547	Touch/Right	151.82	CW	T1	P1	n/a	n/a	0	7	32.67	0.213	-0.980
04 June 2018	B4	A03547	Touch/Right	154.6	CW	T1	P1	n/a	n/a	0	7	32.65	0.166	-0.330
06 June 2018	B5	A03547	Touch/Right	151.82	CW	T2	P1	n/a	n/a	0	8	32.67	0.275	0.070
06 June 2018	B6	A03547	Touch/Right	154.6	CW	T2	P1	n/a	n/a	0	8	32.65	0.211	-0.370
07 June 2018	B7*	A03547	Touch/Right	151.82/2402	CW	T2	P1	n/a	n/a	0	8	32.43	0.247	0.360
SAR Limit							**Spatial Peak**					**RF Exposure Category**		
FCC 47 CFR 2.1093							**Extremity**	**10g Average**		**4.0 W/kg**		**General Population**		

*Due to the nature of the device, SAR was evaluated for simultaneous transmission in the worst case configuration using the worst case antenna accessory. It should also be noted that the simultaneous combination produced the highest measured SAR during a 1 gram volumetric scan evaluation; however, this was not the case when evaluated over a 10 gram volume for EXTREMITY evaluation. Since the intended use of the device is to be hand-held, only EXTREMITY 10g SAR results were reported.

10.0 SCALING OF MAXIMUM MEASURE SAR

Table 10.0 SAR Scaling

Scaling of Maximum Measured SAR [1]							
		Freq	Measured Fluid Deviation		Measured Conducted Power	Measured Drift	Measured SAR (10g)
Plot ID	Configuration	(MHz)	Permittivity	Conductivity	(dBm)	(dB)	(W/kg)
B5	Extremity-Touch/Right	151.82	3.31%	-0.23%	32.7	0.070	0.275
Step 1							
Fluid Sensitivity Adjustment							
	Scale Factor			Measured SAR			Step 1 Adjusted SAR (10g)
Plot ID	(%)		X	(W/kg)		=	(W/kg)
B5	-0.790%		X	0.275		=	0.275
Step 2							
Manufacturer's Tune-Up Tolerance							
	Measured Conducted Power	Rated Power	Delta		Step 1 Adjusted SAR		Step 2 Adjusted SAR (10g)
Plot ID	(dBm)	(dBm)	(dB)	+	(W/kg)	=	(W/kg)
B5	32.7	33.0	-0.3	+	**0.275**	=	**0.295**
Step 3 (ISED)							
Drift Adjustment							
	Measured Drift			Step 2 Adjusted SAR			Step 3 Adjusted SAR (10g)
Plot ID	(dB)		+	(W/kg)		=	(W/kg)
B5	0.070		+	0.295		=	0.295
Step 4 (FCC)							
Simultaneous Transmission - Bluetooth and/or WiFi							
	Rated Output Power (Pmax)	Freq	Separation Distance	Estimated SAR		Step 2 Adjusted SAR	Step 4 Adjusted SAR (10g)
Plot ID	(mW)	(MHz)	(mm)	(W/kg)	+	(W/kg)	= (W/kg)
B5*	2.5	2402	0	0.042	+	0.295	= 0.337
Step 5							
Reported SAR							
	FCC From Steps 1, 2 and 4			ISED From Steps 1 through 3			
Plot ID	10g SAR (W/kg)			10g SAR (W/kg)			
B5	**0.295**			0.295			
Simultaneous	**0.337**			0.337			

*The device is capable of simultaneous transmission between the BLE/ANT + transmitter and the VHF transmitter, Test exclusion of the BLE/ANT+ transmitter is evaluated using Max Power = 4dBm (2.52mW), Separation Distance = 5mm, Transmit Frequency = 2.402GHz.

Per KDB 447498 D01v06 [4.3.1(a)], SAR Test Exclusion is given by:

[(Max Power, mW) / (Separation Distance, mm)] * [√f, GHz] ≤ 3.0 for 1g SAR
[(2.52)/(5)] * [(√2.402)] = 0.8 ≤ 3.0

Therefore the BLE/ANT+ transmitter meets the SAR Test Exclusion criteria.

Per KDB 447498 D01v06 [4.3.2(b)], the estimated Bluetooth SAR is given by:

[(Max Power, mW) / (Separation Distance, mm)] * [(√f, GHz) / (x)], where x = 18.75 for 10g SAR
[(2.52)/(5)] * [(√2.402) / (18.75)] = 0.042W/kg

The estimated simultaneous SAR contribution is added to the measured SAR from Step 2 above.

NOTES to Table 10.0
(1) Scaling of the Maximum Measured SAR is based on the highest, 100% duty cycle, Face, Body and/or Head SAR measured of 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 indentification 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 9.1 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.

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. 11 June 2018 Date

11.0 SAR EXPOSURE LIMITS

Table 11.0 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.			

12.0 DETAILS OF SAR EVALUATION

12.0 Day Log

DAY LOG							
Date	Ambient Temp °C	Fluid Temp °C	Humidity	TSL	Fluid Dielectric	SPC	Test
1 Jun 2018	24	23.7	26%	150B	X	X	X
4 Jun 2018	23	23.0	25%	150B			X
5 Jun 2018	21	22.8	25%	150B			X
6 Jun 2018	21	22.6	26%	150B	X	X	X
7 June 2018	23	22.0	27%	150B			X

12.1 DUT Setup and Configuration

DUT Setup and Configuration	
1	The DUT was evaluated for SAR in accordance with the procedures described in IEEE 1528, FCC KDB 865646, 447498. The device was evaluated at a phantom separation distance of 0mm for EXTREMITY configuration
2	The DUT was evaluated for EXTREMITY SAR at the maximum conducted output power level, preset by the manufacturer, with a fully charged battery in CW modulated transmit operation.

