Test Report Serial Number:	45461501 R2.0
Test Report Date:	15 July 2019
Project Number:	1433

SAR Test Report - New Certification

Applicant:

GARMIN

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

Maximum Reported 10g SAR			
FCC	Extremity DTS	0.50	W/kg
ISED	Extremity DTS	0.50	
General Pop. Limit:		4.00	

FCC ID:	ISED Certification Number
IPH-03618	1792A-03618
Product Model Number / HVIN	**Product Name / PMN**
A03618	A03618

In Accordance With:

FCC 47 CFR §2.1093

Radiofrequency Radiation Exposure Evaluation: Portable Devices

IC RSS-102 Issue 5

Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

Approved By:

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

ilac-MRA ACCREDITED

Industry Canada

FC

Test Lab Certificate: 2470.01 **IC Registration 3874A-1** **FCC Registration: CA3874**

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Table of Contents

1.0 DOCUMENT CONTROL 4
2.0 CLIENT AND DEVICE INFORMATION 5
3.0 SCOPE OF EVALUATION 6
4.0 NORMATIVE REFERENCES 7
5.0 STATEMENT OF COMPLIANCE 8
6.0 SAR MEASUREMENT SYSTEM 9
7.0 RF CONDUCTED POWER MEASUREMENT 10
TABLE 7.0 CONDUCTED POWER MEASUREMENTS 10
TABLE 7.1 CONDUCTED POWER MEASUREMENTS 11
8.0 NUMBER OF TEST CHANNELS (N_C) AND CONFIGURATIONS 12
9.0 ACCESSORIES EVALUATED 13
TABLE 9.0 ACCESSORIES EVALUATED 13
10.0 SAR MEASUREMENT SUMMARY 14
TABLE 10.0: MEASURED RESULTS 14
11.0 SCALING OF MAXIMUM MEASURED SAR 15
TABLE 11.0 SAR SCALING 15
12.0 SAR EXPOSURE LIMITS 17
TABLE 12.0 EXPOSURE LIMITS 17
13.0 DETAILS OF SAR EVALUATION 18
13.0 DAY LOG 18
13.1 DUT SETUP AND CONFIGURATION 19
13.2 DUT POSITIONING 19
13.3 GENERAL PROCEDURES AND REPORT 20
13.4 FLUID DIELECTRIC AND SYSTEMS PERFORMANCE CHECK 21
13.5 SCAN RESOLUTION 100MHZ TO 2GHZ 21
13.6 SCAN RESOLUTION 2GHZ TO 3GHZ 22
13.7 SCAN RESOLUTION 5GHZ TO 6GHZ 22
14.0 MEASUREMENT UNCERTAINTIES 23
TABLE 14.0 MEASUREMENT UNCERTAINTY 23
TABLE 14.1 CALCULATION OF DEGREES OF FREEDOM 24
15.0 FLUID DIELECTRIC PARAMETERS 25
TABLE 15.0 FLUID DIELECTRIC PARAMETERS 2450MHZ BODY TSL 25
16.0 SYSTEM VERIFICATION TEST RESULTS 27
TABLE 16.0 SYSTEM VERIFICATION RESULTS 2450MHZ BODY TSL 27
17.0 SYSTEM VALIDATION SUMMARY 28
TABLE 17.0 SYSTEM VALIDATION SUMMARY 28
18.0 MEASUREMENT SYSTEM SPECIFICATIONS 29
TABLE 18.0 MEASUREMENT SYSTEM SPECIFICATIONS 29

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19.0 TEST EQUIPMENT LIST *31*
TABLE 19.0 EQUIPMENT LIST AND CALIBRATION 31
20.0 FLUID COMPOSITION *32*
TABLE 20.0 FLUID COMPOSITION 2450MHZ BODY TSL 32
APPENDIX A – SYSTEM VERIFICATION PLOTS *33*
SPC-2450B MAR 05 2019 33
APPENDIX B – MEASUREMENT PLOTS OF MAXIMUMUM MEASURED SAR *35*
GARMIN-2450B MAR 06 2019 35
GARMIN-2450B MAR 06 2019 37
APPENDIX C - SETUP PHOTOS *39*
APPENDIX D – DUT AND ACCESSORY PHOTOS *42*
APPENDIX E – PROBE CALIBRATION *47*
APPENDIX F – DIPOLE CALIBRATION *48*
APPENDIX G - PHANTOM *49*

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1.0 DOCUMENT CONTROL

Samples Tested By:	Trevor Whillock
Report Prepared By:	Trevor Whillock
Report Reviewed By:	Ben Hewson

Report Issue Number	Description	By	Report Issue Date
R0.0	Draft	Trevor Whillock	13 June 2019
R0.1	Section 2.0,7.0 & 11.0- Revised Rated Power	Trevor Whillock	21 June 2019
	Cover Page-Revised Max SAR		
R1.0	Inital Release	Trevor Whillock	26 June 2019
	Section 2.0 -Added Reference to Manufacturer		
R2.0	Section 16.0 -Revised Normalized Target Values and Deviation in SPC Report	Trevor Whillock	15 July 2019
	Section 19.0- Revised Equipment Table to Include Corrrect Probe Cal Dates		
	Appendix E- Changed Cal Probe Report to Correlate with System Check and Test Dates		

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2.0 CLIENT AND DEVICE INFORMATION

