Test Report Serial Number:	45461584 R1.0
Test Report Date:	25 March 2020
Project Number:	1494

SAR Test Report - New Certification

Applicant:

GARMIN

Maximum Reported 10g SAR			
FCC	Extremity DTS	1.93	W/kg
ISED	Extremity DTS	2.19	
General Pop. Limit:		4.00	

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

FCC ID: **IPH-03989**

Product Model Number / HVIN: **A03989**

ISED Registration Number: **1792A-03989**

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

Test Lab Certificate: 2470.01

IC Registration 3874A-1

FCC Registration: CA3874

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1.0 DOCUMENT CONTROL

Revision History					
Samples Tested By:	Trevor Whillock		**Date(s) of Evaluation:**	11 March - 12 March 2020	
Report Prepared By:	Trevor Whillock		**Report Reviewed By:**	Trevor Whillock	
Report Revision	**Description of Revision**		**Revised Section**	**Revised By**	**Revision Date**
0.0	Draft Release		n/a	Trevor Whillock	24 March 2020
1.0	Initial Release		n/a	Trevor Whillock	25 March 2020

2.0 CLIENT AND DEVICE INFORMATION

Client Information	
Applicant Name	**Garmin International Inc.**
Applicant Address	1200 East 151st St.
	Olathe, KS, 66062
	USA
DUT Information	
Device Identifier(s):	**FCC ID:** **IPH-03989**
	IC ID: **1792A-03989**
Device Model(s) / HVIN:	A03989
Type of Equipment:	Digital Transmission System (DTS)
	Low Power Communication Device Transmitter (DXX)
	NFC Transmitter (13.56MHz)

DUT Information (Cont.)	
Transmit Frequency Range:	DTS (WiFi): 2412-2462MHz
	DSS (BT): 2402-2480MHz
	DXX (BLE): 2402-2480
	DXX (ANT): 2402-2480
Number of Channels:	Programmable
- Antenna Port Conducted	DTS (WiFi): 2412-2462 MHz: 17.84 dBm
- Detector: Average (RMS)	DSS (BT): 2402-2480 MHz: 14.11 dBm
	DXX (BLE): 2402-2480 MHz: 4dBm
	DXX (ANT): 2402-2480 MHz: 1.62 dBm
Antenna Type / Gain	PCB Inverted "F": 0.6 dBi
Duty Cycle:	DTS (WiFi) Setting (0): 100%, DTS (BT): 17%
DUT Power Source:	5VDC USB, Internal Li-Ion
DUT Dimensions: (L x W x H)	45 mm x 45 mm x 14 mm
Deviation(s) from standard/procedure:	None
Modification of DUT:	None

3.0 SCOPE OF EVALUATION

This Certification Report was prepared on behalf of:

Garmin International Inc.

,(the '*Applicant*"), in accordance with the applicable Federal Communications Commission (FCC) CFR 47 and Innovation, Scientific and Economic Development (ISED) Canada rules parts and regulations (the '*Rules*'). The scope of this investigation was limited to only the equipment, devices and accessories (the '*Equipment*') supplied by the *Applicant*. The tests and measurements performed on this *Equipment* were only those set forth in the applicable *Rules* and/or the Test and Measurement Standards they reference. The *Rules* applied and the Test and Measurement Standards used during this evaluation appear in the Normative References section of this report. The limits set forth in the technical requirements of the applicable *Rules* were applied to the measurement results obtained during this evaluation and, unless otherwise noted, these limits were used as the Pass/Fail criteria. The Pass/Fail statements made in this report apply to only the tests and measurements performed on only the *Equipment* tested during this evaluation. Where applicable and permissible, information including test and measurement data and/or results from previous evaluations of same or similar equipment, devices and/or accessories may be cited in this report.

As per FCC 47 CFR Part §2.1091 and §2.1093, an RF Exposure evaluation report is required for this *Equipment* and the results of the RF Exposure evaluation appear in this report.

The A03989, FCC ID: IPH-A03989 ISED ID: 1792A-A03989, is a wrist-worn transmitter that is capable of operating in the 2.4GHz WiFi and Bluetooth frequency bands and has an additional NFC feature that operates at a fixed transmit frequency of 13.56MHz. The device is not capable of simultaneous transmission between transmitters. The device is equipped with a transducer element for receiving data signals. 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.

Application:
This is an application for a new device certification.

Scope:

Due to the nature of the device, the scope of this evaluation is to evaluate the SAR for intended use applications. It will include evaluation of the 2.4 GHz transmitter for all required RF exposure configurations and accessories types. The analysis of the Standalone Transmission SAR is found in Section 11.0 of this report.

The Test Plan developed for this evaluation is based on the required test channels and configurations which produced the highest worst case SAR and where applicable, SAR test reduction and/or SAR test exclusion may be utilized. The DUT was evaluated for SAR at the maximum tune up tolerance and 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, and RSS 102.

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.	

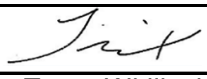
5.0 STATEMENT OF COMPLIANCE

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.	A03989	
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 11th-12th, 2020

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

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



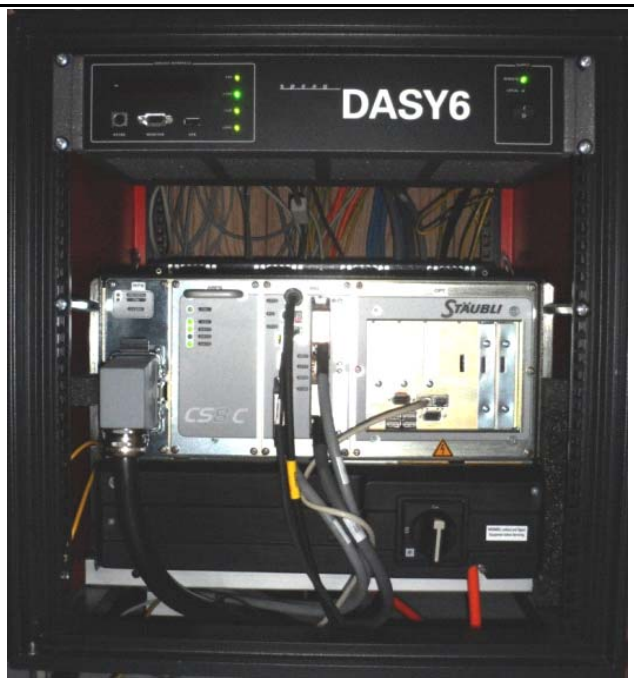
Trevor Whillock
Test Lab Engineer
Celltech Labs Inc.
25 March 2019
Date