12.2 DUT Positioning

DUT Positioning
Positioning
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.
FACE Configuration
This device is not intended to be held to the face and was not tested in the FACE configuration.
BODY Configuration
This device is not intended to be held to the BODY and was not tested in the BODY configuration.
HEAD Configuration
This device is not intended to be held to the ear and was not tested in the HEAD configuration.
Extremity Configuration
The DUT was securely clamped into the device holder with the surface of the DUT normally in contact with the EXTREMITY and in direct contact with the bottom of the phantom, or 0mm separation from the DUT to the phantom surface.
Limb Worn Configuration
This device is not intended to be worn on the limb and was not tested in the LIMB WORN configuration.
NEAR-BODY Configuration
This device does not support wireless routing and was not tested in the NEAR-BODY configuration (≤ 5mm).

12.3 General Procedures and Report

General Procedures and Reporting
General Procedures
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 ± 0.5°C. The Active TSL temperature was maintained to within ±1.0°C throughout the test series. TSL analysis and SPC were repeated when the Active TSL use exceeded 84 hours. 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 *Maximum Distance to Phantom Surface* to the fluid surface was performed following the power drift measurement.
Reporting
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. 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 ONLY scaled up, not down. The final results of this scaling is the *reported SAR* which appears on the Cover Page of this report.

12.4 Fluid Dielectric and Systems Performance Check

Fluid Dielectric and Systems Performance Check
Fluid Dielectric Measurement Procedure
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 Aprel Dielectric Property Measurement System. A frequency range of ± 100MHz for frequencies > 300MHz and ± 50MHz for frequencies ≤ 300MHz 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 OET Bulletin 65 Supplement C 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 ≤ 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.
Systems Performance Check
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. 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 ≤ 10% of the measured and normalize SAR of the validation source's Calibration Certificate. 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 ± 1°C of the initial fluid analysis.

12.5 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 ± 1 mm**
Maximum probe angle normal to phantom surface. (Flat Section ELI Phantom)	**5° ± 1°**
Area Scan Spatial Resolution ΔX, ΔY	**15 mm**
Zoom Scan Spatial Resolution ΔX, ΔY	**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 ± 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	

12.6 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 ΔX, ΔY	**12 mm**
Zoom Scan Spatial Resolution ΔX, ΔY	**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	

12.7 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 ΔX, ΔY	**10 mm**
Zoom Scan Spatial Resolution ΔX, ΔY	**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	

13.0 MEASUREMENT UNCERTAINTIES

Table 13.0 Measurement Uncertainty

UNCERTAINTY BUDGET FOR DEVICE EVALUATION (IEEE 1528-2013 Table 9)									
Uncertainty Component	**IEEE 1528 Section**	**Uncertainty Value ±%**	**Probability Distribution**	**Divisor**	**ci 1g**	**ci 10g**	**Uncertainty Value ±% (1g)**	**Uncertainty Value ±% (10g)**	**V_i or V_{eff}**
Measurement System									
Probe Calibration*	E.2.1	6.6	Normal	1	1	1	6.60	6.60	∞
Axial Isotropy*	E.2.2	4.7	Rectangular	1.732050808	0.7	0.7	1.9	1.9	∞
Hemispherical Isotropy*	E.2.2	9.6	Rectangular	1.732050808	0.7	0.7	3.9	3.9	∞
Boundary Effect*	E.2.3	8.3	Rectangular	1.732050808	1	1	4.8	4.8	∞
Linearity*	E.2.4	4.7	Rectangular	1.732050808	1	1	2.7	2.7	∞
System Detection Limits*	E.2.4	1.0	Rectangular	1.732050808	1	1	0.6	0.6	∞
Modulation Response	E.2.5	4.0	Rectangular	1.732050808	1	1	2.3	2.3	∞
Readout Electronics*	E.2.6	1.0	Normal	1	1	1	1.0	1.0	∞
Response Time*	E.2.7	0.8	Rectangular	1.732050808	1	1	0.5	0.5	∞
Integration Time*	E.2.8	1.4	Rectangular	1.732050808	1	1	0.8	0.8	∞
RF Ambient Conditions - Noise	E.6.1	0.0	Rectangular	1.732050808	1	1	0.0	0.0	∞
RF Ambient Conditions - Reflection	E.6.1	0.0	Rectangular	1.732050808	1	1	0.0	0.0	∞
Probe Positioner Mechanical Tolerance*	E.6.2	0.4	Rectangular	1.732050808	1	1	0.2	0.2	∞
Probe Positioning wrt Phantom Shell*	E.6.3	2.9	Rectangular	1.732050808	1	1	1.7	1.7	∞
Extrapolation, interpolation & integration algorithms for max. SAR evaluation*	E.5	3.9	Rectangular	1.732050808	1	1	2.3	2.3	∞
Test Sample Related									
Test Sample Positioning	E.4.2	0.3	Normal	1	1	1	0.3	0.3	5
Device Holder Uncertainty*	E.4.1	3.6	Normal	1	1	1	3.6	3.6	∞
SAR Drift Measurement**	E.2.9	0.0	Rectangular	1.732050808	1	1	0.0	0.0	∞
SAR Scaling***	E.6.5	2.0	Rectangular	1.732050808	1	1	1.2	1.2	∞
Phantom and Tissue Parameters									
Phantom Uncertainty*	E.3.1	4.0	Rectangular	1.732050808	1	1	2.3	2.3	∞
SAR Correction Uncertainty	E.3.2	1.2	Normal	1	1	0.84	1.2	1.0	∞
Liquid Conductivity (measurement)	E.3.3	6.8	Normal	1	0.78	0.71	5.3	4.8	10
Liquid Permittivity (measurement)	E.3.3	5.3	Normal	1	0.23	0.26	1.2	1.4	10
Liquid Conductivity (Temperature)	E.3.2	0.1	Rectangular	1.732050808	0.78	0.71	0.1	0.0	∞
Liquid Permittivity Temperature)	E.3.2	0.0	Rectangular	1.732050808	0.23	0.26	0.0	0.0	∞
Effective Degrees of Freedom(1)								**V_{eff} =**	**873.2**
Combined Standard Uncertainty			**RSS**				**12.59**	**12.40**	
Expanded Uncertainty (95% Confidence Interval)			**k=2**				**25.18**	**24.80**	
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%.