Client Information	
Applicant Name	**Garmin International Inc.**
Applicant Address	1200 East 151 St.
	Olathe, KS,66062
	USA
Manufacturer Name	**Garmin Corporation**
Manufacturer Address	No.68, Zhangshu 2nd Rd., Xizhi Dist.
	New Taipei City 221
	Taiwan, R.O.C
DUT Information	
Device Identifier(s):	**FCC ID:** **IPH-03618**
	IC: **1792A-03618**
Type of Equipment:	Digital Transmission System (DTS) FCC Part 15, RSS 247
	Low Power Communication Device Transmitter (DXX) FCC Part 15
Device Model(s) / HVIN:	A03618
Device Marketing Name / PMN:	A03618
Test Sample Serial No.:	T/A Sample - Identical Prototype
Transmit Frequency Range:	WiFi: 2412 - 2462 MHz
	BT: 2402 - 2480 MHz
	NFC: 13.56 MHz
Number of Channels:	See Section 8.0
Manuf. Max. Avg Rated Output Power:	WiFi 2.4GHz: 802.11b: 12.68 dBm Avg. / 802.11g: 13.15 dBm Avg. / 802.11n: 12.85 dBm avg.
	BT:GFSK: 12.35 dBm Avg. / PI/4-DQPSK: 6.71 dBm Avg. / 8-DPSK: 6.76 dBm Avg.
	BLE: GMSK: 0.49 dBm Avg.
	ANT: GFSK: -1.30 dBm Avg.
Modulation:	WiFi 802.11b/g/n: DSSS, OFDM, MCS0-7
	BT: GFSK, PI/4-DQPSK
	BLE: GMSK
	ANT: GFSK
Duty Cycle:	100.0%
DUT Power Source:	5V USB, Internal Li-ion battery
Deviation(s) from standard/procedure:	None
Modification of DUT:	None

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3.0 SCOPE OF EVALUATION

The A03618, FCC ID: IPH-03618 ISED ID: 1792A-03618, is a wrist-worn transceiver that is capable of operating in the 2.4GHz WiFi and Bluetooth frequency bands with an additional NFC feature that operates at a fixed frequency of 13.56MHz .The device is intended for General Population Use. The product operates from an internal proprietary Li-ion rechargeable battery which can be connected to a compliant USB interface port, AC or DC adapter for charging. Test samples provided by the manufacturer were capable of transmitting at select frequencies and modulations preset by the manufacturer. An additional antenna modification was prepared for one sample allowing the ability to connect test equipment for antenna port 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, 248227 and RSS 102.

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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 Title 47: Part 2.1093:	Code of Federal Regulations Telecommunication 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
FCC KDB KDB 248227 D01v02r02	SAR Test Guidane for IEEE 802.11 (WiFI) Transmitters
* When the issue number or issue date is omitted, the latest version is assumed.	

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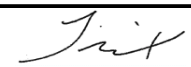
5.0 STATEMENT OF COMPLIANCE

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:	Model / HVIN:	
Garmin International Inc.	A03618	
Standard(s) Applied:	**Measurement Procedure(s):**	
FCC 47 CFR §2.1093 Health Canada's Safety Code 6	FCC KDB 865664, FCC KDB 447498, FCC KDB248227 Industry Canada RSS-102 Issue 5 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		March 5th & 6th, 2019

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. 15 July 2019 Date

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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 VME-bus computer.

DASY 6 SAR System

DASY 6 Measurement Controller

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7.0 RF CONDUCTED POWER MEASUREMENT

Table 7.0 Conducted Power Measurements

Conducted Power Measurements									
Channel	Frequency (MHz)	Measured Power (dBm)	Rated Power (dBm)	Rated Power (W)	Delta (dB)	SAR Test Channel (Y/N)	Mode	Modulation	
1	2412	12.68	12.68	0.02	0.00	-	WLAN 2.4G	DSS-1Mbps	802.11b
2	2417	12.59	12.68	0.02	-0.09	-		DSS-1Mbps	
3	2422	12.40	12.68	0.02	-0.28	-		DSS-1Mbps	
4	2427	12.23	12.68	0.02	-0.45	-		DSS-1Mbps	
5	2432	12.28	12.68	0.02	-0.40	-		DSS-1Mbps	
6	2437	12.18	12.68	0.02	-0.50	-		DSS-1Mbps	
7	2442	11.98	12.68	0.02	-0.70	-		DSS-1Mbps	
8	2447	12.28	12.68	0.02	-0.40	-		DSS-1Mbps	
9	2452	12.13	12.68	0.02	-0.55	-		DSS-1Mbps	
10	2457	11.75	12.68	0.02	-0.93	-		DSS-1Mbps	
11	2462	11.73	12.68	0.02	-0.95	-		DSS-1Mbps	
1	2412	11.50	12.68	0.02	-1.18	-		DSS-2Mbps	
		11.37	12.68	0.02	-1.31	-		DSS-5.5Mbps	
		11.13	12.68	0.02	-1.55	-		DSS-11Mbps	
		12.57	13.15	0.02	-0.58	-		OFDM-6Mbps	802.11g
		13.08	13.15	0.02	-0.07	Y		OFDM-54Mbps	
		12.34	12.85	0.02	-0.51	-		MCS-0	802.11n
		12.52	12.85	0.02	-0.33	-		MCS-7	
5	2432	11.48	12.68	0.02	-1.20	-		DSS-2Mbps	802.11b
		11.20	12.68	0.02	-1.48	-		DSS-5.5Mbps	
		11.05	12.68	0.02	-1.63	-		DSS-11Mbps	
		12.18	13.15	0.02	-0.97	-		OFDM-6Mbps	802.11g
		13.06	13.15	0.02	-0.09	Y		OFDM-54Mbps	
		12.37	12.85	0.02	-0.48	-		MCS-0	802.11n
		12.49	12.85	0.02	-0.36	-		MCS-7	
11	2467	11.38	12.68	0.02	-1.30	-		DSS-2Mbps	802.11b
		10.89	12.68	0.02	-1.79	-		DSS-5.5Mbps	
		10.73	12.68	0.02	-1.95	-		DSS-11Mbps	
		12.25	13.15	0.02	-0.90	-		OFDM-6Mbps	802.11g
		12.68	13.15	0.02	-0.47	Y		OFDM-54Mbps	
		12.44	12.85	0.02	-0.41	-		MCS-0	802.11n
		12.21	12.85	0.02	-0.64	-		MCS-7	

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Table 7.1 Conducted Power Measurements

Conducted Power Measurements								
Channel	Frequency (MHz)	Measured Power (dBm)	Rated Power (dBm)	Rated Power (W)	Delta (dB)	SAR Test Channel (Y/N)	Mode	Modulation
2	2402	12.04	12.35	0.02	-0.31	Y	BT/BLE/ANT	BT(GFSK)
41	2441	10.93	12.35	0.02	-1.42	-		
80	2480	10.66	12.35	0.02	-1.69	-		
2	2402	6.16	6.71	0.005	-0.55	-		BT(PI/4-DQPSK)
		6.24	6.76	0.005	-0.52	-		BT(8-DPSK)
		-0.16	0.49	0.001	-0.65	-		BLE(GMSK)
		-1.30	-1.30	0.001	0.00	-		ANT(GFSK)

The rated power and tolerance are stated for typical transmission modes and data rates. Some modes and data rates may produce lower than rated conducted power levels. Power measurements taken across the various channels, modes and data rates did not produce levels in excess of the Rated Power plus Tolerance. SAR was evaluated using the power level setting and duty cycle specified by the manufacturer 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.