6.0 SAR MEASUREMENT SYSTEM

SAR Measurement System

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

DASY 6 SAR System with SAM Phantom



DASY 6 Measurement Controller

7.0 RF CONDUCTED POWER MEASUREMENT

Table 7.0 Conducted Power Measurements

A03989 Conducted Power Measurements - Average									
Channel	Frequency (MHz)	Measured Power (dBm)	Max Rated Power (dBm)	Rated Power (W)	Delta (dB)	SAR Test Channel (Y/N)	Mode	Modulation	Bandwidth (MHz)
1	2412	15.64	17.84	0.061	-2.20	-	802.11b	DSSS-5.5Mbps	20
2	2417	17.82	17.84	0.061	-0.02	Y		DSSS-5.5Mbps	
3	2422	17.66	17.84	0.061	-0.18	-		DSSS-5.5Mbps	
4	2427	17.64	17.84	0.061	-0.20	-		DSSS-5.5Mbps	
5	2432	17.77	17.84	0.061	-0.07	-		DSSS-5.5Mbps	
6	2437	17.84	17.84	0.061	0.00	Y		DSSS-5.5Mbps	
7	2442	17.80	17.84	0.061	-0.04	-		DSSS-5.5Mbps	
8	2447	17.78	17.84	0.061	-0.06	-		DSSS-5.5Mbps	
9	2452	17.76	17.84	0.061	-0.08	-		DSSS-5.5Mbps	
10	2457	17.83	17.84	0.061	-0.01	Y		DSSS-5.5Mbps	
11	2462	15.44	17.84	0.061	-2.40	-		DSSS-5.5Mbps	
12	2467	17.71	17.84	0.061	-0.13	-		DSSS-5.5Mbps	
13	2472	17.68	17.84	0.061	-0.16	-		DSSS-5.5Mbps	
2	2417	17.43	17.84	0.061	-0.41	-		CCK-1Mbps	
		17.40	17.84	0.061	-0.44	-		CCK-2Mbps	
		17.60	17.84	0.061	-0.24	-		DSSS-11Mbps	
		16.27	16.40	0.044	-0.13	-	802.11g	OFDM-6Mbps	
		15.15	16.40	0.044	-1.25	-		OFDM-54Mbps	
		15.92	16.11	0.041	-0.19	-	802.11n	MCS-0	
		15.10	16.11	0.041	-1.01	-		MCS-7	
6	2442	17.56	17.84	0.061	-0.28	-	802.11b	CCK-1Mbps	
		17.58	17.84	0.061	-0.26	-		CCK-2Mbps	
		17.66	17.84	0.061	-0.18	-		DSSS-11Mbps	
		16.40	16.40	0.044	0.00	-	802.11g	OFDM-6Mbps	
		15.92	16.40	0.044	-0.48	-		OFDM-54Mbps	
		16.11	16.11	0.041	0.00	-	802.11n	MCS-0	
		16.03	16.11	0.041	-0.08	-		MCS-7	
10	2462	17.49	17.84	0.061	-0.35	-	802.11b	CCK-1Mbps	
		17.60	17.84	0.061	-0.24	-		CCK-2Mbps	
		17.62	17.84	0.061	-0.22	-		DSSS-11Mbps	
		16.30	16.40	0.044	-0.10	-	802.11g	OFDM-6Mbps	
		15.29	16.40	0.044	-1.11	-		OFDM-54Mbps	
		16.01	16.11	0.041	-0.10	-	802.11n	MCS-0	
		14.94	16.11	0.041	-1.17	-		MCS-7	

Table 7.1 Conducted Power Measurements

A03989 Conducted Power Measurements - Average								
Channel	**Frequency** *(MHz)*	**Measured Power** *(dBm)*	**Max Rated Power** *(dBm)*	**Rated Power** *(W)*	**Delta** *(dB)*	**SAR Test Channel** *(Y/N)*	**Mode**	**Modulation**
2	2402	14.11	14.11	0.026	0.00	**Y**	BT	GFSK
41	2441	13.60	14.11	0.026	-0.51			
80	2480	13.39	14.11	0.026	-0.72			
2	2402	8.71	8.71	0.007	0.00			Pi/4-DQPSK
2	2402	-0.92	-0.92	0.001	0.00		BLE	GMSK
2	2402	-0.63	-0.63	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.

8.0 NUMBER OF TEST CHANNELS (N_C)

WiFi SAR Evaluation:

SAR was evaluated in DSSS mode with a sample rate of 5.5Mbps at a 100% duty cycle (setting 0). 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 Ch 1, Ch 6 and Ch 11, however the highest conducted power was found on Ch 2, Ch 6, and Ch 10. Based on evaluated SAR levels of the highest Middle band frequency or highest output channels; SAR test reduction methodology was applied;

When applicable, SAR test reduction methods may be utilized.

802.11b DSSS SAR test reduction is determined according to the following:

a) When the *reported* SAR of the highest measured maximum output power channel is ≤ to 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.

b) When the *reported* SAR is > 0.8 W/kg, SAR is required for that exposure configuration using the next highest output power channel. When any *reported* SAR is > 1.2 W/Kg, SAR is required for the third channel.

Therefore; Ch 2 and Ch 10 were not required for evaluation in any exposure configuration.

2.4 GHz 802.11g/n OFDM SAR Test Exclusion Requirements

a) When KDB Publication 447498 SAR test exclusion applies to the OFDM configuration.

b) When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

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.

See 13.1 for details.

BT/BLE/ANT SAR Test Evaluation:

Bluetooth was evaluated for SAR at a transmit duty cycle of 17% in the worst-case configuration from the WiFi test evaluation.
The duty cycle cannot be altered in test mode or by the user.

General SAR Test Reduction Considerations:

As per KDB 447498D01 4.4.1,

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.
Due to the nature of this device, WiFi and Bluetooth were evaluated for standalone SAR only.

