DECLARATION OF COMPLIANCE

SAR RF EXPOSURE EVALUATION - FCC / IC Original Filing

TEST LAB INFORMATION	**Name**	**CELLTECH LABS INC.**			
	Address	21-364 Lougheed Road, Kelowna, B.C. V1X 7R8 Canada			
TEST LAB ACCREDITATION	**Type**	**ISO / IEC 17025**	**Accreditation**	**A2LA Test Lab Certificate No. 2470.01**	
APPLICANT INFORMATION	**Name**	**GARMIN INTERNATIONAL INC.**			
	Address	1200, East 151st Street, Olathe, KS, 66062 USA			
STANDARDS APPLIED	**FCC**	**47 CFR §2.1093**		**IC**	**Health Canada Safety Code 6**
PROCEDURES APPLIED	**FCC**	**KDB 447498 D01v05r02, KDB 865664 D01v01r03**		**IC**	**RSS102 Issue 4**
	FCC	**KDB 248227 D01v01r02**		**IEC**	**62209-1:2005**
	IEEE	**IEEE 1528-2013**		**IEC**	**62209-2:2010**
DEVICE CLASSIFICATION	**FCC**	Digital Transmission System (DTS) - §15 Subpart C			
	FCC	Unlicensed National Information Infrastructure TX (NII) - §15 Subpart E			
	IC	Low Power License-Exempt Radiocommunication Device (RSS-210 Issue 8)			
DEVICE DESCRIPTION	**Wireless Extremity-Worn Device**				
APPLICATION TYPE	**Original Filing**				
DATE(S) OF EVALUATION	September 19 – October 3, 2014			**SAMPLES RECEIVED**	**September 16, 2014**
DEVICE IDENTIFIERS	**FCC ID**	IPH-02257	**IC ID**	1792A-02257	**TEST SAMPLE S/N**

Devices Tested

Model	Internal Transmitters	Data Rates	Frequency Range	Manufacturer's Rated Output Power
A02257	802.11b	DBPSK (1 Mbps), DQPSK (2 Mbps), CCK (5.5, 11 Mbps)	2412 – 2462 MHz	15dBm +/-1dB
	802.11g	OFDM (6, 9, 12, 24, 36, 48, 54 Mbps)	2412 – 2462 MHz	15dBm +/-1dB
	802.11n	MCS0, MCS1, MCS2, MCS3, MCS4, MCS5, MCS6, MCS7	2412 – 2462 MHz	15dBm +/-1dB
	802.15		2400-2483 MHz	4 dBm

Antennas Tested	Batteries Tested	
Internal	Internal Li-ion	5V USB

EVALUATION RESULTS

Maximum SAR Level Evaluated FCC	**Body/Extremity**	**0.267**	**W/kg**	**10g**	**FCC/IC SAR Limit**	**General Public / Uncontrolled**
Maximum SAR Level Evaluated IC	**Body/Extremity**	**0.374**			**4.0 W/kg**	

Celltech Labs Inc. declares under its sole responsibility that this wireless portable device has demonstrated compliance with the Specific Absorption Rate (SAR) RF exposure requirements specified in FCC 47 CFR §2.1093 and Health Canada Safety Code 6 for the General Population / Uncontrolled Exposure environment. The device was tested in accordance with the measurement procedures specified in FCC OET Bulletin 65, Supplement C (Edition 01-01), Industry Canada RSS-102 Issue 4, IEEE Standard 1528-2013 and International Standard IEC 62209-2:2010. All measurements were performed in accordance with the SAR system manufacturer recommendations.

The results and statements contained in this report pertain only to the device(s) evaluated

I attest to the accuracy of data. All measurements were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Test Report Approved By		Art Voss, P.Eng.	Senior Engineer	Celltech Labs Inc.

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REVISION HISTORY			
REVISION NO.	**DESCRIPTION**	**IMPLEMENTED BY**	**RELEASE DATE**
0.1	Draft Release	Mark Hoddinott	October 22, 2014
1.1	Initial Release	Art Voss	November 2, 2014
1.2	Corrections to References	Art Voss	November 3, 2014
1.3	Corrections to References	Art Voss	December 17, 2014

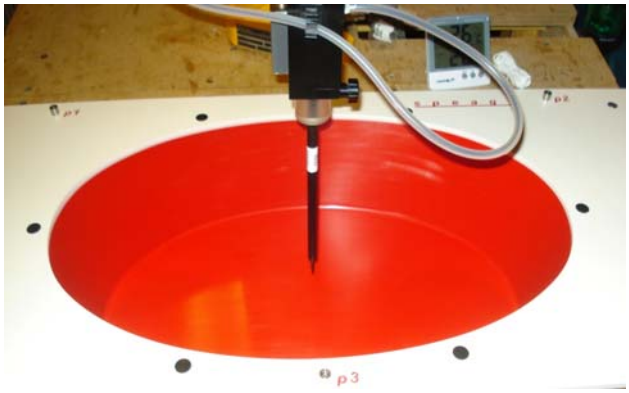
TEST REPORT SIGN-OFF			
DEVICE TESTED BY	**REPORT PREPARED BY**	**QA REVIEW BY**	**REPORT APPROVED BY**
Art Voss	Cheri Frangiadakis	Art Voss	Art Voss

1.0 INTRODUCTION

This measurement report demonstrates that the Garmin International Inc. Model(s): A02257 Wireless Extremity-Worn Device complies with the SAR (Specific Absorption Rate) RF exposure requirements specified in FCC 47 CFR §2.1093 (see reference [1]) and Health Canada's Safety Code 6 (see reference [2]) for the General Population / Uncontrolled Exposure environment. The measurement procedures described in KDB 447498 (see reference [8]), KDB 865664 (see reference [9]), IC RSS-102 Issue 4 (see reference [4]), IEEE Standard 1528-2013 (see reference [5]) and IEC Standard 62209-2:2010 (see reference [6]) were employed. A description of the device, operating configuration, detailed summary of the test results, methodology and procedures used in the evaluation, equipment used and the various provisions of the rules are included within this test report.