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8.0 NUMBER OF TEST CHANNELS (N_C) AND CONFIGURATIONS

This device is a wrist-worn device and was evaluated for extremity SAR. Although the intended use is to be wrist-worn with the back side of the device in contact with the human skin, the device was additionally evaluated to the worst case setup configuration leveraged from a previous EU evaluation. The Front side (Screen) of the device was found to be the worst case setup configuration and produced the highest SAR.

WiFi SAR Evaluation:

SAR was evaluated in OFDM mode with a sample rate of 54Mbps at a 100% duty cycle. The power level setting selected was specified by the manufacturer to be the max output power and produce the most conservative SAR.

As per FCC KDB 24827, the required 802.11 test channels are Ch1, Ch6 and Ch 11; however, higher conducted output power was found on adjacent channels in the mid 2.4GHz WIFI frequency band. As a result the channels selected for SAR evaluation included Ch1, Ch5, and Ch11. Highest conducted output power was found on channel 1. Based on evaluated SAR level of the highest output channel; SAR test reduction methodology was applied to reduce the total number of required test channels and exclude channel 5 and channel 11 from SAR test evaluation.

When applicable, SAR test reduction methods may be utilized.

The initial test configuration for 2.4 GHz transmission modes is determined by the 802.11 configuration with the highest maximum output power specified for production units, including tune-up tolerance, in each standalone and aggregated frequency band.

When the reported SAR of the initial test configuration is > 0.8 W/kg, SAR measurement is required for subsequent next highest measured output power channel(s) in the initial test configuration until reported SAR is ≤ 1.2 W/kg or all required channels are tested.

While 1-g SAR thresholds are specified in the procedures for SAR test reduction and exclusion, these thresholds should be multiplied by 2.5 when 10-g extremity SAR is considered.

Therefore; Channel 5 and 11 was not required for evaluation in any exposure configuration.

BT/BLE/ANT SAR Test Evaluation:

Bluetooth was evaluated for SAR at 100% duty cycle in the worst-case configuration from the WiFi test evaluation.

General SAR Test Reduction Considerations

As per KDB 447498D01,

Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid band or highest output power channel is:

c) ≤ 0.4W/kg or 1.0W/kg, for 1-g or 10-g respectively, when the transmission band is ≥200Mh

BLE/ANT was not evaluated for SAR.

Per FCC KDB 447498 4.3.1 the BLE/ANT transmitter meets the standalone SAR test exclusion criteria. See section 11.0 for details.

NOTE: This device is not capable of simultaneous transmission between the BT/BLE/ANT and WiFi transmitters.

NFC:

The RFID transmitter is a low power communication device transmitter and does not require standalone SAR evaluation. Simultaneous transmission evaluation with it and the 802.11b/g/n or BT 802.15 is not required.

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9.0 ACCESSORIES EVALUATED

Table 9.0 Accessories Evaluated

's Accessory List				
Test Report ID Number	**'s Part Number**	**Description**	**SAR Evaluated**	**SAR Tested**
B1	010-12932-20	22mm Watch Band, Grey Silicone Strap	**Y**	**Y**
B2	B072NSBTZ5	22mm Watch Band, stainless steel Metal Business Strap	**Y**	**Y**
B3	011-04878-1X	20mm Watch Band, stainless steel Metal Business Strap	**Y**	**N**
P1	362-00087-00	AC Adapter, 5.0V, 1.0A, USB-A Recpt	**n/a**	**n/a**
P2	320-01069-20	USB Charging Cable	**n/a**	**n/a**

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10.0 SAR MEASUREMENT SUMMARY

Table 10.0: Measured Results

Measured SAR Results (10g) - BODY(FCC/ISED)														
Date	Plot ID #	DUT Model	Test Type	Test Freq. (*MHz*)	Modulation	Accessories				DUT Spacing		Meas. Cond. Power	Measured SAR 10g	SAR Drift
						Antenna ID	Battery ID	Body ID	Audio ID	DUT (*mm*)	Antenna (*mm*)	(*dBm*)	(*W/kg*)	(*dB*)
Extremity SAR WiFi & BT 2.4 GHz														
05 Mar 2019	B1	A03618	BODY-Back	2412	OFDM-54Mbps	n/a	n/a	B1	n/a	0	0	13.08	0.161	-0.460
05 Mar 2019	B2	A03618	BODY-Back	2412	OFDM-54Mbps	n/a	n/a	B2	n/a	0	0	13.08	0.126	0.290
06 Mar 2019	B3	A03618	BODY-Front	2412	OFDM-54Mbps	n/a	n/a	B1	n/a	0	0	13.08	0.394	1.240
06 Mar 2019	B4	A03618	BODY-Back	2402	BT BR-GFSK	n/a	n/a	B1	n/a	0	0	12.04	0.159	-0.010
06 Mar 2019	B5	A03618	BODY-Front	2402	BT BR-GFSK	n/a	n/a	B1	n/a	0	0	12.04	**0.463**	0.040
FCC 47 CFR 2.1093				**Health Canada Safety Code 6**			**Extremity**	**10g Average**		**4.0 W/kg**		**General Population**		

Reference Section 8.0 for details

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11.0 SCALING OF MAXIMUM MEASURED SAR