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

10.0 SAR MEASUREMENT SUMMARY

Table 10.0: Measured Results

Measured SAR Results (10g) - Extremity (FCC/ISED)																
Date	Plot ID #	Test Type	DUT Model	DUT Type	Test Freq.	Modulation	Accessories				DUT Spacing		Meas. Cond. Power	Measured SAR	SAR Drift
							Antenna P/N	Battery Type	Accessory P/N	Audio P/N	DUT	Antenna		10g	
					(MHz)						(mm)	(mm)	(dBm)	(W/kg)	(dB)
Extremity SAR WiFi & BT 2.4 GHz															
11 Mar 2020	B1	Extremity-Back Side	A03989	Wrist-worn Transmitter	2437	DSS-5.5Mbps	n/a	Li-Ion	010-12932-21	n/a	0	0	17.84	0.591	-0.870
11 Mar 2020	B2	Extremity-Front Side	A03989	Wrist-worn Transmitter	2437	DSS-5.5Mbps	n/a	Li-Ion	010-12932-21	n/a	0	0	17.84	1.790	-0.700
11 Mar 2020	B3	Extremity-Front Side	A03989	Wrist-worn Transmitter	2417	DSS-5.5Mbps	n/a	Li-Ion	010-12932-21	n/a	0	0	17.84	0.566	-0.800
12 Mar 2020	B4	Extremity-Front Side	A03989	Wrist-worn Transmitter	2457	DSS-5.5Mbps	n/a	Li-Ion	010-12932-21	n/a	0	0	17.84	1.750	-0.400
12 Mar 2020	B5	Extremity-Front Side	A03989	Wrist-worn Transmitter	2402	BT-GFSK	n/a	Li-Ion	010-12932-21	n/a	0	0	12.77	0.085	0.140
12 Mar 2020	B6	Extremity-Front Side	A03989	Wrist-worn Transmitter	2437	DSS-5.5Mbps	n/a	Li-Ion	010-12496-06	n/a	0	0	17.84	1.880	-0.520
12 Mar 2020	B7	Extremity-Front Side	A03989	Wrist-worn Transmitter	2437	DSS-5.5Mbps	n/a	Li-Ion	010-12863-08	n/a	0	0	17.84	1.880	-0.560
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

*Per KDB 248227 D01 5.2.1(a);
Testing of other required test channels is not required when the reported 1-g or 10g SAR for the mid-band or highest output power channel is ≤ 0.8 W/kg or 2.0 W/kg,for 1-g or 10-g respectively.

**Per KDB 447498D01 4.4.1(c)
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:
≤ 0.4W/kg or 1.0W/kg, for 1-g or 10-g respectively, when the transmission band is ≥200Mh

11.0 SCALING OF MAXIMUM MEASURED SAR

Table 11.0 SAR Scaling

Scaling of Maximum Measured SAR (10g)					
Measured Parameters		Configuration			
		Extremity			
Plot ID		B7			
Maximum Measured SAR_M		1.8800			(W/kg)
Frequency		2437			(MHz)
Power Drift		-0.560			(dB)
Conducted Power		17.840			(dBm)
Fluid Deviation from Target					
Δe	Permitivity	-4.95			(%)
Δσ	Conductivity	6.55			(%)

Note(1): Power Drift is Positive, Drift Adjustment not Required.

Fluid Sensitivity Calculation (10g)		IEC 62209-2 Annex F			
Delta SAR = Ce * Δe + Cσ * Δσ					(F.1)
$Ce = (-0.0007854*f^3) + (0.009402*f^2) - (0.02742*f) - 0.2026$					(F.2)
$Cσ = (0.009804*f^3) - (0.08661*f^2) + (0.02981*f) + 0.7829$					(F.3)
f	Frequency (GHz)	2.437			
Ce		-0.159			
Cσ		0.262			
Ce * Δe		-4.950			
Cσ * Δσ		6.550			
ΔSAR		2.4998			(%)

Manufacturer's Tuneup Tolerance				
Measured Conducted Power	17.840			(dBm)
Rated Conducted Power	17.840			(dBm)
ΔP	0.000 (4)			(dB)

Note(4): SAR was Evaluated at the Maximum Tuneup Tolerance. SAR Adjustment is not Required.

SAR Adjustment for Fluid Sensitivity				
$SAR_1 = SAR_M * ΔSAR$	1.927			(W/kg)

SAR Adjustment for Tuneup Tolerance				
$SAR_2 = SAR_1 + [ΔP]$	1.927			(W/kg)

SAR Adjustment for Drift				
$SAR_3 = SAR_2 + Drift$	2.192			(W/kg)

reported SAR				
$FCC = SAR_2$	**1.93**			(W/kg)
$ISED = SAR_3$	**2.19**			(W/kg)

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

[(1.78)/(5)] X [√2.402] = 0.552 ≤ 7.5

Where:
max. power of channel, including tune-up tolerance, mW = 1.78 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.
Due to the nature of this device, WiFi and Bluetooth were evaluated for standalone SAR only.