2.0 SAR MEASUREMENT SYSTEM

Celltech Labs Inc. SAR measurement facility utilizes the Dosimetric Assessment System (DASY™) manufactured by Schmid & Partner Engineering AG (SPEAG™) of Zurich, Switzerland. The DASY4 measurement system is comprised of the measurement server, robot controller, computer, near-field probe, probe alignment sensor, Elliptical Planar Phantom (ELI) phantom, specific anthropomorphic mannequin (SAM) phantom, and various planar phantoms 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, teach pendant (Joystick), and remote control, is used to drive the robot 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 into digital electric signal of the DAE and transfers data to the DASY4 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 and a command decoder and control logic unit. Transmission to the DASY4 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.



DASY4 SAR System with ELI Planar Phantom

DASY4 Measurement Server

3.0 CONDUCTED OUTPUT POWER MEASUREMENTS

RF CONDUCTED OUTPUT POWER MEASUREMENTS						
Freq. (MHz)	Ch.	Power Setting	Average Conducted RF Output Power Levels (dBm)			
802.11b Mode			1 Mbps	2 Mbps	5.5 Mbps	11 Mbps
2412	1	18	12.7	12.2	11.50	9.4

RF CONDUCTED OUTPUT POWER MEASUREMENTS					
Freq. (MHz)	Ch.	Power Setting	Average Conducted RF Output Power Levels (dBm)		
			802.11b	802.11g	802.11n
			1 Mbps	6 Mbps	MCS0
2412	1	MAX	12.30	8.2	7.9
2417	2	MAX	12.40		9.5
2422	3	MAX	12.90		
2427	4	MAX	13.00		
2432	5	MAX	12.75		
2437	6	MAX	15.00	10.6	10.9
2442	7	MAX	13.80		
2447	8	MAX	14.30		
2452	9	MAX	13.00		
2457	10	MAX	13.00		
2462	11	MAX	12.10	8.3	8.0
2467	12	MAX	12.10		
2472	13	MAX	12.50	9.2	9.7

Notes
1. The unit was tested at its maximum output power capability
2. The unit was tested at 100% duty cycle transmit.
3. The output power in production units will be set lower than these values.

4.0 FLUID DIELECTRIC PARAMETERS

FLUID DIELECTRIC PARAMETERS

Date:	2 Oct 2014		Frequency:	2450MHz	Tissue:	Body
Freq (MHz)	Test_e	Test_s	Target_e	Target_s	Deviation Permittivity	Deviation Conductivity
2350.0000	51.64	1.77	52.83	1.85	-2.25%	-4.32%
2360.0000	51.60	1.77	52.82	1.86	-2.31%	-4.84%
2370.0000	51.57	1.78	52.81	1.87	-2.35%	-4.81%
2380.0000	51.53	1.80	52.79	1.88	-2.39%	-4.26%
2390.0000	51.49	1.80	52.78	1.89	-2.44%	-4.76%
2400.0000	51.52	1.83	52.77	1.90	-2.37%	-3.68%
2410.0000	51.46	1.83	52.75	1.91	-2.45%	-4.19%
2417.0000	51.41	1.84	52.74	1.92	-2.53%	-3.81%
2420.0000	51.39	1.85	52.74	1.92	-2.56%	-3.65%
2430.0000	51.36	1.87	52.73	1.93	-2.60%	-3.11%
2437.0000	51.37	1.88	52.72	1.94	-2.55%	-3.10%
2440.0000	51.38	1.88	52.71	1.94	-2.52%	-3.09%
2450.0000	51.22	1.90	52.70	1.95	-2.81%	-2.56%
2457.0000	51.26	1.90	52.69	1.96	-2.73%	-2.91%
2460.0000	51.27	1.90	52.69	1.96	-2.70%	-3.06%
2470.0000	51.26	1.91	52.67	1.98	-2.68%	-3.54%
2480.0000	51.24	1.94	52.66	1.99	-2.70%	-2.51%
2490.0000	51.23	1.95	52.65	2.01	-2.70%	-2.99%
2500.0000	51.20	1.97	52.64	2.02	-2.74%	-2.48%
2510.0000	51.15	1.99	52.62	2.04	-2.79%	-2.45%
2520.0000	51.14	1.99	52.61	2.05	-2.79%	-2.93%
2530.0000	51.07	2.01	52.60	2.06	-2.91%	-2.43%
2540.0000	51.09	2.02	52.59	2.08	-2.85%	-2.88%
2550.0000	50.96	2.03	52.57	2.09	-3.06%	-2.87%

**interpolated using DASY4 software*

Test Date	Fluid Type	Ambient Temperature	Fluid Temperature	Fluid Depth	Atmospheric Pressure	Relative Humidity	ρ (Kg/m^3)
2 Oct	2450 Body	24°C	23.5 °C	≥ 15 cm	kPa	25%	1000

5.0 SAR MEASUREMENT SUMMARY

BODY-WORN SAR EVALUATION RESULTS

Plot #	Test Date	Test Mode	Test Freq.	Test Chan.	Data Rate	Battery	DUT Position (Side facing phantom)	DUT Distance to Phantom	Conducted Power Before Test	Measured SAR (10g)	SAR Drift During Test
			MHz		Mbps				dBm	W/kg	dB
B1	Oct 3	802.11b	2417	2	1	Li-ion	Back Touch	0mm	12.40	0.114	-1.280
B2	Oct 3	802.11b	2437	6	1	Li-ion	Back Touch	0mm	14.25	**0.212**	-1.470
B3	Oct 3	802.11b	2457	10	1	Li-ion	Back Touch	0mm	13.00	0.141	-1.350

SAR SAFETY LIMIT(S)		BODY	SPATIAL PEAK	RF EXPOSURE CATEGORY
FCC 47 CFR 2.1093	Health Canada Safety Code 6	4.0 W/kg	10g average	General Population / Uncontrolled

Notes	
1.	Detailed measurement data and plots showing the maximum SAR location of the DUT are reported in Appendix A.
2.	The DUT was not required to be evaluated in 802.11g mode or higher data rates because the highest output power channel was < ¼ dB higher than the corresponding 802.11b channel on the lowest data rate, in accordance with the procedures of FCC KDB 248227 (see reference [9]).
3.	The SAR drift of the DUT was measured by the DASY4 system for the duration of the SAR evaluation.
4.	The DUT battery was fully charged prior to each SAR evaluation.
5.	The fluid temperature remained within +/-2°C from the dielectric parameter measurement to the completion of the SAR test.
6.	The dielectric parameters of the simulated tissue mixture were measured prior to the SAR evaluations using a Dielectric Probe Kit and a Network Analyzer.