Table 11.0 SAR Scaling

Scaling of Maximum Measured SAR [1]														
Plot ID	Configuration	Freq (MHz)	Measured Fluid Deviation Permittivity	Measured Fluid Deviation Conductivity	Measured Conducted Power (dBm)	Measured Drift (dB)	Measured SAR (10g) (W/kg)							
B3	BODY-Front Side	2412	3.39%	2.84%	13.08	-0.460	0.394							
B5	BODY-Front Side	2402	3.26%	3.87%	12.04	0.040	0.463							
Step 1														
Fluid Sensitivity Adjustment														
Plot ID	Scale Factor (%)		X	Measured SAR (W/kg)		=	Step 1 Adjusted SAR (10g) (W/kg)							
B3	n/a		X	0.394		=	0.394							
B5	n/a		X	0.463		=	0.463							
Step 2														
Manufacturer's Tune-Up Tolerance														
Plot ID	Measured Conducted Power (dBm)		Rated Power (dBm)		Delta (dB)	+	Step 1 Adjusted SAR (W/kg)		=	Step 2 Adjusted SAR (10g) (W/kg)				
B3	13.08		13.15		-0.1	+	**0.394**		=	**0.403**				
B5	12.04		12.35		-0.3	+	**0.463**		=	**0.496**				
Step 3 (ISED)														
Drift Adjustment														
Plot ID	Measured Drift (dB)		+	Step 2 Adjusted SAR (W/kg)		=	Step 3 Adjusted SAR (10g) (W/kg)							
B3	-0.460		+	**0.403**		=	**0.487**							
B5	0.040		+	0.496		=	0.496							
Step 4 (FCC)														
Simultaneous Transmission - Bluetooth and/or WiFi														
Plot ID	Rated Output Power (Pmax) (mW)	Freq (MHz)	Separation Distance (mm)	Estimated SAR (W/kg)	+	Step 2 Adjusted SAR (W/kg)		=	Step 4 Adjusted SAR (10g) (W/kg)					
B3	13.15	2412	0	n/a	+	0.403		=	0.403					
B5	12.35	2402	0	n/a	+	0.496		=	0.496					
Step 5														
Reported SAR														
Plot ID	FCC From Steps 1 and 2 10g SAR (W/kg)								ISED From Steps 1 through 3 10g SAR (W/kg)					
B3	**0.403**								**0.487**					
B5	**0.496**								**0.496**					

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The SAR test exclusion threshold for the BLE/ANT transmitter as per FCC KDB 447498 4.3.1 is as follows:

[(*max. power of channel, including tune-up tolerance, mW*) / (*min. test separation distance, mm*)] X [√f(GHz)] ≤ 7.5 for 10-g SAR

[(1.12)/(5)] X [√2.402] = 0.347≤ 7.5

Where:
max. power of channel, including tune-up tolerance, mW = 1.12 mW
min. test separation distance, mm = 5mm
f(GHz) = 2.402 GHz

Therefore; the BLE/ANT Transmitter meets the SAR test exclusion criteria.

NOTE: This device is not capable of simultaneous transmission between the BT/BLE/ANT and WiFi transmitters.

The RFID transmitter is a low power communication device transmitter and does not require standalone SAR evaluation. Simultaneous transmission evaluation with it and the 802.11b/g/n or BT 802.15 is not required.

NOTES to Table 11.0
(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. 15 July 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.			

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13.0 DETAILS OF SAR EVALUATION

13.0 Day Log

DAY LOG						Fluid Dielectric	SPC	Test
Date	Ambient Temp °C	Fluid Temp °C	Pressure (kPa)	Humidity	TSL			
05 Mar 2019	23	22.1	103.6	25%	2450B	X	X	X
06 Mar 2019	23	22.5	101.1	25%	2450B			X

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13.1 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, 248277, and RSS-102. The device was evaluated at a phantom separation distance of 0mm with the back side of the deivce against the phantom.
2	The Device was capable of transmitting at various modulations and data rates. The Conducted Power was higher when measured in OFDM-54Mbps mode at 100% duty cycle than any other 2.4 GHz WiFi configuration. The DUT was evaluated for SAR in OFDM-54Mbps mode at the maximum conducted output power level, preset by the manufacturer.
3	The Device was capable of transmitting at various modulations and data rates. The Conducted Power was higher when measured in GFSK Mode for 2.4GHz Blutooth band than any other configuration.SAR was evaluated in GFSK mode using power level setting specified by the manufacture to be the max output power and produce the most conservative SAR. The highest measured maximum output power was measured on Ch 2 in GFSK mode.
4	Each SAR evaluation was performed with a fully charged battery.

13.2 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
The DUT was 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 surface.
HEAD Configuration
This device is not intended to be held to the ear and was not tested in the HEAD configuration.
Limb Worn Configuration
The DUT was positioned with the back side directly againts the phantom surface with the strap opened to allow direct contact or 0mm of the DUT and watch band to the phantom surface.

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13.3 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 ±2.0°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. 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.

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13.4 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 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 ≤ 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.

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 ± 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	

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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 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	

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 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	

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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

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Table 14.1 Calculation of Degrees of Freedom

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

15.0 FLUID DIELECTRIC PARAMETERS

Table 15.0 Fluid Dielectric Parameters 2450MHz BODY TSL

****
Aprel Laboratory
Test Result for UIM Dielectric Parameter
Tue 05/Mar/2019 09:12:25
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
2.3500	52.83	1.85	54.66	1.91
2.3600	52.82	1.86	54.63	1.91
2.3700	52.81	1.87	54.46	1.91
2.3800	52.79	1.88	54.54	1.92
2.3900	52.78	1.89	54.32	1.94
2.4000	52.77	1.90	54.59	1.95
2.4100	52.75	1.91	54.41	1.98
2.4200	52.74	1.92	54.69	2.01
2.4300	52.73	1.93	54.15	2.06
2.4400	52.71	1.94	54.38	2.03
2.4500	52.70	1.95	54.64	2.06
2.4600	52.69	1.96	54.61	2.07
2.4700	52.67	1.98	54.46	2.05
2.4800	52.66	1.99	54.54	2.06
2.4900	52.65	2.01	54.14	2.08
2.5000	52.64	2.02	54.08	2.11
2.5100	52.62	2.04	54.13	2.12
2.5200	52.61	2.05	54.11	2.16
2.5300	52.60	2.06	54.17	2.17
2.5400	52.59	2.08	54.07	2.18
2.5500	52.57	2.09	54.32	2.20