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. 25 March 2020 Date

12.0 SAR EXPOSURE LIMITS

Table 12.0 Exposure Limits

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

13.0 DETAILS OF SAR EVALUATION

13.0 Day Log

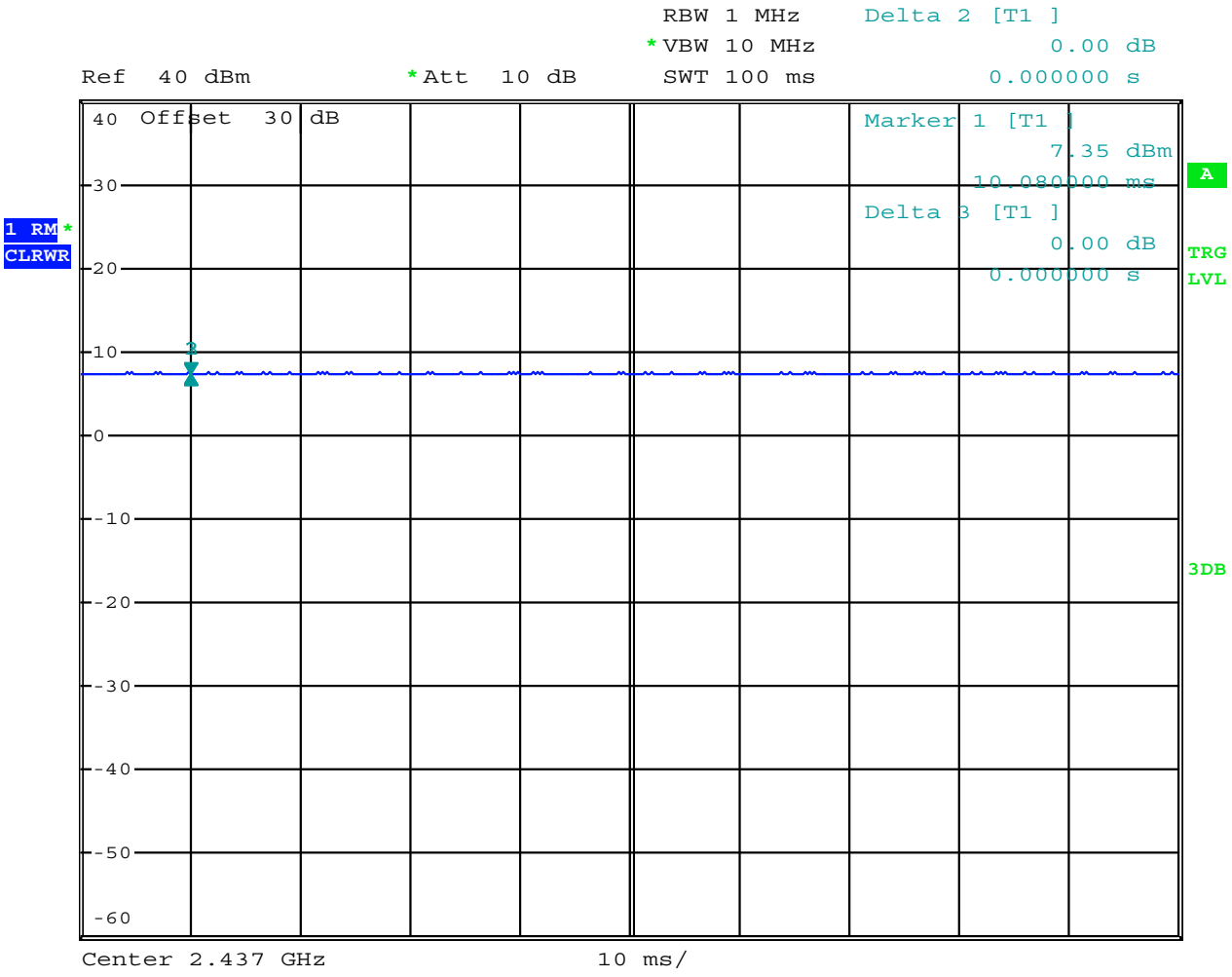
DAY LOG								
Date	Ambient Temp (°C)	Fluid Temp (°C)	Relative Humidity (%)	Barometric Pressure (kPa)	Fluid Dielectric	SPC	Test	Task
11 Mar 2020	22	23.9	25%	101.8	X	X	X	2450H SAR Eval, Fluid Parameters & SPC*
12 Mar 2020	23	23.7	25%	102.7			X	2450H SAR Eval*

*Per IEEE 1528 Test Series was started within 24 hours and completed within 48 hours of Fluid Parameter Measurements

13.1 DUT Setup and Configuration

DUT Setup and Configuration	
1	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.Report Reference number 45461585. The device was evaluated at a separation distance of 0mm between the device and the phantom using HEAD Tissue fluid. The Front side (Screen) of the device was found to be the worst case setup configuration and produced the highest SAR. The DUT was evaluated for SAR in accordance with the procedures described in IEEE 1528, FCC KDB 865646, 248277 and RSS-102.
2	2.4GHz 802.11g/n OFDM SAR Test Exclusion As Per KDB 248277 D01v02r02 - 5.2.2, b) When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg. 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. Maximum 802.11g/n OFDM specified power(POFDM)= 16.40 dBm Maximum 802.11b DSSS specified power (PDSSS)= 17.84 dBm Ratio OFDM/DSSS power = -1.44 dBm (0.72%) Highest reported* SAR (SARMAX)= 1.927 W/kg POFDM/PDSSS X SARMAX = 1.39 W/kg ≤ 3.0 W/kg Since the ratio of the ODFM/DSSS specified power is less than one (0dB), the reported SAR would not exceed 3.0W/kg *The reported SAR in this case is the measured SAR adjusted for fluid sensitivity.
3	The Device was capable of transmitting at various modulations, data rates and duty cycles. The Conducted Power was highest when measured in DSSS Mode-5.5 Mbps at 100% Duty cycle(setting 0) than any other configuration in the 2.4GHz Band. The DUT was evaluated for SAR at the maximum conducted output power level, preset by the manufacturer.
4	Bluetooth was evaluated for SAR in GFSK mode with a transmit duty cycle of 17% in the worst-case configuration from the WiFi test evaluation.The Duty cycle could not be altered in test mode or by the user. The DUT was evaluated for SAR at the maximum conducted output power level, preset by the manufacturer.
5	Each SAR evaluation was performed with a fully charged battery.