* Provided by SPEAG

Table 13.1 Calculation of Degrees of Freedom

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

14.0 FLUID DIELECTRIC PARAMETERS

Table 14.0 Fluid Dielectric Parameters 150MHz BODY TSL

****
Aprel Laboratory
Test Result for UIM Dielectric Parameter
Fri 01/Jun/2018 11:47:39
Freq Frequency(GHz)
FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon
FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma
FCC_eB FCC Limits for Body Epsilon
FCC_sB FCC Limits for Body Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM
****

Freq	FCC_eB	FCC_sB	Test_e	Test_s
0.1000	63.13	0.76	64.50	0.75
0.1100	62.89	0.77	62.54	0.76
0.1200	62.64	0.78	65.31	0.75
0.1300	62.39	0.78	62.11	0.76
0.1400	62.15	0.79	61.94	0.74
0.1500	61.90	0.80	60.32	0.75
0.1600	61.65	0.81	62.61	0.79
0.1700	61.41	0.82	61.40	0.77
0.1800	61.16	0.82	62.08	0.80
0.1900	60.91	0.83	61.30	0.79
0.2000	60.67	0.84	61.29	0.79

FLUID DIELECTRIC PARAMETERS

Date:	1 Jun 2018	Fluid Temp:	23.7	Frequency:	150MHz	Tissue:	Body

Freq (MHz)		Test_e	Test_s	Target_e	Target_s	Deviation Permittivity	Deviation Conductivity
100.0000		64.5000	0.7500	63.1300	0.76	2.17%	-1.32%
110.0000		62.5400	0.7600	62.8900	0.77	-0.56%	-1.30%
120.0000		65.3100	0.7500	62.6400	0.78	4.26%	-3.85%
130.0000		62.1100	0.7600	62.3900	0.78	-0.45%	-2.56%
140.0000		61.9400	0.7400	62.1500	0.79	-0.34%	-6.33%
150.0000		60.3200	0.7500	61.9000	0.80	-2.55%	-6.25%
151.8200	*	60.7368	0.7573	61.8545	0.80	-1.81%	-5.55%
154.6000	*	61.3734	0.7684	61.7850	0.80	-0.67%	-4.50%
160.0000		62.6100	0.7900	61.6500	0.81	1.56%	-2.47%
170.0000		61.4000	0.7700	61.4100	0.82	-0.02%	-6.10%
180.0000		62.0800	0.8000	61.1600	0.82	1.50%	-2.44%
190.0000		61.3000	0.7900	60.9100	0.83	0.64%	-4.82%
200.0000		61.2900	0.7900	60.6700	0.84	1.02%	-5.95%

*Channel Frequency Tested

Table 14.1 Fluid Dielectric Parameters 150MHz BODY TSL

****
Aprel Laboratory
Test Result for UIM Dielectric Parameter
Wed 06/Jun/2018 09:34:02
Freq Frequency(GHz)
FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon
FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma
FCC_eB FCC Limits for Body Epsilon
FCC_sB FCC Limits for Body Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM
****

Freq	FCC_eB	FCC_sB	Test_e	Test_s
0.1000	63.13	0.76	67.26	0.78
0.1100	62.89	0.77	68.59	0.81
0.1200	62.64	0.78	68.03	0.78
0.1300	62.39	0.78	65.57	0.80
0.1400	62.15	0.79	64.85	0.79
0.1500	61.90	0.80	63.67	0.80
0.1600	61.65	0.81	64.96	0.80
0.1700	61.41	0.82	64.38	0.79
0.1800	61.16	0.82	65.97	0.84
0.1900	60.91	0.83	67.39	0.83
0.2000	60.67	0.84	66.24	0.83

FLUID DIELECTRIC PARAMETERS

Date:	6 Jun 2018	Fluid Temp:	22.6	Frequency:	150MHz	Tissue:	Body

Freq (MHz)		Test_e	Test_s	Target_e	Target_s	Deviation Permittivity	Deviation Conductivity
100.0000		67.2600	0.7800	63.1300	0.76	6.54%	2.63%
110.0000		68.5900	0.8100	62.8900	0.77	9.06%	5.19%
120.0000		68.0300	0.7800	62.6400	0.78	8.60%	0.00%
130.0000		65.5700	0.8000	62.3900	0.78	5.10%	2.56%
140.0000		64.8500	0.7900	62.1500	0.79	4.34%	0.00%
150.0000		63.6700	0.8000	61.9000	0.80	2.86%	0.00%
151.8200	*	63.9048	0.8000	61.8545	0.80	3.31%	-0.23%
154.6000	*	64.2634	0.8000	61.7850	0.80	4.01%	-0.57%
160.0000		64.9600	0.8000	61.6500	0.81	5.37%	-1.23%
170.0000		64.3800	0.7900	61.4100	0.82	4.84%	-3.66%
180.0000		65.9700	0.8400	61.1600	0.82	7.86%	2.44%
190.0000		67.3900	0.8300	60.9100	0.83	10.64%	0.00%
200.0000		66.2400	0.8300	60.6700	0.84	9.18%	-1.19%