6.0 SAR SCALING FOR TUNE-UP TOLERANCE

Scaling of Maximum Measured SAR

Plot ID	Configuration	Freq (MHz)	Measured Fluid Deviation		Measured Conducted Power (dBm)	Measured Drift (dBm)	Measured SAR (W/kg)
			Permittivity	Conductivity			
B2	Body	2437	-2.55%	-3.10%	15.0	-1.470	0.212

Step 1

Fluid Sensitivity Adjustment (1)

Plot ID	Measured SAR (W/kg)	X	Scale Factor (%)	=	Adjusted SAR (W/kg)
B2	0.212	X	n/a	=	**0.212**

Step 2

Manufacturer's Tune-Up Tolerance (2)

Plot ID	Measured Conducted Power (dBm)	Rated Conducted Power (dBm)	Delta (dB)	+	Adjusted SAR (W/kg)	=	Reported SAR (W/kg)
B2	15.0	15.0+/- 1dBm	+1.0	+	**0.212**	=	**0.267**

Step 3

802.15

Plot ID	Output Power Pmax (mW)	Freq (GHz)	Separation Distance (mm)	Estimated SAR (W/kg)	+	Reported SAR (W/kg)	=	Simultaneous Reported SAR (W/kg)
The transmitters are not capable of simultaneous transmission								

Step 4 (IC/EU/AU)

Drift Adjustment (4)

Plot ID	Measured Drift (dBm)	+	Reported or Simultaneous Reported SAR (W/kg)	=	Scaled SAR (W/kg)
B2	-1.470	+	**0.267**	=	**0.374**

7.0 SIMULTANEOUS TRANSMISSION ASSESSMENT

802.11b/g + 802.15:

These transmitters are not capable of simultaneous transmission. The 802.15 is rated at 4dBm and is below the threshold for standalone SAR evaluation.

8.0 DETAILS OF SAR EVALUATION

1. The DUT was evaluated for body-worn SAR in accordance with the test positions required by FCC KDB 447498 D01v05 (see reference [8]).
2. The DUT was supplied with test mode software that was able to transmit at any selected channel / data-rate required for SAR testing.
3. The DUT was tested with a modulated DSSS signal in 802.11b mode.
4. The battery was fully charged before each SAR evaluation.

9.0 SAR EVALUATION PROCEDURES

a. (i) The evaluation was performed in the applicable area of the phantom depending on the type of device being tested. For devices held to the ear during normal operation, both the left and right ear positions were evaluated using the SAM phantom.
(ii) For body-worn and face-held devices a planar phantom was used.

b. The SAR was determined by a pre-defined procedure within the DASY4 software. Upon completion of a reference and optical surface check, the exposed region of the phantom was scanned near the inner surface with a grid spacing of 10mm x 10mm.
An area scan was determined as follows:

c. Based on the defined area scan grid, a more detailed grid is created to increase the points by a factor of 10. The interpolation function then evaluates all field values between corresponding measurement points.

d. A linear search is applied to find all the candidate maxima. Subsequently, all maxima are removed that are >2 dB from the global maximum. The remaining maxima are then used to position the cube scans.
A 1g and 10g spatial peak SAR was determined as follows:

e. Extrapolation is used to determine the values between the dipole center of the probe and the surface of the phantom. This data cannot be measured because the center of the dipole sensors is 1.0 mm away from the probe tip and the distance between the probe and the boundary must be larger than 25% of the probe diameter. The probe diameter is 2.4 mm. In the DASY4 software, the distance between the sensor center and phantom surface is set to 2.0 mm. This provides a distance of 1.0 mm between the probe tip and the surface. The extrapolation of the values between the dipole center and the surface of the phantom was based on trivariate quadratics computed from the previously calculated 3D interpolated points nearest the phantom surface.

f. Interpolated data is used to calculate the average SAR over 1g and 10g cubes by spatially discretizing the entire measured cube. The volume used to determine the averaged SAR is a 1mm grid (42875 interpolated points).

g. A zoom scan volume of 30 mm x 30 mm x 30 mm (5x5x7 points) centered at the peak SAR location determined from the area scan is used for all zoom scans for devices with a transmit frequency < 800 MHz. Zoom scans for frequencies ≥ 800 MHz are determined with a scan volume of 30 mm x 30 mm x 30 mm (7x7x7 points) to ensure complete capture of the peak spatial-average SAR. When the area scan estimated SAR is < 1.4W/kg, less points can be used for higher frequency zoom scans.

10.0 SYSTEM VERIFICATION

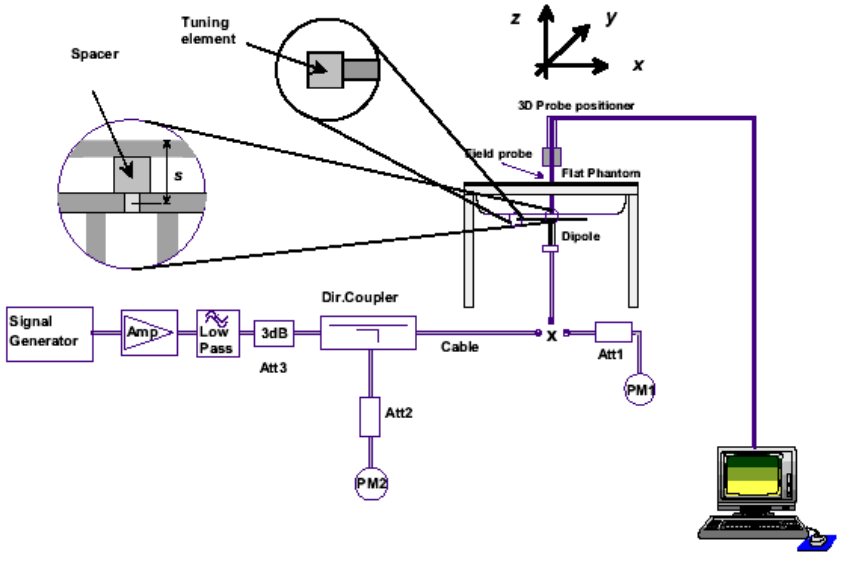
Prior to the SAR evaluations, a system check was performed at the planar section of the ELI phantom with a 2450MHz SPEAG validation dipole (see Appendix B) in accordance with the procedures described in IEEE Standard 1528-2013 (see reference [5]) and IEC 62209-2:2010 (see reference [7]). A forward power of 250 mW 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 (see Appendix E).