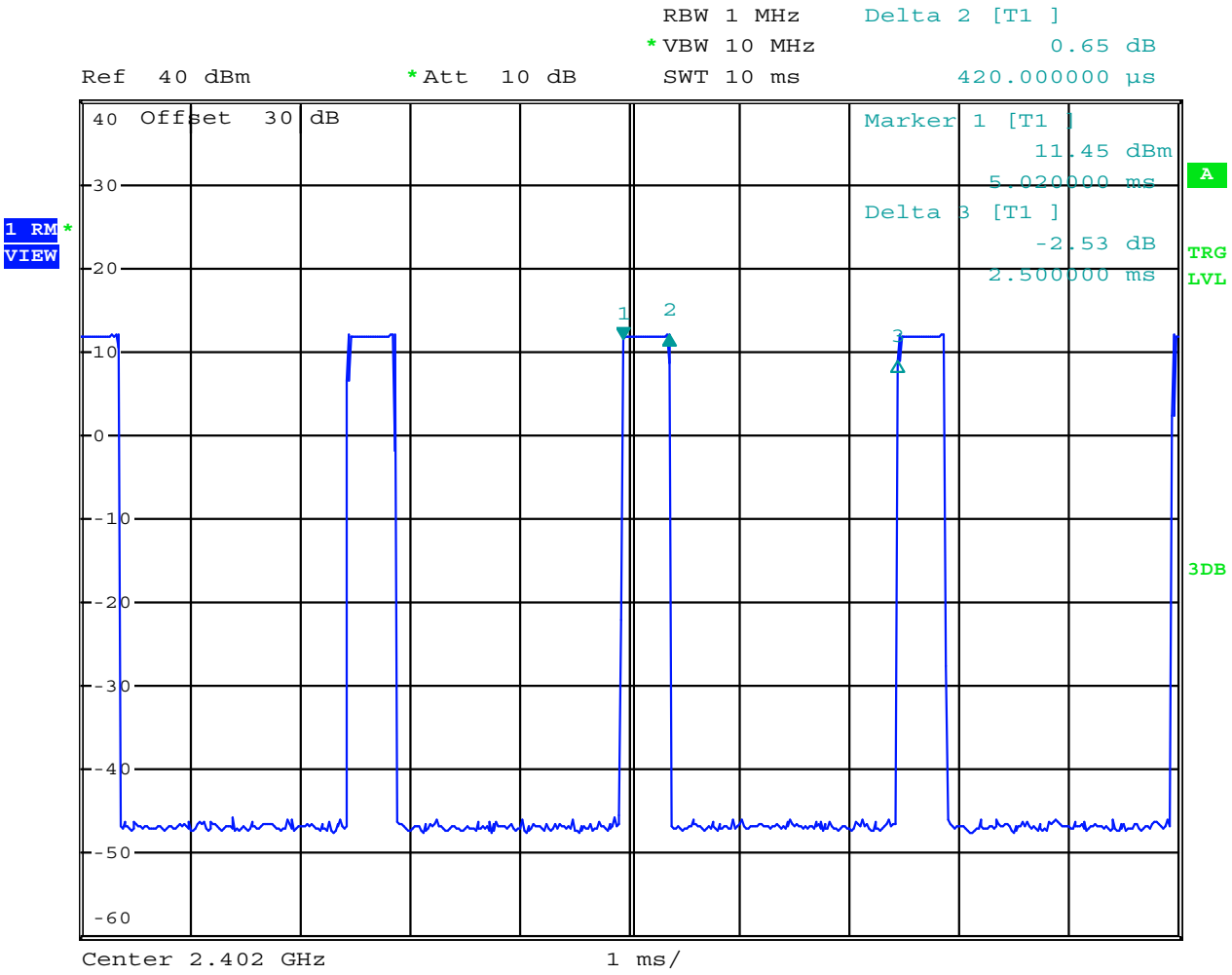
13.2 Duty Cycle Evaluation



Date: 1.MAR.2020 12:45:04

DSSS at 5.5 Mbps was found to be the worst-case test mode for 2.4GHZ WIFi. The transmit Duty cycle was 100% (setting 0) as indicated in the above plot. This duty cycle cannot be altered by the user. A measurement Crest factor of 1.92 was used by the SAR measurement server. The measured SAR in Table 10.0 is the post-processed SAR adjusted by the Crest Factor.

13.3 Duty Cycle Evaluation



Date: 1.MAR.2020 12:42:15

BT- GFSK mode was found to be the worst-case test mode for Bluetooth. The transmit Duty cycle was 17% as indicated in the above plot. This duty cycle cannot be altered by the user. A measurement Crest factor of 3.39 was used by the SAR measurement server. The measured SAR in Table 10.0 is the post-processed SAR adjusted by the Crest Factor.

13.4 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 against the phantom surface with the strap opened to allow direct contact or 0mm of the DUT and watch band to the phantom surface.

13.5 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.

13.6 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.

13.7 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	

13.8 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	

13.9 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	

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 w rt 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 Pow er 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	**1.9**	N	1	1	0.84	1.9	1.6	∞
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} =**	**1161**
Combined Standard Uncertainty			**RSS**				**11.1**	**11.0**	
Expanded Uncertainty (95% Confidence Interval)			**k=2**				**22.3**	**22.0**	
Measurement Uncertainty Table in accordance with IEEE Standard 1528-2013									

(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 Pow er Scaling not Required

* Provided by SPEAG for DASY

** Standard Uncertainty Calibration Data Provided by SPEAG for EX3DEV4 Probe

Table 14.1 Calculation of Degrees of Freedom

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

15.0 FLUID DIELECTRIC PARAMETERS

Table 15.0 Fluid Dielectric Parameters 2450MHz HEAD TSL

****
Aprel Laboratory
Test Result for UIM Dielectric Parameter
Wed 11/Mar/2020 10:26:07
Freq Frequency(GHz)
FCC_eH FCC OET 65 Supplement C (June 2001) Limits for Head Epsilon
FCC_sH FCC OET 65 Supplement C (June 2001) Limits for Head Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM
****

Freq	FCC_eH	FCC_sH	Test_e	Test_s
2.3500	39.38	1.71	37.64	1.82
2.3600	39.36	1.72	37.75	1.82
2.3700	39.34	1.73	37.68	1.86
2.3800	39.32	1.74	37.52	1.86
2.3900	39.31	1.75	37.60	1.84
2.4000	39.29	1.76	37.55	1.89
2.4100	39.27	1.76	37.39	1.88
2.4200	39.25	1.77	37.28	1.91
2.4300	39.24	1.78	37.13	1.89
2.4400	39.22	1.79	37.35	1.91
2.4500	39.20	1.80	37.30	1.92
2.4600	39.19	1.81	37.16	1.94
2.4700	39.17	1.82	37.23	1.95
2.4800	39.16	1.83	37.33	1.97
2.4900	39.15	1.84	37.16	1.97
2.5000	39.14	1.85	36.95	1.99
2.5100	39.12	1.87	36.99	2.02
2.5200	39.11	1.88	36.86	2.01
2.5300	39.10	1.89	37.12	2.05
2.5400	39.09	1.90	36.99	2.03
2.5500	39.07	1.91	36.97	2.06

FLUID DIELECTRIC PARAMETERS

Date:	11 Mar 2020	Fluid Temp:	23.9	Frequency:	2450MHz	Tissue:	Head

Freq (MHz)		Test_e	Test_s	Target_e	Target_s	Deviation Permittivity	Deviation Conductivity
2350.0000		37.6400	1.8200	39.3800	1.71	-4.42%	6.43%
2360.0000		37.7500	1.8200	39.3600	1.72	-4.09%	5.81%
2370.0000		37.6800	1.8600	39.3400	1.73	-4.22%	7.51%
2380.0000		37.5200	1.8600	39.3200	1.74	-4.58%	6.90%
2390.0000		37.6000	1.8400	39.3100	1.75	-4.35%	5.14%
2400.0000		37.5500	1.8900	39.2900	1.76	-4.43%	7.39%
2402.0000	*	37.5180	1.8880	39.2860	1.76	-4.50%	7.27%
2410.0000		37.3900	1.8800	39.2700	1.76	-4.79%	6.82%
2417.0000	*	37.3130	1.9010	39.2560	1.77	-4.95%	7.58%
2420.0000		37.2800	1.9100	39.2500	1.77	-5.02%	7.91%
2430.0000		37.1300	1.8900	39.2400	1.78	-5.38%	6.18%
2437.0000	*	37.2840	1.9040	39.2260	1.79	-4.95%	6.55%
2440.0000		37.3500	1.9100	39.2200	1.79	-4.77%	6.70%
2450.0000		37.3000	1.9200	39.2000	1.80	-4.85%	6.67%
2457.0000	*	37.2020	1.9340	39.1930	1.81	-5.08%	7.03%
2460.0000		37.1600	1.9400	39.1900	1.81	-5.18%	7.18%
2467.0000		37.2090	1.9470	39.1760	1.82	-5.02%	7.15%
2470.0000		37.2300	1.9500	39.1700	1.82	-4.95%	7.14%
2480.0000		37.3300	1.9700	39.1600	1.83	-4.67%	7.65%
2490.0000		37.1600	1.9700	39.1500	1.84	-5.08%	7.07%
2500.0000		36.9500	1.9900	39.1400	1.85	-5.60%	7.57%
2510.0000		36.9900	2.0200	39.1200	1.87	-5.44%	8.02%
2520.0000		36.8600	2.0100	39.1100	1.88	-5.75%	6.91%
2530.0000		37.1200	2.0500	39.1000	1.89	-5.06%	8.47%
2540.0000		36.9900	2.0300	39.0900	1.90	-5.37%	6.84%
2550.0000		36.9700	2.0600	39.0700	1.91	-5.37%	7.85%