*Channel Frequency Tested

15.0 SYSTEM VERIFICATION TEST RESULTS

Table 15.0 System Verification Results 150MHz BODY TSL

System Verification Test Results					
Date		Frequency (MHz)	Validation Source		
			P/N		S/N
1 Jun 2018		150	CLA-150		4007
Fluid Type	Fluid Temp °C	Ambient Temp °C	Ambient Humidity (%)	Forward Power (mW)	Source Spacing (mm)
Body	23.7	24	26%	1000	0
Fluid Parameters					
Permittivity			Conductivity		
Measured	Target	Deviation	Measured	Target	Deviation
63.67	61.90	2.86%	0.80	0.80	0.00%
Measured SAR					
1 gram			10 gram		
Measured	Target	Deviation	Measured	Target	Deviation
4.23	4.08	3.68%	2.81	2.70	4.07%
Measured SAR Normalized to 1.0W					
1 gram			10 gram		
Normalized	Target	Deviation	Normalized	Target	Deviation
4.23	4.01	5.49%	2.81	2.65	6.04%

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.

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.

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.

The forward power applied was same forward power applied by the calibration lab during the calibration of this validation source.

Table 15.1 System Verification Results 150MHz BODY TSL

System Verification Test Results					
Date		Frequency (MHz)	Validation Source		
			P/N		S/N
6 Jun 2018		150	CLA-150		4007
Fluid Type	Fluid Temp °C	Ambient Temp °C	Ambient Humidity (%)	Forward Power (mW)	Source Spacing (mm)
Body	22.6	21	26%	1000	0
Fluid Parameters					
Permittivity			Conductivity		
Measured	Target	Deviation	Measured	Target	Deviation
63.67	61.90	2.86%	**0.80**	0.80	0.00%
Measured SAR					
1 gram			10 gram		
Measured	Target	Deviation	Measured	Target	Deviation
4.15	4.08	1.72%	**2.77**	2.70	2.59%
Measured SAR Normalized to 1.0W					
1 gram			10 gram		
Normalized	Target	Deviation	Normalized	Target	Deviation
4.15	4.01	3.49%	**2.77**	2.65	4.53%

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.

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.

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.

The forward power applied was same forward power applied by the calibration lab during the calibration of this validation source.

16.0 SYSTEM VALIDATION SUMMARY

Table 16.0 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		EX3DV4	3600	CLA-30	1005	Head					
150	03-May-18	EX3DV4	3600	CLA-150	4007	Body	66.48	0.79	Pass	Pass	Pass
150	04-May-17	EX3DV4	3600	CLA-150	4007	Head	51.51	0.81	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
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-Jul-17	EX3DV4	3600	D1800V2	247	Head	40.70	1.33	Pass	Pass	Pass
2450	23-Jul-18	EX3DV4	3600	D2450V2	825	Body	49.51	1.92	Pass	Pass	Pass
2450	24-Jul-18	EX3DV4	3600	D2450V2	825	Head	37.95	1.87	Pass	Pass	Pass
5250	24-Jul-17	EX3DV4	3600	D5GHzV2	1031	Body	46.42	5.69	Pass	Pass	Pass
5250	24-Jul-17	EX3DV4	3600	D5GHzV2	1031	Head	35.96	4.99	Pass	Pass	Pass

17.0 MEASUREMENT SYSTEM SPECIFICATIONS

Table 17.0 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

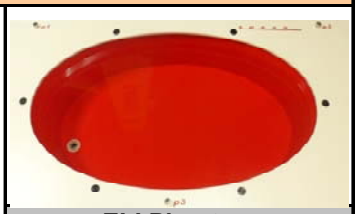
Probe Specification

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 ± 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 μW/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^{O}. 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

18.0 TEST EQUIPMENT LIST

Table 18.0 Equipment List and Calibration

Test Equipment List				
DESCRIPTION	ASSET NO.	SERIAL NO.	DATE CALIBRATED	CALIBRATION INTERVAL
Schmid & Partner DASY 6 System	-	-	-	-
-DASY Measurement Server	00158	1078	CNR	CNR
-Robot	00046	599396-01	CNR	CNR
-DAE4	00019	353	20-Apr-18	Annual
-EX3DV4 E-Field Probe	00213	3600	25-Apr-18	Annual
-CLA 30 Validation Dipole	00300	1005	23-Nov-17	Triennial
-CLA150 Validation Dipole	00251	4007	27-Apr-17	Triennial
-D450V3 Validation Dipole	00221	1068	23-Apr-18	Triennial
-D835V2 Validation Dipole	00217	4D075	20-Apr-18	Triennial
-D900V2 Validation Dipole	00020	54	24-Apr-17	Triennial
-D1640/1620-S-2 Validation Dipole	00299	207-00102	07-Nov-17	Triennial
-D2450V2 Validation Dipole	00219	825	24-Apr-18	Triennial
-D5GHzV2 Validation Dipole	00126	1031	26-Apr-18	Triennial
ELI Phantom	00247	-	CNR	CNR
HP 85070C Dielectric Probe Kit	00033	none	CNR	CNR
Gigatronics 8652A Power Meter	00110	1835801	29-Feb-16	Triennial
Gigatronics 80701A Power Sensor	00248	1833687	29-Feb-16	Triennial
HP 8753ET Network Analyzer	00134	US39170292	29-Dec-17	Triennial
Rohde & Schwarz SMR20 Signal Generator	00006	100104	29-May-17	Triennial
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	Triennial
Traceable VWR Jumbo Humidity/Thermometer	00295	170120555	17-Feb-17	Triennial
DC-18G 10W 30db Attenuator	00102	-	COU	COU
R&S FSP40 Spectrum Analyzer	00241	100500	15-May-18	Triennial
RF Cable-SMA	00311	-	CNR	CNR
HP Calibration Kit	00145	-	10-Feb-17	Triennial