System Verification Test Resluts

Date	Frequency (MHz)	Fluid Type	Fluid Temp °C	Ambient Temp °C	Ambient Humidity (%)	Input Power (mW)	Dipole Spacing (mm)	Validation Source P/N	Validation Source S/N
02 Oct 2014	2450	Body	23.5	24	25%	250	10	D2450V2	825

SAR						Fluid Parameters					
1 gram			10 gram			Permittivity			Conductivity		
Measured	Target	Deviation	Measured	Target	Deviation	Measured	Target	Deviation	Measured	Target	Deviation
11.90	12.70	-6.30%	**5.52**	5.91	-6.60%	51.22	52.70	-2.81%	1.90	1.95	-2.56%

Notes	
	1. The target SAR value is the measured value from the dipole calibration performed by the system manufacturer (see Appendix E).
	2. The target dielectric parameters are the nominal values from the dipole calibration performed by SPEAG (see Appendix E) and specified in IC RSS-102 Issue 4 (see reference [4]).
	3. The fluid temperature remained within +/-2°C from the dielectric parameter measurement to the completion of the system performance check evaluation.
	4. 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 (see Appendix C).



System Performance Check Measurement Setup Diagram

2450 MHz Validation Dipole Setup

11.0 SIMULATED EQUIVALENT TISSUES

The simulated equivalent tissue recipe listed in the table below is derived from the SAR system manufacturer's suggested recipe in the DASY4 manual (see reference [10]). The ingredient percentage may have been adjusted minimally in order to achieve the appropriate target dielectric parameters within the specified tolerance.

2450 MHz SIMULATED TISSUE MIXTURES	
INGREDIENT	**2450 MHz Body**
Water	69%
Glycol Monobutyl	31%

12.0 SAR LIMITS

SAR RF EXPOSURE LIMITS			
FCC 47 CFR 2.1093	**Health Canada Safety Code 6**	**(General Population / Uncontrolled Exposure)**	**(Occupational / Controlled Exposure)**
Spatial Average (averaged over the whole body)		0.08 W/kg	0.4 W/kg
Spatial Peak (averaged over any 1 g of tissue)		1.6 W/kg	8.0 W/kg
Spatial Peak (hands/wrists/feet/ankles averaged over 10 g)		**4.0 W/kg**	20.0 W/kg
The Spatial Average value of the SAR averaged over the whole body.			
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.			
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.			
Uncontrolled environments are defined as locations where there is potential exposure of individuals who have no knowledge or control of their potential exposure.			
Controlled environments are defined as locations where there is potential exposure of individuals who have knowledge of their potential exposure and can exercise control over their exposure.			

13.0 ROBOT SYSTEM SPECIFICATIONS

Specifications	
Positioner	Stäubli Unimation Corp. Robot Model: RX60L
Repeatability	0.02 mm
No. of axis	6
Data Acquisition Electronic (DAE) System	
Cell Controller	
Processor	AMD Athlon XP 2400+
Clock Speed	2.0 GHz
Operating System	Windows XP Professional
Data Converter	
Features	Signal Amplifier, multiplexer, A/D converter, and control logic
Software	Measurement Software: DASY4, V4.7 Build 80
	Postprocessing Software: SEMCAD, V1.8 Build 186
Connecting Lines	Optical downlink for data and status info.; Optical uplink for commands and clock
DASY4 Measurement Server	
Function	Real-time data evaluation for field measurements and surface detection
Hardware	PC/104 166MHz Pentium CPU; 32 MB chipdisk; 64 MB RAM
Connections	COM1, COM2, DAE, Robot, Ethernet, Service Interface
E-Field Probe	
Model	EX3DV4
Serial No.	3600
Construction	Symmetrical design with triangular core
Frequency	10 MHz to 6 GHz
Linearity	±0.2 dB (30 MHz to 3 GHz)
Phantom(s)	
Type	ELI V5.0
Shell Material	Fiberglass
Thickness	2.0 ±0.1 mm
Volume	Approx. 25 liters

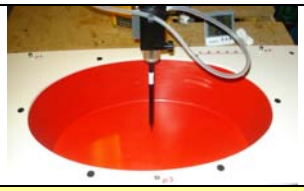
14.0 PROBE SPECIFICATION (EX3DV4)

Construction:	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g. DGBE)
Calibration:	Basic Broadband Calibration in air: 10-3000 MHz Conversion Factors (CF) for HSL 900 and HSL 1750
Frequency:	10 MHz to >6 GHz; Linearity: ±0.2 dB (30 MHz to 3 GHz)
Directivity:	±0.3 dB in HSL (rotation around probe axis) ±0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range:	10 μW/g to >100 mW/g; Linearity: ±0.2 dB (noise: typically < 1 μW/g)
Dimensions:	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1.0 mm
Application:	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better than 30%.

EX3DV4 E-Field Probe

15.0 ELI PHANTOM V5.0

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 Planar Phantom

16.0 DEVICE HOLDER

The DASY4 device holder has two scales for device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear openings). The plane between the ear openings and the mouth tip has a rotation angle of 65°. The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. For evaluations of larger devices a Plexiglas platform is attached to the device holder.