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FLUID DIELECTRIC PARAMETERS

Date:	5 Mar 2019	Fluid Temp:	22.1	Frequency:	2450MHz	Tissue:	Body

Freq (MHz)		Test_e	Test_s	Target_e	Target_s	Deviation Permittivity	Deviation Conductivity
2350.0000		54.6600	1.9100	52.8300	1.85	3.46%	3.24%
2360.0000		54.6300	1.9100	52.8200	1.86	3.43%	2.69%
2370.0000		54.4600	1.9100	52.8100	1.87	3.12%	2.14%
2380.0000		54.5400	1.9200	52.7900	1.88	3.32%	2.13%
2390.0000		54.3200	1.9400	52.7800	1.89	2.92%	2.65%
2400.0000		54.5900	1.9500	52.7700	1.90	3.45%	2.63%
2402.0000	*	54.5540	1.9560	52.7660	1.90	3.39%	2.84%
2410.0000		54.4100	1.9800	52.7500	1.91	3.15%	3.66%
2412.0000	*	54.4660	1.9860	52.7480	1.91	3.26%	3.87%
2420.0000		54.6900	2.0100	52.7400	1.92	3.70%	4.69%
2430.0000		54.1500	2.0600	52.7300	1.93	2.69%	6.74%
2437.0000	*	54.3110	2.0390	52.7160	1.94	3.03%	5.27%
2440.0000		54.3800	2.0300	52.7100	1.94	3.17%	4.64%
2450.0000		54.6400	2.0600	52.7000	1.95	3.68%	5.64%
2460.0000		54.6100	2.0700	52.6900	1.96	3.64%	5.61%
2462.0000	*	54.5800	2.0660	52.6860	1.96	3.59%	5.19%
2470.0000		54.4600	2.0500	52.6700	1.98	3.40%	3.54%
2472.0000		54.4760	2.0520	52.6680	1.98	3.43%	3.53%
2480.0000		54.5400	2.0600	52.6600	1.99	3.57%	3.52%
2490.0000		54.1400	2.0800	52.6500	2.01	2.83%	3.48%
2500.0000		54.0800	2.1100	52.6400	2.02	2.74%	4.46%
2510.0000		54.1300	2.1200	52.6200	2.04	2.87%	3.92%
2520.0000		54.1100	2.1600	52.6100	2.05	2.85%	5.37%
2530.0000		54.1700	2.1700	52.6000	2.06	2.98%	5.34%
2540.0000		54.0700	2.1800	52.5900	2.08	2.81%	4.81%
2550.0000		54.3200	2.2000	52.5700	2.09	3.33%	5.26%

*Channel Frequency Tested

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16.0 SYSTEM VERIFICATION TEST RESULTS

Table 16.0 System Verification Results 2450MHz BODY TSL

System Verification Test Results					
Date		Frequency (MHz)	Validation Source		
			P/N		S/N
05 Mar 2019		2450	D2450V2		825
Fluid Type	Fluid Temp °C	Ambient Temp °C	Ambient Humidity (%)	Forward Power (mW)	Source Spacing (mm)
Body	22.1	23	25%	250	10
Fluid Parameters					
Permittivity			Conductivity		
Measured	Target	Deviation	Measured	Target	Deviation
54.64	52.70	3.68%	2.06	1.95	5.64%
Measured SAR					
1 gram			10 gram		
Measured	Target	Deviation	Measured	Target	Deviation
12.80	12.80	0.00%	5.90	6.05	-2.48%
Measured SAR Normalized to 1.0W					
1 gram			10 gram		
Normalized	Target	Deviation	Normalized	Target	Deviation
51.20	50.40	1.59%	23.60	23.70	-0.42%

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.

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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		
							Permitivity	Conductivity	Sensitivity	Linearity	Isotropy
30	24-Sep-18	EX3DV4	3600	CLA-30	1005	Head	50.15	0.72	Pass	Pass	Pass
150	27-Jun-18	EX3DV4	3600	CLA-150	4007	Body	66.48	0.79	Pass	Pass	Pass
150	11-Jul-18	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-May-18	EX3DV4	3600	D2450V2	825	Body	49.51	1.92	Pass	Pass	Pass
2450	24-May-18	EX3DV4	3600	D2450V2	825	Head	37.95	1.87	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
5750	25-Jul-18	EX3DV4	3600	D5GHzV2	1031	Body	47.10	5.60	Pass	Pass	Pass

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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	SAM Phantom
Shell Material	Fiberglass
Thickness	2mm +/- .2mm
Volume	> 30 Liter

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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 SAM 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.

SAM 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

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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	25-Apr-18	25-Apr-19
-EX3DV4 E-Field Probe	00213	3600	25-Apr-18	25-Apr-19
-CLA 30 Validation Dipole	00300	1005	23-Nov-17	23-Nov-20
-CLA150 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
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 anual calibration cycle.
When applicable, reference Appendix F

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20.0 FLUID COMPOSITION

Table 20.0 Fluid Composition 2450MHz BODY TSL

Tissue Simulating Liquid (TSL) Composition				
Component by Percent Weight				
Water	Glycol	Salt(1)	HEC(2)	Bacteriacide(3)
69.98	30.0	0.02	0.0	0.0

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

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APPENDIX A – SYSTEM VERIFICATION PLOTS

Date/Time: 3/5/2019 9:58:36 AM

Test Laboratory: Celltech Labs

SPC-2450B Mar 05 2019

DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:825

Communication System: UID 0, CW (0); Communication System Band: FullSpan (0.0 - 6000.0 MHz); Frequency: 2450 MHz;Communication System PAR: 0 dB; PMF: 1