*Channel Frequency Tested

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
11 Mar 2020		2450	D2450V2		825
Fluid Type	Fluid Temp °C	Ambient Temp °C	Ambient Humidity (%)	Forward Power (mW)	Source Spacing (mm)
Head	23.9	22	25%	250	10
Fluid Parameters					
Permittivity			Conductivity		
Measured	Target	Deviation	Measured	Target	Deviation
37.30	39.20	-4.85%	1.92	1.80	6.67%
Measured SAR					
1 gram			10 gram		
Measured	Target	Deviation	Measured	Target	Deviation
13.90	13.30	4.51%	6.29	6.16	2.11%
Measured SAR Normalized to 1.0W					
1 gram			10 gram		
Normalized	Target	Deviation	Normalized	Target	Deviation
55.60	52.10	6.72%	25.16	24.30	3.54%

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.

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	31-May-19	EX3DV4	3600	CLA-30	1005	Head	52.40	0.75	Pass	Pass	Pass
150	12-Aug-19	EX3DV4	3600	CLA-150	4007	Head	49.46	0.79	Pass	Pass	Pass
450	13-Aug-19	EX3DV4	3600	D450V3	1068	Head	43.70	0.83	Pass	Pass	Pass
750	20-Jun-19	EX3DV4	3600	D750V3	1061	Head	44.27	0.83	Pass	Pass	Pass
835	15-Aug-19	EX3DV4	3600	D835V2	4d075	Head	42.01	0.89	Pass	Pass	Pass
1800	18-Jun-19	EX3DV4	3600	D1800V2	247	Head	41.20	1.39	Pass	Pass	Pass
2450	02-Apr-19	EX3DV4	3600	D2450V2	825	Head	36.58	1.85	Pass	Pass	Pass

18.0 MEASUREMENT SYSTEM SPECIFICATIONS

Table 18.0 Measurement System Specifications

Measurement System Specification	
Specifications	
Positioner	Stäubli Unimation Corp. Robot Model: TX90XL
Repeatability	+/- 0.035 mm
No. of axis	6.0
Data Acquisition Electronic (DAE) System	
Cell Controller	
Processor	Intel(R) Core(TM) i7-7700
Clock Speed	3.60 GHz
Operating System	Windows 10 Professional
Data Converter	
Features	Signal Amplifier, multiplexer, A/D converter, and control logic
Software	Measurement Software: DASY6, V 6.10.0.12 / DASY52 V10.3(1513)
	Postprocessing Software: SEMCAD X, V14.6.13(7474)
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	4 MHz -10GHz
Linearity	±0.2 dB (30 MHz to 10 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

19.0 TEST EQUIPMENT LIST

Table 19.0 Equipment List and Calibration

Test Equipment List				
DESCRIPTION	**ASSET NO.**	**SERIAL NO.**	**DATE CALIBRATED**	**CALIBRATION DUE**
Schmid & Partner DASY 6 System	-	-	-	-
-DASY Measurement Server	00158	1078	CNR	CNR
-Robot	00046	599396-01	CNR	CNR
-DAE4	00019	353	19-Mar-19	19-Mar-20
-EX3DV4 E-Field Probe	00213	3600	26-Mar-19	26-Mar-20
-CLA 30 Validation Dipole	00300	1005	23-Nov-17	23-Nov-20
-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	00186	1837002	COU	COU
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	00334	192385455	06-Aug-19	06-Aug-21
Traceable VWR Jumbo Humidity/Thermometer	00295	170120555	17-Feb-17	*15-Mar-20
Digital Multi Meter DMR-1800	00250	TE182	6-22-17	6-22-20
Bipolar Power Supply 6299A	00086	1144A02155	CNR	CNR
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
Rental Equipment				
R&S Base Station (Mobile Phone)	n/a	153128	08-Apr-19	08-Apr-20

CNR = Calibration Not Required

SB=Stand By

COU = Calibrate on Use

*Verifed and Extended

* *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

Note: Per KDB 865664, Dipoles are evaluated annually for return loss and impedance. The dipole's SAR target can only be assessed by the SAR equipment manufacturer and remains the target until the dipole is recalibrated by the manufacturer. The dipole's SAR is evaluated and compared to this target during each and every System Verification which is performed prior to and/or during each DUT SAR evaluation. The results of these verifications are shown in Section 16.0

20.0 FLUID COMPOSITION

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

Table 20.0 Fluid Composition 2450MHz HEAD TSL

Table 20.0			2450MHz Head	
Tissue Simulating Liquid (TSL) Composition				
Component by Percent Weight				
Water	Glycol	Salt(1)	HEC(2)	Bacteriacide(3)
52.0	48.0	0.0	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

APPENDIX A – SYSTEM VERIFICATION PLOTS

Date/Time: 3/11/2020 11:29:44 AM

Test Laboratory: Celltech Labs

SPC-2450H Mar 11 2020

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 parameters used: f = 2450 MHz; σ = 1.92 S/m; ε_r = 37.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