CNR = Calibration Not Required

COU = Calibrate on Use

19.0 FLUID COMPOSITION

Table 19.0 Fluid Composition 150MHz BODY TSL

Table x			150MHz Body	
Tissue Simulating Liquid (TSL) Composition				
Component by Percent Weight				
Water	Sugar	Salt(1)	HEC(2)	Bacteriacide(3)
46.6	49.7	2.6	1.0	0.1

(1) Non-Iodinized
(2) **H**ydroxy**E**thyl-**C**ellulose: Sigma-Aldrich P/N 54290-500g
(3) Dow Chemical Dowicil 75 Antimicrobial Perservative

APPENDIX A – SYSTEM VERIFICATION PLOTS

Date/Time: 6/1/2018 12:35:34 PM

Test Laboratory: Celltech Labs

SPC-150B Jun 01 2018

DUT: CLA-150; Type: CLA-150;

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_150B[01JN18]
Medium parameters used: f = 150 MHz; σ = 0.75 S/m; ε_r = 60.32; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

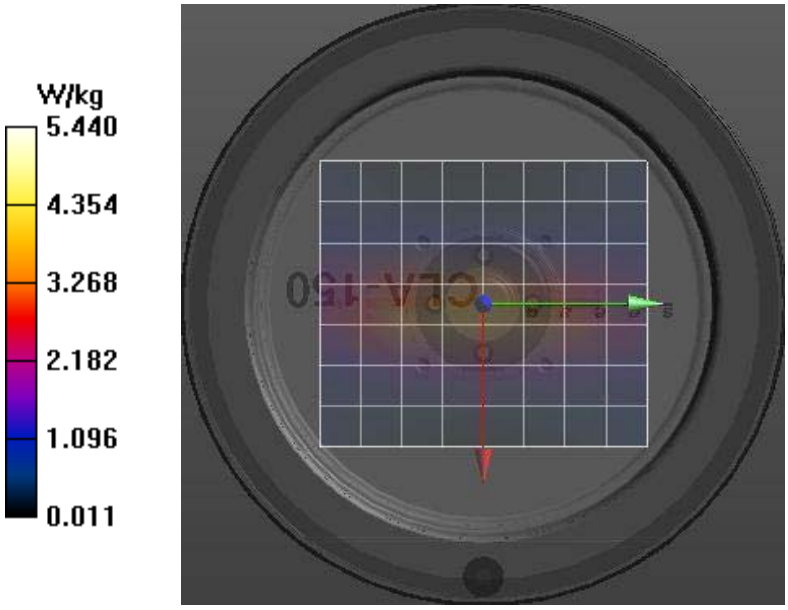
- Probe: EX3DV4 - SN3600; ConvF(9.62, 9.62, 9.62); Calibrated: 4/25/2018, ConvF(9.62, 9.62, 9.62); Calibrated: 4/25/2018, ConvF(9.62, 9.62, 9.62); Calibrated: 4/25/2018;
    - Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection), z = 16.0, 31.0, 151.0
- Electronics: DAE4 Sn353; Calibrated: 4/20/2018
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax;
- DASY52 52.10.0(1446);