Medium: TSL_2450B[05MR19]
Medium parameters used: f = 2450 MHz; σ = 2.06 S/m; ε_r = 54.64; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

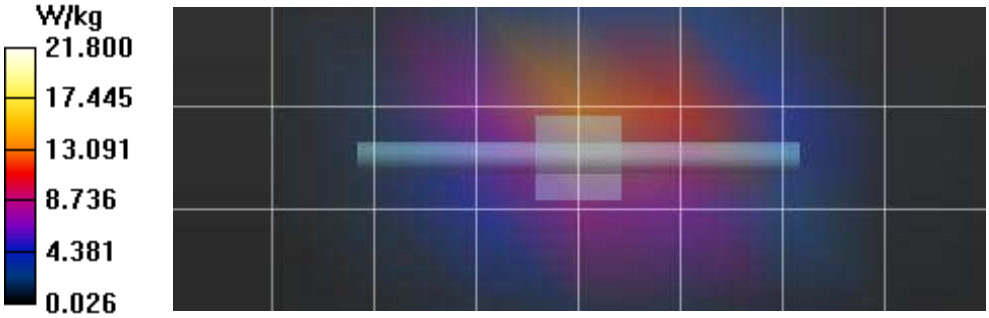
- Probe: EX3DV4 - SN3600; ConvF(6.54, 6.54, 6.54); Calibrated: 4/25/2018, ConvF(6.54, 6.54, 6.54); Calibrated: 4/25/2018, ConvF(6.54, 6.54, 6.54); Calibrated: 4/25/2018;
  - Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection), z = -1.5, 31.0, 151.0
- Electronics: DAE4 Sn353; Calibrated: 4/20/2018
- Phantom: Twin-SAM V4.0 (30deg probe tilt); Type: QD 000 P40 CC;
- DASY52 52.10.1(1476);

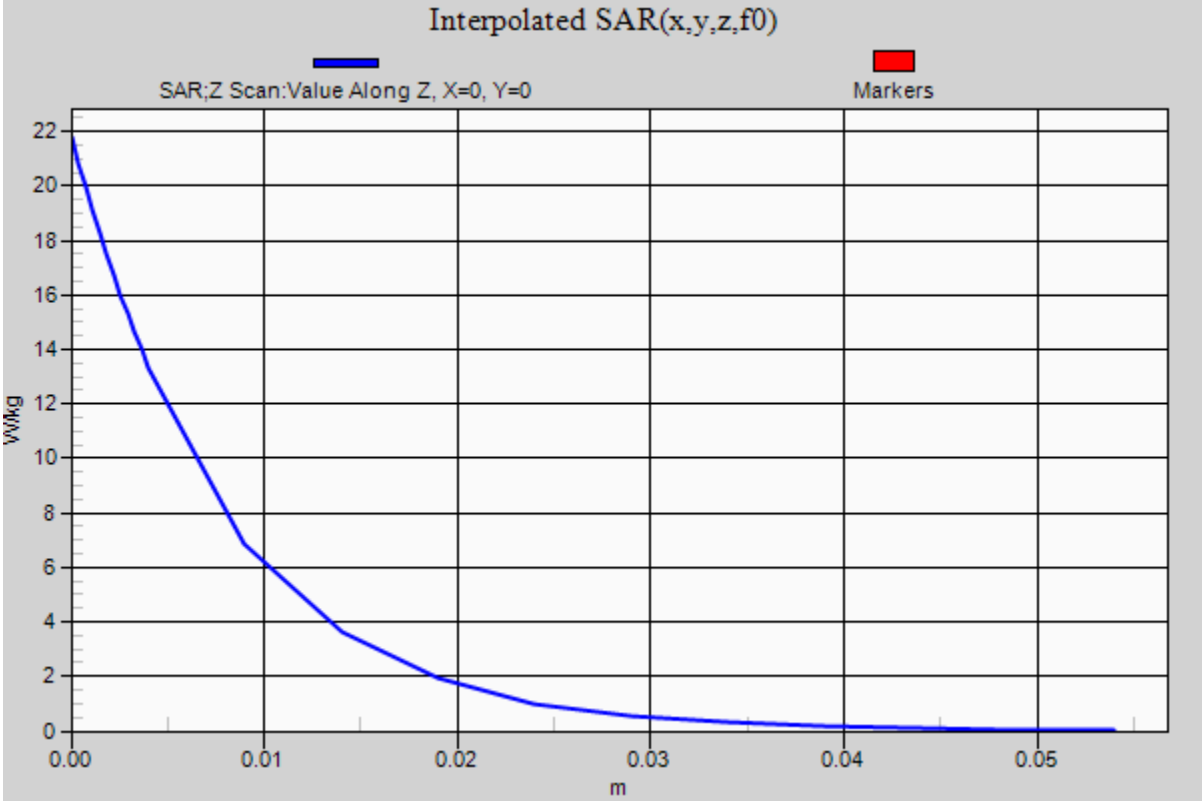
Frequency: 2450 MHz

SPC/SPC 2450B Input=250mw, Target=12.8W/kg/Area Scan (4x9x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 13.1 W/kg

SPC/SPC 2450B Input=250mw, Target=12.8W/kg/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 80.38 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 26.2 W/kg
SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.9 W/kg
Maximum value of SAR (measured) = 14.6 W/kg

SPC/SPC 2450B Input=250mw, Target=12.8W/kg/Z Scan (1x1x22): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Penetration depth = 7.770 (7.518, 7.910) [mm]
Maximum value of SAR (interpolated) = 21.8 W/kg




Interpolated SAR(x,y,z,f0)
SAR;Z Scan:Value Along Z, X=0, Y=0
Markers
W/kg
22
20
18
16
14
12
10
8
6
4
2
0
0.00
0.01
0.02
0.03
0.04
0.05
m

APPENDIX B – MEASUREMENT PLOTS OF MAXIMUMUM MEASURED SAR

Plot B3

Date/Time: 3/6/2019 12:20:57 PM

Test Laboratory: Celltech Labs

Garmin-2450B Mar 06 2019

DUT: A03618; Type: Sports Watch;