Device Holder

17.0 TEST EQUIPMENT LIST

TEST EQUIPMENT		ASSET NO.	SERIAL NO.	DATE CALIBRATED	CALIBRATION INTERVAL
USED	DESCRIPTION				
x	Schmid & Partner DASY4 System	-	-	-	-
x	-DASY4 Measurement Server	00158	1078	CNR	CNR
x	-Robot	00046	599396-01	CNR	CNR
x	-DAE4	00019	353	9-Apr-14	Biennial
x	-EX3DV4 E-Field Probe	00213	3600	15-Apr-14	Annual
x	-D2450V2 Validation Dipole	00219	825	20-Apr-12	Triennial
	Side Planar Phantom	00156	161	CNR	CNR
x	ELI Elliptical Phantom	00247	03-01	CNR	CNR
	SPEAG SAM Twin Phantom V4.0C	00154	1033	CNR	CNR
x	HP 85070C Dielectric Probe Kit	00033	none	CNR	CNR
x	Gigatronics 8652A Power Meter	00007	1835272	17June-14	Biennial
x	Gigatronics 80701A Power Sensor	00248	1833687	18 Feb-14	Biennial
x	Gigatronics 80701A Power Sensor	00249	1834473	17 Feb-14	Biennial
x	HP 8753ET Network Analyzer	n/a	US39173737	4-Aug-14*	Biennial
x	Rohde & Schwarz SMR20 Signal Generator	00006	100104	08-May-14	Biennial
x	Amplifier Research 5S1G4 Power Amplifier	00106	26235	CNR	CNR
Abbr.	CNR = Calibration Not Required				

*Rented Equipment

18.0 MEASUREMENT UNCERTAINTY (IEC 62209-2)

UNCERTAINTY BUDGET FOR DEVICE EVALUATION (IEC 62209-2:2010)

Source of Uncertainty	IEC 62209-2 Section	Tolerance / Uncertainty ±%	Probability Distribution	Divisor	ci 1g	ci 10g	Standard Uncertainty ±% (1g)	Standard Uncertainty ±% (10g)	V_i or V_{eff}
Measurement System									
Probe Calibration (2450 MHz)	7.2.2.1	6.0	Normal	1	1	1	6.0	6.0	∞
Isotropy	7.2.2.2	4.7	Rectangular	1.732050808	1	1	2.7	2.7	∞
Boundary Effect	7.2.2.6	1	Rectangular	1.732050808	1	1	0.6	0.6	∞
Linearity	7.2.2.3	4.7	Rectangular	1.732050808	1	1	2.7	2.7	∞
Detection Limits	7.2.2.5	1	Rectangular	1.732050808	1	1	0.6	0.6	∞
Readout Electronics	7.2.2.7	0.3	Normal	1	1	1	0.3	0.3	∞
Response Time	7.2.2.8	0.8	Rectangular	1.732050808	1	1	0.5	0.5	∞
Integration Time	7.2.2.9	2.6	Rectangular	1.732050808	1	1	1.5	1.5	∞
RF Ambient Conditions	7.2.4.5	3	Rectangular	1.732050808	1	1	1.7	1.7	∞
Probe Positioner Mechanical Restrictions	7.2.3.1	0.4	Rectangular	1.732050808	1	1	0.2	0.2	∞
Probe Positioning wrt Phantom Shell	7.2.3.3	2.9	Rectangular	1.732050808	1	1	1.7	1.7	∞
Post-processing	7.2.5	1	Rectangular	1.732050808	1	1	0.6	0.6	∞
Test Sample Related									
Test Sample Positioning	7.2.3.4.3	2.9	Normal	1	1	1	2.9	2.9	12
Device Holder Uncertainty	7.2.3.4.2	3.6	Normal	1	1	1	3.6	3.6	8
Drift of Output Power (meas. SAR drift)	7.2.2.10	0	Rectangular	1.732050808	1	1	0.0	0.0	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	7.2.3.2	4	Rectangular	1.732050808	1	1	2.3	2.3	∞
SAR Correction Algorithm for deviations in permittivity and conductivity	7.2.4.3	1.2	Normal	1	1	0.81	1.2	0.97	∞
Liquid Conductivity (measured)	7.2.4.3	2.6	Normal	1	0.78	0.71	2.0	1.8	∞
Liquid Permittivity (measured)	7.2.4.3	4.63	Normal	1	0.23	0.26	1.1	1.2	∞
Liquid Permittivity - temp. uncertainty	7.2.4.4	1.23	Rectangular	1.732050808	0.78	0.71	0.6	0.5	∞
Liquid Conductivity - temp. uncertainty	7.2.4.4	0.93	Rectangular	1.732050808	0.23	0.26	0.1	0.1	∞
Combined Standard Uncertainty	**7.3.1**		**RSS**				**9.69**	**9.64**	
Expanded Uncertainty (95% Confidence Interval)	**7.3.2**		**k=2**				**19.38**	**19.28**	

Measurement Uncertainty Table in accordance with International Standard IEC 62209-2:2010

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2

19.0 REFERENCES

[1] Federal Communications Commission - “Radiofrequency radiation exposure evaluation: portable devices”, Rule Part 47 CFR §2.1093.

[2] Health Canada - “Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz”, Safety Code 6: 1999.

[3] Federal Communications Commission, Office of Engineering and Technology - “SAR Measurement Requirements for 100 MHz to 6 GHz”; KDB 865664 D01v01r03: Feb 2014.

[4] Industry Canada - “Radio Frequency Exposure Compliance of Radio Communication Apparatus (All Frequency Bands)”, Radio Standards Specification RSS-102 Issue 4: March 2010.

[5] IEEE Standard 1528-2013 - “Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”: June 2013.

[6] International Standard IEC 62209-1:2005 - “Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures.”

[7] International Standard IEC 62209-2 Edition 1.0 2010-03 - “Human exposure to radio frequency fields from hand-held & body-mounted wireless communication devices - Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)”.

[8] Federal Communications Commission, Office of Engineering and Technology - “Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies”; KDB 447498 D01v05r02: Feb 2014.

[9] Federal Communications Commission, Office of Engineering and Technology - “SAR Measurement Procedures for 802.11a/b/g Transmitters”; KDB 248227 D01 v01r02 May 2007.

[10] Schmid & Partner Engineering AG - DASY4 Manual V4.6, Chapter 17 Application Note, Body Tissue Recipe: Sept. 2005.

[11] International Standard ISO/IEC 17025:2005 - “General requirements for the competence of testing and calibration laboratories”.

[12] Federal Communications Commission - “Measurements Required: RF Power Output”; Rule Part 47 CFR §2.1046.