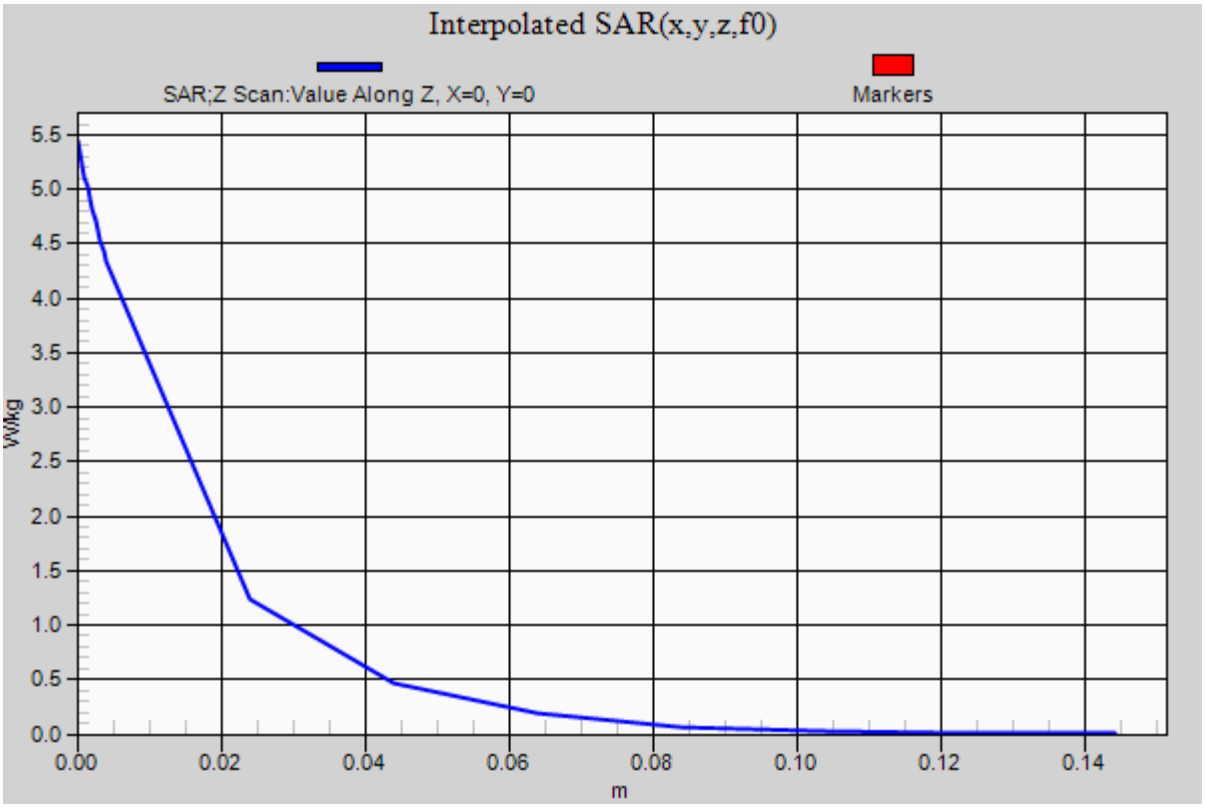
Frequency: 150 MHz

SPC/SPC 150B Input=1.0W, Target=4.08W/kg 2/Area Scan (8x9x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 4.31 W/kg

SPC/SPC 150B Input=1.0W, Target=4.08W/kg 2/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 72.81 V/m; Power Drift = 0.33 dB
Peak SAR (extrapolated) = 6.48 W/kg
SAR(1 g) = 4.23 W/kg; SAR(10 g) = 2.81 W/kg
Maximum value of SAR (measured) = 4.53 W/kg

SPC/SPC 150B Input=1.0W, Target=4.08W/kg 2/Z Scan (1x1x19): Measurement grid: dx=20mm, dy=20mm, dz=20mm
Penetration depth = n/a (n/a, 15.99) [mm]
Maximum value of SAR (interpolated) = 5.44 W/kg


W/kg
5.440
4.354
3.268
2.182
1.096
0.011


Interpolated SAR(x,y,z,f0)
SAR;Z Scan:Value Along Z, X=0, Y=0
Markers
W/kg
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
m

Date/Time: 6/6/2018 10:28:44 AM, Date/Time: 6/6/2018 10:35:49 AM

Test Laboratory: Celltech Labs

SPC-150B Jun 06 2018.da53-1

DUT: CLA-150; Type: CLA-150

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_150B[06JN18]
Medium parameters used: f = 150 MHz; σ = 0.8 S/m; ε_r = 63.67; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

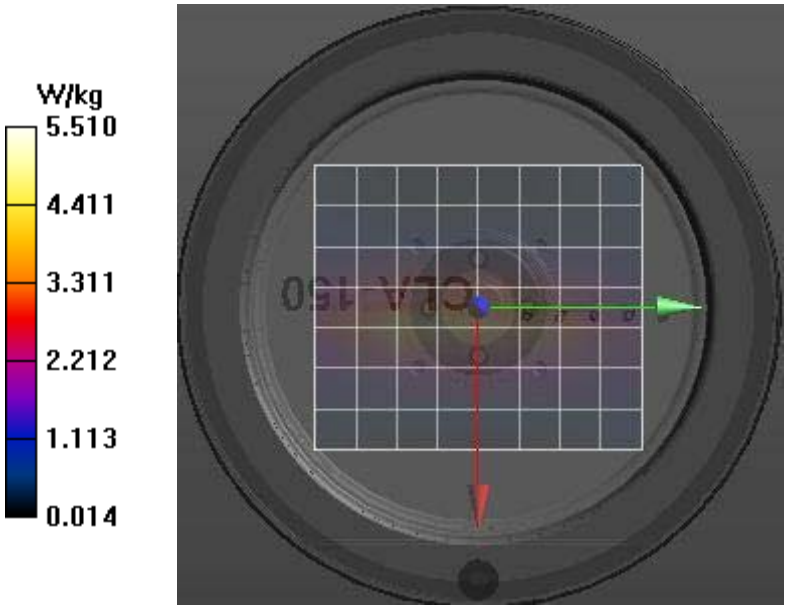
- Probe: EX3DV4 - SN3600; ConvF(9.62, 9.62, 9.62); Calibrated: 4/25/2018, ConvF(9.62, 9.62, 9.62); Calibrated: 4/25/2018, ConvF(9.62, 9.62, 9.62); Calibrated: 4/25/2018;
  - Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection), z = 16.0, 31.0, 151.0
- Electronics: DAE4 Sn353; Calibrated: 4/20/2018
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax;
- DASY52 52.10.1(1476);