Communication System: UID 10077 - CAB, IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps); Communication System Band: WLAN 2.4GHz (2412.0 - 2484.0 MHz); Frequency: 2412 MHz;Communication System PAR: 11 dB; PMF: 1.62742

Medium: TSL_2450B[05MR19]
Medium parameters used (interpolated): f = 2412 MHz; σ = 1.986 S/m; ε_r = 54.466; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: EX3DV4 - SN3600; ConvF(6.54, 6.54, 6.54); Calibrated: 4/25/2018, ConvF(6.54, 6.54, 6.54); Calibrated: 4/25/2018, ConvF(6.54, 6.54, 6.54); Calibrated: 4/25/2018;
  - Modulation Compensation: PMR for UID 10077 - CAB, Calibrated: 4/25/2018
- 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: 4/20/2018
- Phantom: Twin-SAM V4.0 (30deg probe tilt); Type: QD 000 P40 CC;
- DASY52 52.10.1(1476);

Frequency: 2412 MHz

2450B/B3 A03618, Body-Front, 2412 MHz, Silicone Band-WIFI/Area Scan (8x7x1): Measurement grid: dx=12mm, dy=12mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.15 W/kg

2450B/B3 A03618, Body-Front, 2412 MHz, Silicone Band-WIFI/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 19.90 V/m; Power Drift = 1.24 dB
Peak SAR (extrapolated) = 2.25 W/kg
SAR(1 g) = 0.988 W/kg; SAR(10 g) = 0.394 W/kg

Info: Interpolated medium parameters used for SAR evaluation.

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

2450B/B3 A03618, Body-Front, 2412 MHz, Silicone Band-WIFI/Z Scan (1x1x19): Measurement grid: dx=20mm, dy=20mm, dz=20mm

Info: Interpolated medium parameters used for SAR evaluation.
Penetration depth = n/a (n/a, 9.373) [mm]
Maximum value of SAR (interpolated) = 1.09 W/kg

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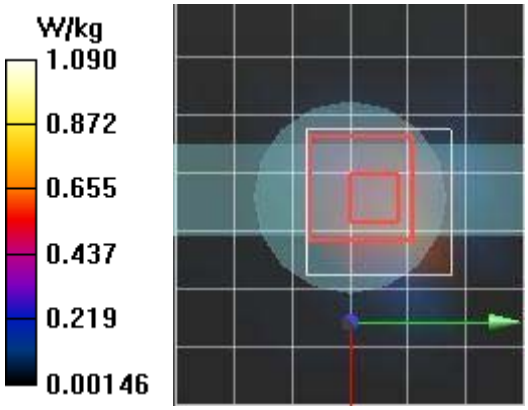

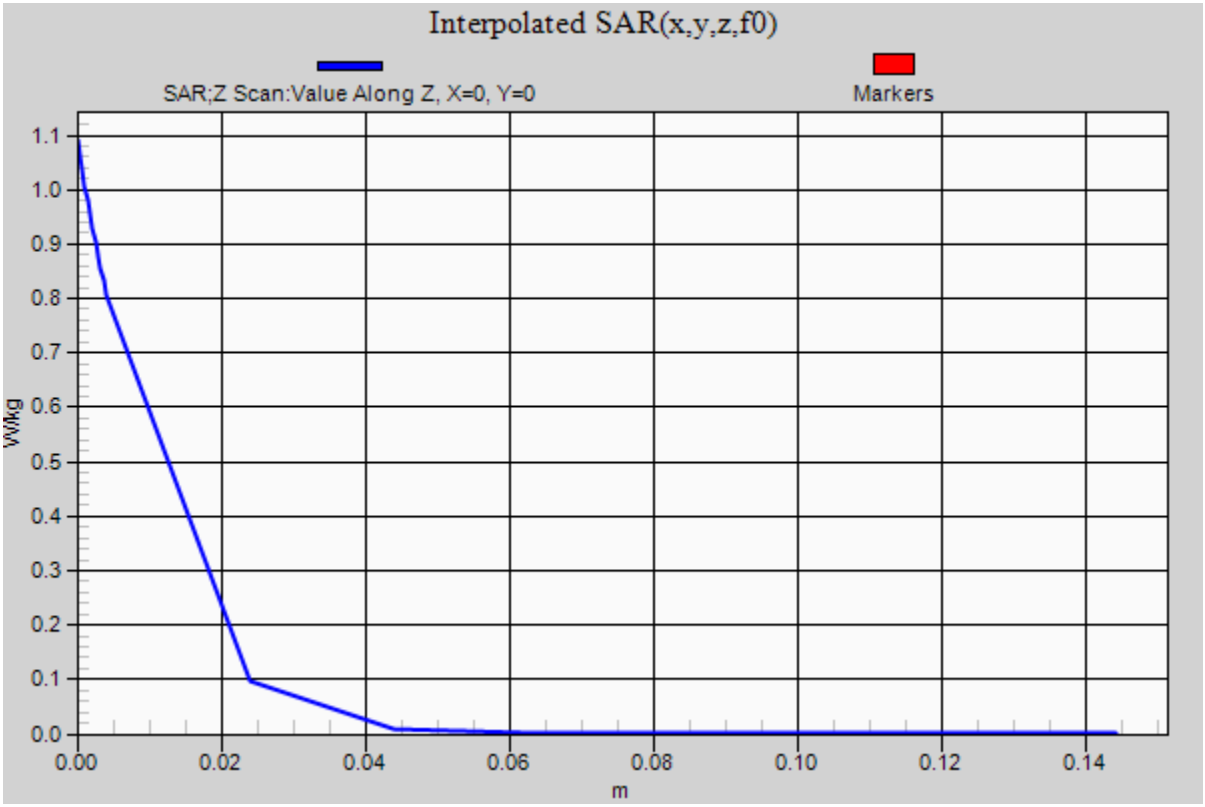

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Plot B5

Date/Time: 3/6/2019 11:27:54 AM

Test Laboratory: Celltech Labs

Garmin-2450B Mar 06 2019

DUT: A03618; Type: Sports Watch

Communication System: UID 10030 - CAA, IEEE 802.15.1 Bluetooth (GFSK, DH1); Communication System Band: ISM 2.4 GHz Band (2400.0 - 2483.5 MHz); Frequency: 2402 MHz;Communication System PAR: 5.3 dB; PMF: 1.83865