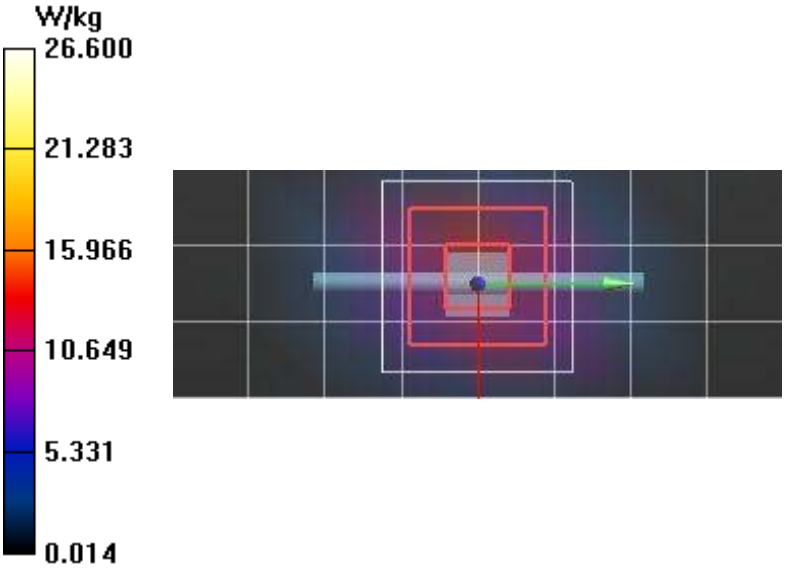
DASY Configuration:

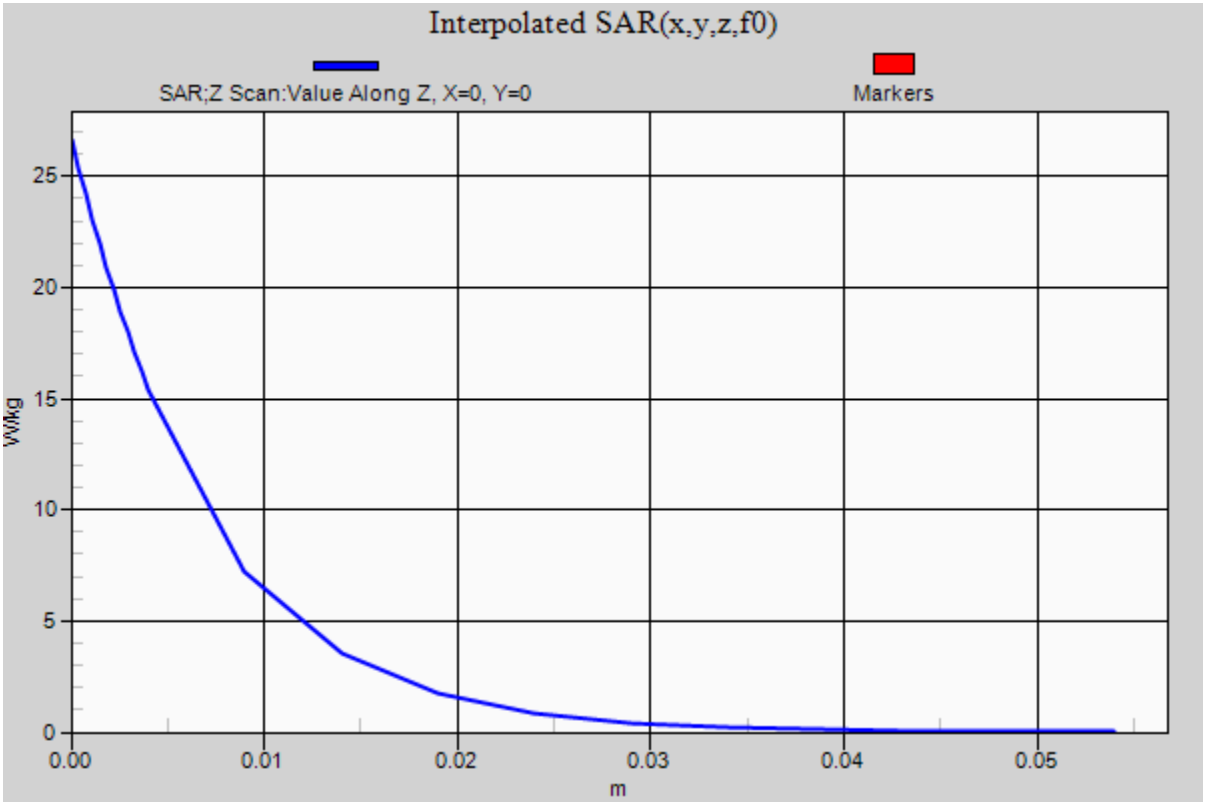
- Probe: EX3DV4 - SN3600; ConvF(6.46, 6.46, 6.46) @ 2450 MHz; Calibrated: 3/26/2019
  - Modulation Compensation:
- Sensor-Surface: 4mm (Mechanical Surface Detection), z = -1.5, 31.0, 151.0
- Electronics: DAE4 Sn353; Calibrated: 3/19/2019
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax; Serial: 1234
- DASY52 52.10.3(1513); SEMCAD X 14.6.13(7474)

SPC/SPC 2450H Input=250mw, Target=[13.3][6.16]W/kg 2/Area Scan (4x9x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 13.4 W/kg

SPC/SPC 2450H Input=250mw, Target=[13.3][6.16]W/kg 2/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 90.53 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 30.4 W/kg
SAR(1 g) = 13.9 W/kg; SAR(10 g) = 6.29 W/kg
Smallest distance from peaks to all points 3 dB below = 10 mm
Ratio of SAR at M2 to SAR at M1 = 46.8%
Maximum value of SAR (measured) = 15.8 W/kg

SPC/SPC 2450H Input=250mw, Target=[13.3][6.16]W/kg 2/Z Scan (1x1x22): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Penetration depth = 6.880 (6.617, 7.027) [mm]
Maximum value of SAR (interpolated) = 26.6 W/kg





APPENDIX B – MEASUREMENT PLOTS OF MAXIMUMUM MEASURED SAR

Plot B5

Date/Time: 3/11/2020 7:40:07 PM

Test Laboratory: Celltech Labs

Garmin-A03989-2450H Mar 12 2020

DUT: A03989; Type: Wrist- Worn Transmitter;

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 parameters used (interpolated): f = 2402 MHz; σ = 1.888 S/m; ε_r = 37.518; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: EX3DV4 - SN3600; ConvF(6.46, 6.46, 6.46) @ 2402 MHz; Calibrated: 3/26/2019
  - Modulation Compensation: PMR for UID 10030 - CAA, Calibrated: 3/26/2019
- 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: 3/19/2019
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax; Serial: 1234
- DASY52 52.10.3(1513); SEMCAD X 14.6.13(7474)

2450H/B5-A03989, Extremity-Front Side, 2402 MHz, Si Band (P/N: 010-12932-21)-BT-GFSK/Area Scan (8x7x1): Measurement grid: dx=12mm, dy=12mm