[13] Industry Canada - “General Requirements and Information for the Certification of Radiocommunication Equipment”, Radio Standards Specification RSS-Gen Issue 4: Nov 2014.

APPENDIX A - SAR MEASUREMENT PLOTS

Plot B1

Date/Time: 03/10/2014 2:42:26 PM

Body Oct 3 2014

DUT: Garmin A02257; Type: Extremity-Worn Device; Serial: Not Specified

Program Notes: Oct 3, 2014 Ambient Temp: 24C; Fluid Temp: 21.7C; Humidity: 47%

Procedure Notes:

Communication System: CW
Frequency: 2417 MHz; Duty Cycle: 1:1
Medium: TSL_2450B Medium parameters used (interpolated): f = 2417 MHz; σ = 1.84 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3

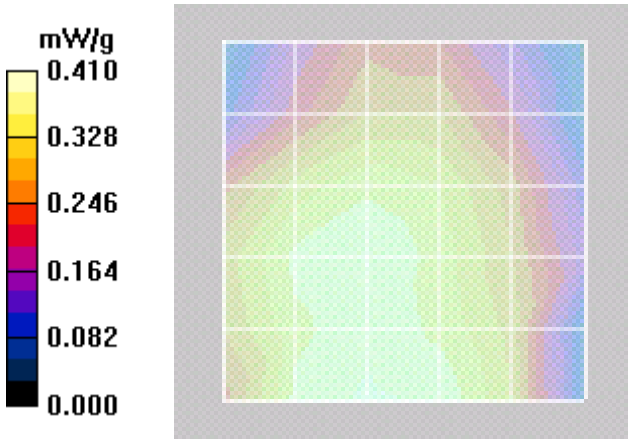
- Probe: EX3DV4 - SN3600; ConvF(6.26, 6.26, 6.26); Calibrated: 15/04/2014
- Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used))Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 09/04/2014
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:xxxx
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

B1 Body, 802.11a Ch 2, 2417MHz/Area Scan (6x6x1): Measurement grid: dx=10mm, dy=10mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.368 mW/g

B1 Body, 802.11a Ch 2, 2417MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 11.5 V/m; Power Drift = -1.28 dB
Peak SAR (extrapolated) = 0.767 W/kg
SAR(1 g) = 0.291 mW/g; SAR(10 g) = 0.114 mW/g

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.410 mW/g



Top of Device Shown Up

Plot B2

Date/Time: 03/10/2014 1:55:38 PM

Body Oct 3 2014

DUT: Garmin A02257; Type: Extremity-Worn Device; Serial: Not Specified

Program Notes: Oct 3, 2014 Ambient Temp: 24C; Fluid Temp: 21.7C; Humidity: 47%

Procedure Notes:

Communication System: CW
Frequency: 2437 MHz; Duty Cycle: 1:1
Medium: TSL_2450B Medium parameters used (interpolated): f = 2437 MHz; σ = 1.88 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3

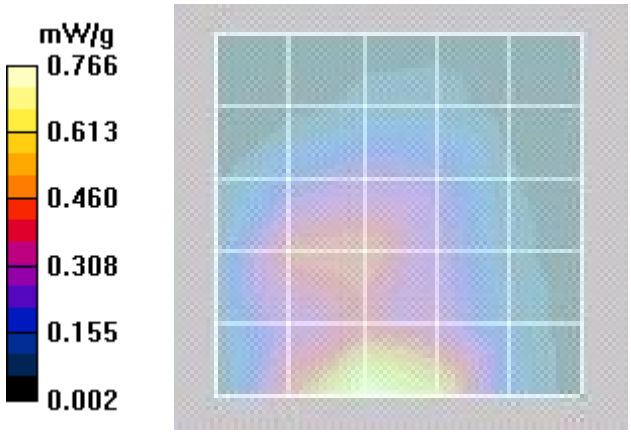
- Probe: EX3DV4 - SN3600; ConvF(6.26, 6.26, 6.26); Calibrated: 15/04/2014
- Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used))Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 09/04/2014
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:xxxx
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

B2 Body, 802.11a Ch 6, 2437MHz/Area Scan (6x6x1): Measurement grid: dx=10mm, dy=10mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.747 mW/g

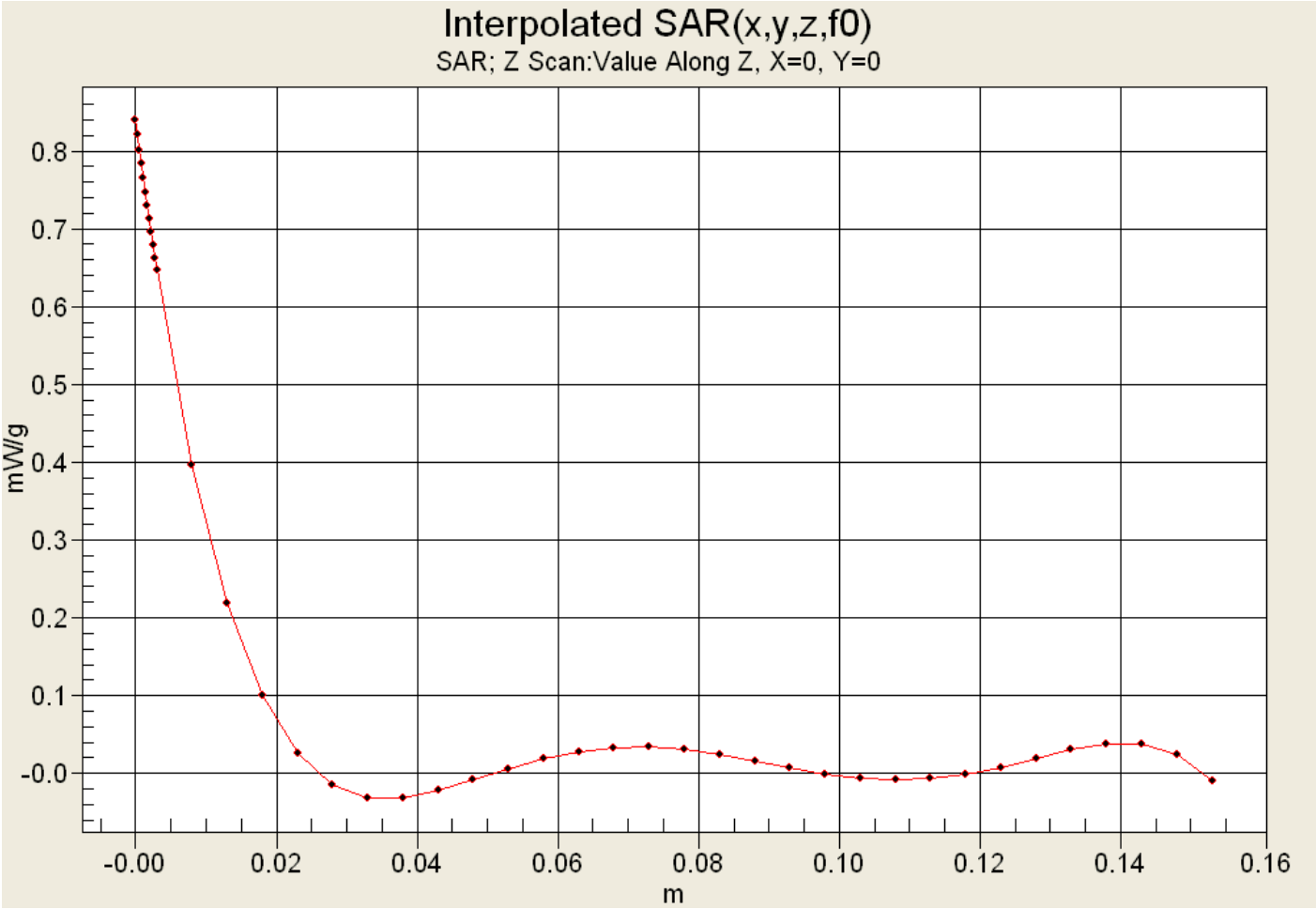
B2 Body, 802.11a Ch 6, 2437MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 15.5 V/m; Power Drift = -1.47 dB
Peak SAR (extrapolated) = 1.44 W/kg
SAR(1 g) = 0.547 mW/g; SAR(10 g) = 0.212 mW/g