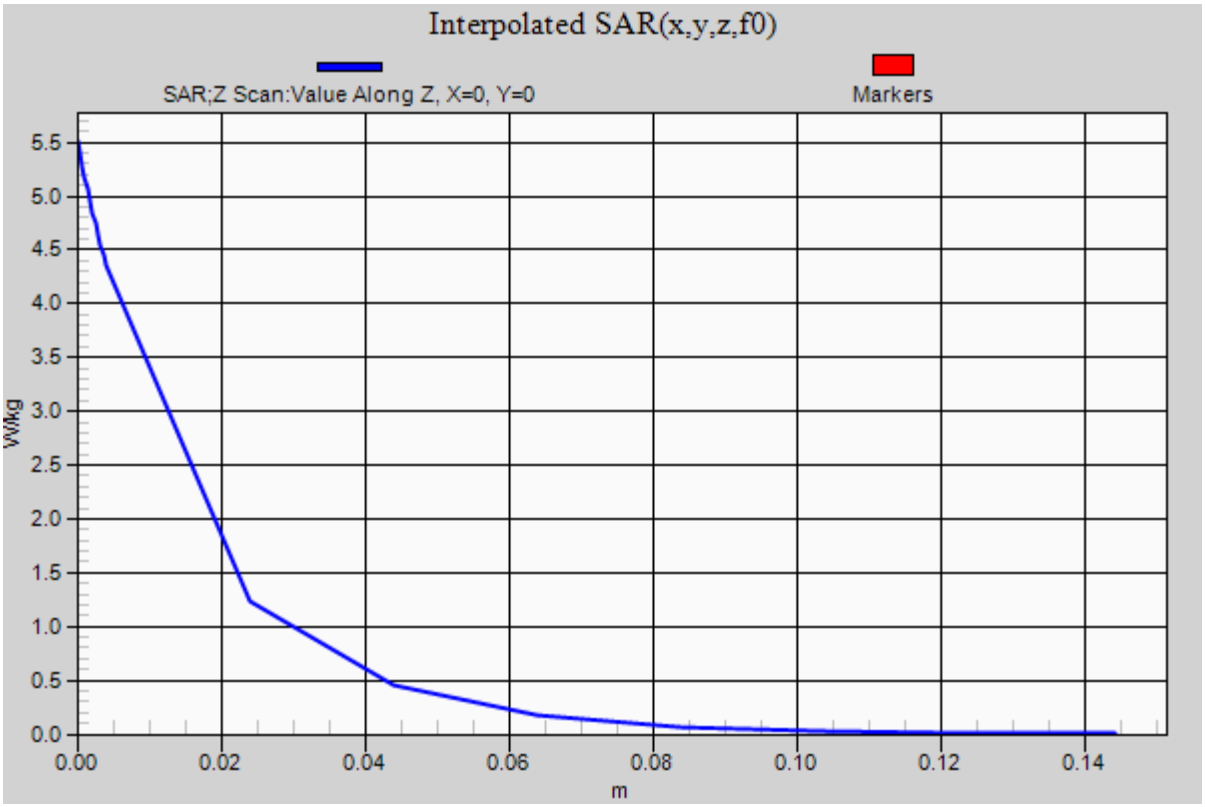
Frequency: 150 MHz

SPC/SPC 150B Input=1.0W, Target=4.08W/kg 2 2/Area Scan (8x9x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 4.09 W/kg

SPC/SPC 150B Input=1.0W, Target=4.08W/kg 2 2/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 73.72 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 6.33 W/kg
SAR(1 g) = 4.15 W/kg; SAR(10 g) = 2.77 W/kg
Maximum value of SAR (measured) = 4.44 W/kg

SPC/SPC 150B Input=1.0W, Target=4.08W/kg 2 2/Z Scan (1x1x19): Measurement grid: dx=20mm, dy=20mm, dz=20mm
Penetration depth = n/a (n/a, 15.79) [mm]
Maximum value of SAR (interpolated) = 5.51 W/kg


W/kg
5.510
4.411
3.311
2.212
1.113
0.014


Interpolated SAR(x,y,z,f0)
SAR;Z Scan:Value Along Z, X=0, Y=0
Markers
W/kg
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
m

APPENDIX B – MEASUREMENT PLOTS OF MAXIMUMUM MEASURED SAR

Plot B5

Date/Time: 6/6/2018 1:56:42 PM, Date/Time: 6/6/2018 2:14:46 PM

Test Laboratory: Celltech Labs

Garmin Test 150B Jun 6 2018

DUT: A03547-Ant 2; Type: Sample; Serial: IMEI Number

Communication System: UID 0, CW (0); Communication System Band: FullSpan (0.0 - 6000.0 MHz); Frequency: 151.82 MHz;Communication System PAR: 0 dB; PMF: 1

Medium: TSL_150B[06JN18]
Medium parameters used (interpolated): f = 151.82 MHz; σ = 0.8 S/m; ε_r = 63.905; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: EX3DV4 - SN3600; ConvF(9.62, 9.62, 9.62); Calibrated: 4/25/2018, ConvF(9.62, 9.62, 9.62); Calibrated: 4/25/2018, ConvF(9.62, 9.62, 9.62); Calibrated: 4/25/2018;
  - Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection), z = -1.5, 31.0, 101.0
- Electronics: DAE4 Sn353; Calibrated: 4/20/2018
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax;
- DASY52 52.10.1(1476);

Frequency: 151.82 MHz

150B/B5-Transmitter 151.82MHz Touch/ Right, Ant T2, bat. P1 2/Area Scan (8x38x1): Measurement grid: dx=15mm, dy=15mm