Medium: TSL_2450B[05MR19]
Medium parameters used (interpolated): f = 2402 MHz; σ = 1.956 S/m; ε_r = 54.554; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: EX3DV4 - SN3600; ConvF(6.54, 6.54, 6.54); Calibrated: 4/25/2018, ConvF(6.54, 6.54, 6.54); Calibrated: 4/25/2018, ConvF(6.54, 6.54, 6.54); Calibrated: 4/25/2018;
  - Modulation Compensation: PMR for UID 10030 - CAA, Calibrated: 4/25/2018
- 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: 4/20/2018
- Phantom: Twin-SAM V4.0 (30deg probe tilt); Type: QD 000 P40 CC;
- DASY52 52.10.1(1476);

Frequency: 2402 MHz

2450B/B5 A03618, Body-Front, 2402 MHz, Silcone Band-BT/Area Scan (8x7x1): Measurement grid: dx=12mm, dy=12mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.03 W/kg

2450B/B5 A03618, Body-Front, 2402 MHz, Silcone Band-BT/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.61 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 2.05 W/kg
SAR(1 g) = 0.983 W/kg; SAR(10 g) = 0.463 W/kg

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 1.10 W/kg

2450B/B5 A03558, Body-Front, 2402 MHz, Silcone Band-BT/Z Scan (1x1x19): Measurement grid: dx=20mm, dy=20mm, dz=20mm

Info: Interpolated medium parameters used for SAR evaluation.
Penetration depth = n/a (n/a, 9.595) [mm]
Maximum value of SAR (interpolated) = 1.47 W/kg

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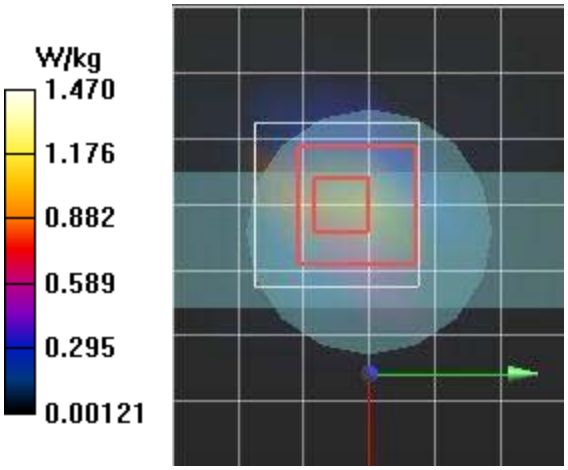

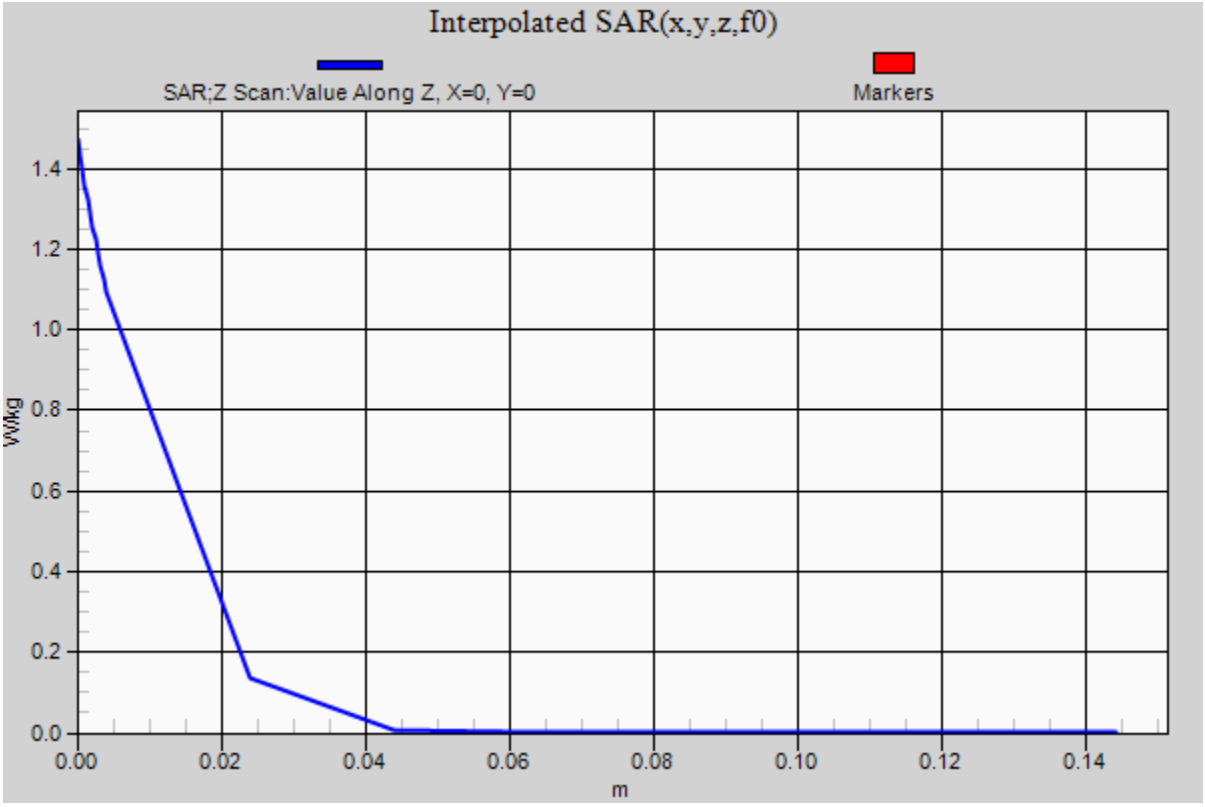

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