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.766 mW/g



Top of Device Shown Up

Z-Axis Scan


Interpolated SAR(x,y,z,f0)
SAR; Z Scan:Value Along Z, X=0, Y=0
mW/g
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
-0.0
-0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
m

Plot B3

Date/Time: 03/10/2014 3:25:21 PM

Body Oct 3 2014

DUT: Garmin A02257; Type: Extremity-Worn Device; Serial: Not Specified

Program Notes: Oct 3, 2014 Ambient Temp: 24C; Fluid Temp: 21.7C; Humidity: 47%

Procedure Notes:

Communication System: CW
Frequency: 2457 MHz; Duty Cycle: 1:1
Medium: TSL_2450B Medium parameters used (interpolated): f = 2457 MHz; σ = 1.9 mho/m; ε_r = 51.3; ρ = 1000 kg/m^3

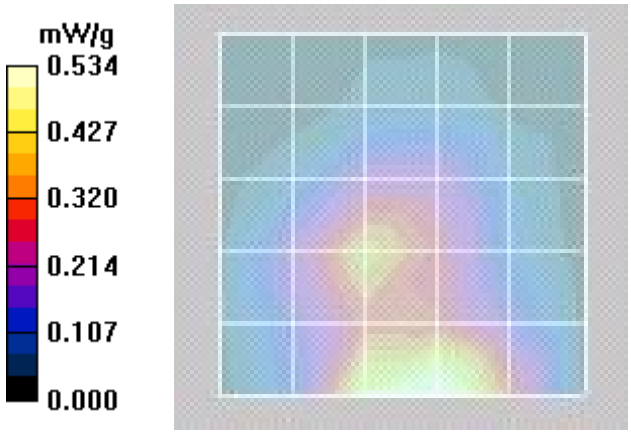
- Probe: EX3DV4 - SN3600; ConvF(6.26, 6.26, 6.26); Calibrated: 15/04/2014
- Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used))Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 09/04/2014
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:xxxx
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

B3 Body, 802.11a Ch 10, 2457MHz/Area Scan (6x6x1): Measurement grid: dx=10mm, dy=10mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.593 mW/g

B3 Body, 802.11a Ch 10, 2457MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 12.6 V/m; Power Drift = -1.35 dB
Peak SAR (extrapolated) = 0.986 W/kg
SAR(1 g) = 0.369 mW/g; SAR(10 g) = 0.141 mW/g

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.534 mW/g



Top of Device Shown Up

APPENDIX B - SYSTEM PERFORMANCE CHECK PLOTS

Date/Time: 03/10/2014 1:22:03 PM

SPC 2450B - EX3 - Oct 3 2014

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 825; Calibrated: 25/04/2012

Program Notes: Oct 3 2014 Ambient Temp: 24C; Fluid Temp: 21.7C; Humidity: 27%

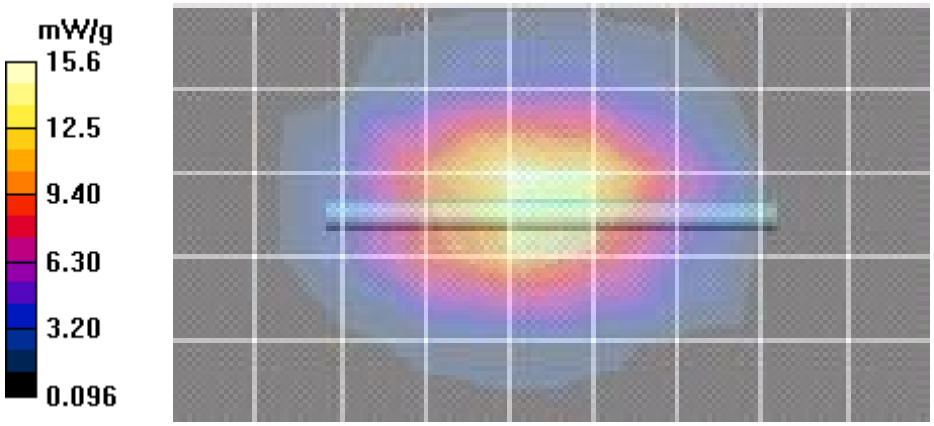
Procedure Notes:

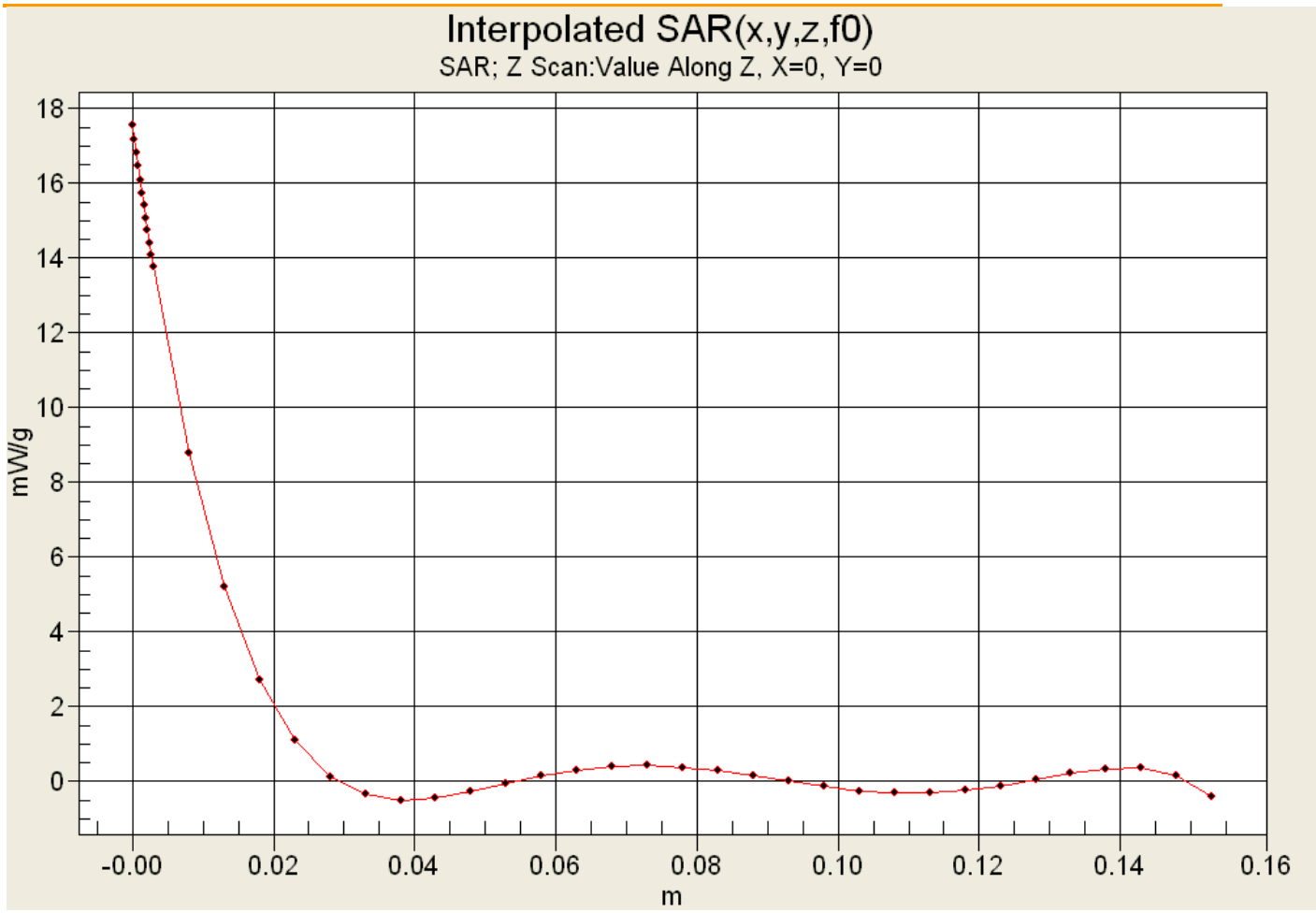
Communication System: CW
Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: TSL_2450B Medium parameters used: f = 2450 MHz; σ = 1.9 mho/m; ε_r = 51.2; ρ = 1000 kg/m^3

- Probe: EX3DV4 - SN3600; ConvF(6.26, 6.26, 6.26); Calibrated: 15/04/2014
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 09/04/2014
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:xxxx
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

2450 MHz Dipole d=10mm P=250mW/Area Scan (6x10x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 14.8 mW/g

2450 MHz Dipole d=10mm P=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 87.8 V/m; Power Drift = -0.005 dB
Peak SAR (extrapolated) = 25.1 W/kg
SAR(1 g) = 11.9 mW/g; SAR(10 g) = 5.52 mW/g
Maximum value of SAR (measured) = 15.6 mW/g




Interpolated SAR(x,y,z,f0)
SAR; Z Scan:Value Along Z, X=0, Y=0
mW/g
18
16
14
12
10
8
6
4
2
0
-0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
m

APPENDIX C - MEASURED FLUID DIELECTRIC PARAMETERS

2450 MHz Body

****

Aprel Laboratory
Test Result for UIM Dielectric Parameter
Tue 02/Oct/2014 14:58:50
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	51.64	1.77
2.3600	52.82	1.86	51.60	1.77
2.3700	52.81	1.87	51.57	1.78
2.3800	52.79	1.88	51.53	1.80
2.3900	52.78	1.89	51.49	1.80
2.4000	52.77	1.90	51.52	1.83
2.4100	52.75	1.91	51.46	1.83
2.4200	52.74	1.92	51.39	1.85
2.4300	52.73	1.93	51.36	1.87
2.4400	52.71	1.94	51.38	1.88
2.4500	52.70	1.95	51.22	1.90
2.4600	52.69	1.96	51.27	1.90
2.4700	52.67	1.98	51.26	1.91
2.4800	52.66	1.99	51.24	1.94
2.4900	52.65	2.01	51.23	1.95
2.5000	52.64	2.02	51.20	1.97
2.5100	52.62	2.04	51.15	1.99
2.5200	52.61	2.05	51.14	1.99
2.5300	52.60	2.06	51.07	2.01
2.5400	52.59	2.08	51.09	2.02
2.5500	52.57	2.09	50.96	2.03