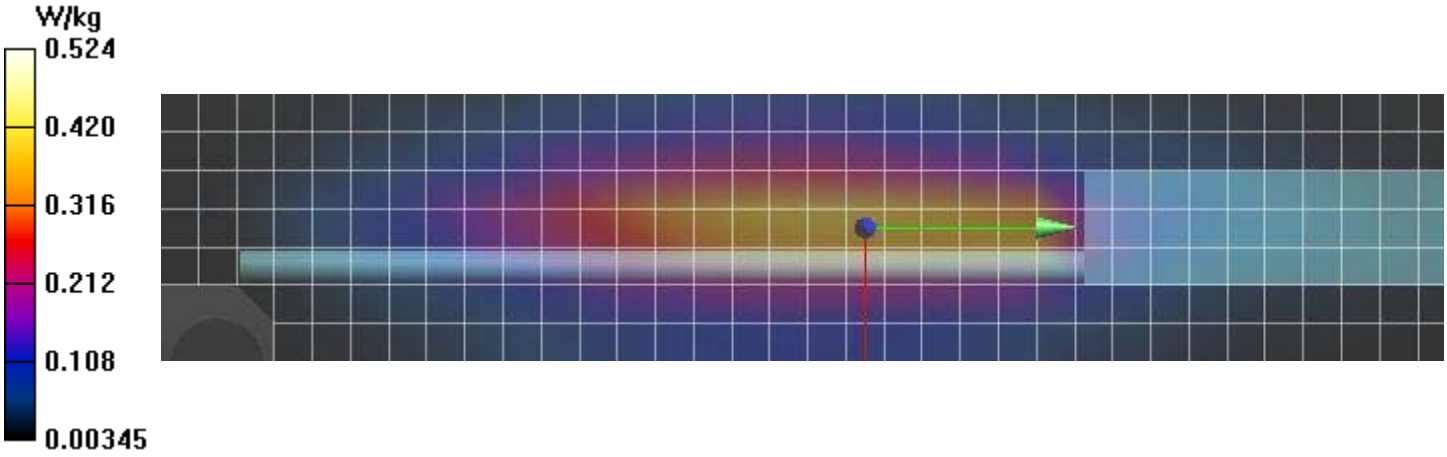
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.401 W/kg

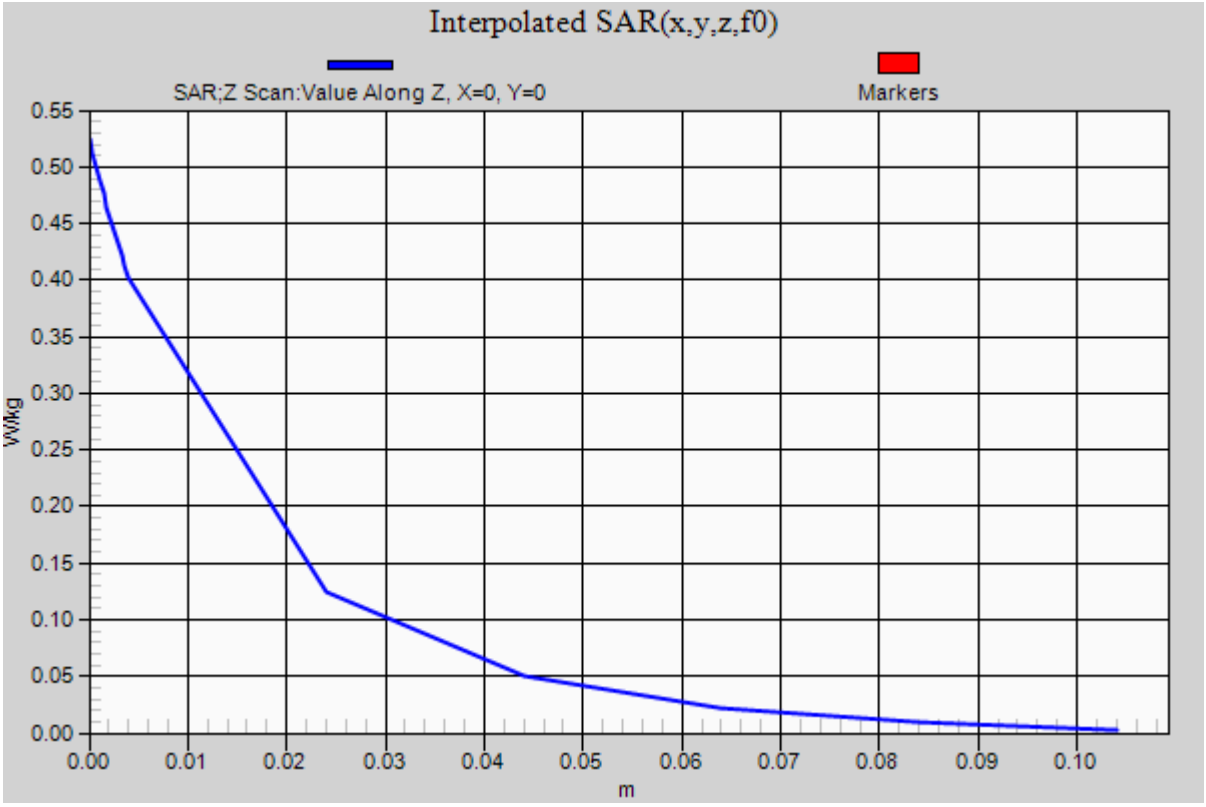
150B/B5-Transmitter 151.82MHz Touch/ Right, Ant T2, bat. P1 2/Zoom Scan (6x14x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 22.30 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 0.569 W/kg
SAR(1 g) = 0.389 W/kg; SAR(10 g) = 0.275 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.413 W/kg

150B/B5-Transmitter 151.82MHz Touch/ Right, Ant T2, bat. P1 2/Z Scan (1x1x17): Measurement grid: dx=20mm, dy=20mm, dz=20mm

Info: Interpolated medium parameters used for SAR evaluation.
Penetration depth = n/a (n/a, 16.99) [mm]
Maximum value of SAR (interpolated) = 0.524 W/kg


W/kg
0.524
0.420
0.316
0.212
0.108
0.00345


Interpolated SAR(x,y,z,f0)
SAR;Z Scan:Value Along Z, X=0, Y=0
Markers
W/kg
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.10
m