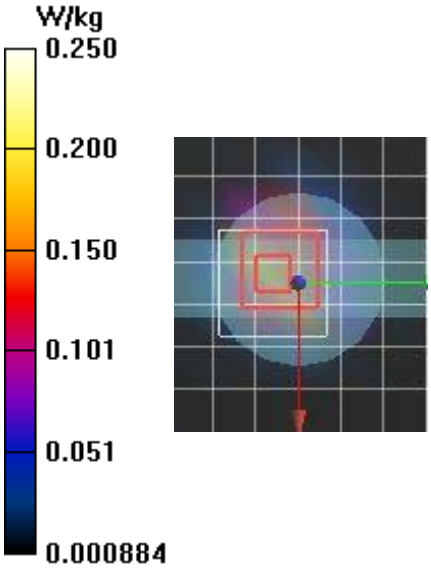
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.168 W/kg

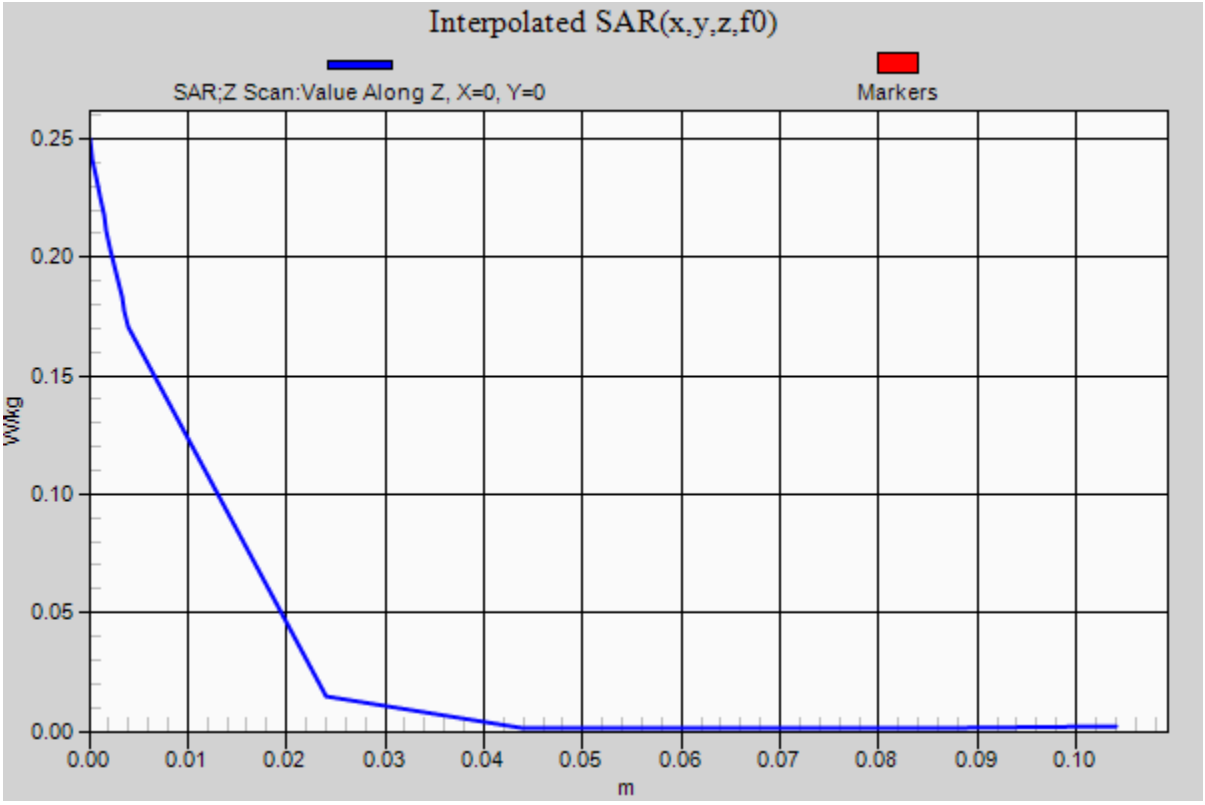
2450H/B5-A03989,Extremity-Front Side, 2402 MHz, Si Band (P/N: 010-12932-21)-BT-GFSK/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.427 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 0.448 W/kg
SAR(1 g) = 0.171 W/kg; SAR(10 g) = 0.085 W/kg
Smallest distance from peaks to all points 3 dB below = 10.6 mm
Ratio of SAR at M2 to SAR at M1 = 57.9%

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.191 W/kg

2450H/B5-A03989, Extremity Front Side, 2402 MHz, Si Band (P/N: 010-12932-21)- BT-GFSK/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, 8.210) [mm]
Maximum value of SAR (interpolated) = 0.250 W/kg





Plot B7

Date/Time: 3/12/2020 12:33:16 PM

Test Laboratory: Celltech Labs

Garmin-A03989-2450H Mar 12 2020

DUT: A03989; Type: Wrist- Worn Transmitter;

Communication System: UID 10060 - CAB, IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps); Communication System Band: WLAN 2.4GHz (2412.0 - 2484.0 MHz); Frequency: 2437 MHz;Communication System PAR: 2.83 dB; PMF: 1.16547
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.904 S/m; ε_r = 37.284; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: EX3DV4 - SN3600; ConvF(6.46, 6.46, 6.46) @ 2437 MHz; Calibrated: 3/26/2019
  - Modulation Compensation: PMR for UID 10060 - CAB, Calibrated: 3/26/2019
- 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: 3/19/2019
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax; Serial: 1234
- DASY52 52.10.3(1513); SEMCAD X 14.6.13(7474)

2450H/B7-A03989,Extremity Front Side, 2437 MHz, Ti Band (P/N: 010-12863-08)-WIFI/Area Scan (8x7x1): Measurement grid: dx=12mm, dy=12mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 3.78 W/kg

2450H/B7-A03989, Extremity-Front Side, 2437 MHz, Ti Band(P/N: 010-12863-08)-WIFI/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 46.67 V/m; Power Drift = -0.56 dB
Peak SAR (extrapolated) = 10.4 W/kg
SAR(1 g) = 3.67 W/kg; SAR(10 g) = 1.88 W/kg
Smallest distance from peaks to all points 3 dB below = 10.6 mm
Ratio of SAR at M2 to SAR at M1 = 59.9%

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 4.09 W/kg

2450H/B7-A03989,Extremity-Front Side, 2437 MHz, Ti Band (P/N: 010-12863-08)-WIFI/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, 8.375) [mm]
Maximum value of SAR (interpolated) = 5.19 W/kg