SAR Test Report

For

Garmin International

Model Name:

AA3111

Product Description:

Personal Navigation Device

FCC ID: IPH-A3111
IC ID: 1792A-A3111

Test Report #: SAR-GARMI-047-17001-FCC

Date of Report: 2017-11-2

***CETECOM* Inc.**

411 Dixon Landing Road ◆ Milpitas, CA 95035 ◆ U.S.A.

Phone: + 1 (408) 586 6200 ◆ Fax: + 1 (408) 586 6299 ◆ E-mail: info@cetecom.com ◆ http://www.cetecom.com

CETECOM Inc. is a Delaware Corporation with Corporation number: 2905571

TABLE OF CONTENTS

Appendices:
Appendix A – Plots
Appendix B – Antenna location, Test Setup Photos
Appendix C – Tissue liquid parameters, Equipment list

1 Assessment

The following device was evaluated against the limits for general population uncontrolled exposure specified in FCC 2.1093 and RSS 102, Issue 5 according to measurement procedures specified in FCC regulation as listed in chapter 5, IEEE 1528:2013 and IEC 62209-2:2010 and no deviations were ascertained during the course of the tests performed.

Manufacturer	Description	Model #
Garmin International	Personal Navigation Device	AA3111

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2017-11-2	Compliance	Peter Nevermann (Director RC&E)	Peter Ne—

Responsible for the Report:

Date	Section	Name	Signature
2017-11-2	Compliance	James Donnellan (Sr. EMC Engineer Eng)	James Donnellan

The test results of this test report relate exclusively to the test item specified in Section 3.
CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the SAR Test Report

Company Name	CETECOM Inc.
Department	Compliance
Address	411 Dixon Landing Road Milpitas, CA 95035 U.S.A.
Telephone	+1 (408) 586 6200
Fax	+1 (408) 586 6299
Industry Canada Company Number	3462B
Director Radio Com. and EMC:	Peter Nevermann
Responsible Project Leader:	Laith Saman

2.2 Identification of the Client and Manufacturer

	Client	**Manufacturer**
Company	Garmin International	Garmin Corporation
Street Address	100 Regency Forest Drive, Suite 350	No. 68, Jangshu 2nd road
City/Zip Code	Cary, NC 27518	Xizhi District, New Taipei City 221
Country	USA	Taiwan

3 Equipment under Test (EUT)

3.1 General Specification of the Equipment under Test

Model No	AA3111
FCC ID	IPH-A3111
IC Certification Number	1792A-A3111
Product Marketing Name (PMN)	fleet™ 790 xy, fleet™ 780 xy, and fleet™ 770 xy
Hardware Version Identification Number (HVIN)	AA3111
Firmware Version Identification Number (FVIN)	2.30
Host Marketing Name (HMN)	N/A
Product Type	Mobile / Portable
Prototype/Production	Production
RF Exposure Environment	General / Uncontrolled
Dimensions	H 121.8 mm, W 199.0 mm, D 23.7 mm
Exposure Conditions	Body Supported (Near the body) Extremity Exposure
Supported Radios	Telit LE910-NA1 an LTE/3G Power Class 3 Module supporting UMTS FDD II & V and LTE 2, 4, 5, 12 & 13. 2.4 GHz Wifi/Bluetooth Module Model: Samsung S5N5C10
Additional Radios	NFC, GPS
Power Back-Off Modes	N/A
Simultaneous Transmission Configurations	Cellular / Wifi
Date of Testing	9-15-2017 – 10-10-2017

3.2 Antenna Information

Antenna	Type	Internal / External	Frequency (MHz)	Manufacturer Stated Max Peak Gain (dBi)
1	Printed Trace F-Antenna	Internal	698	-4.33
			778	-3.44
			828	-2.7
			1730	2.07
			1850	0.32
2	Inverted-F Trace	Internal	2400-2483.5	1.58

3.3 Technical Specification of Supported Radios

Signal Type	Worst Case For Time Averaged Power Timeslots / Duty Cycle	Type(s) of Uplink Modulation	Band	Uplink Transmit Frequency Range (MHz)	Measured Maximum Conducted Output Power (dBm)	Declared Maximum Output Power (dBm)
UMTS	100%	QPSK	FDD II	1852.9-1907.6	23.21	24.5
UMTS	100%	QPSK	FDD V	826.4-846.6	23.56	24.5
LTE	100%	QPSK	2	1850 - 1910	22.88	24.0
LTE	100%	QPSK	4	1710-1755	22.98	24.0
LTE	100%	QPSK	5	824-849	22.44	24.0
LTE	100%	QPSK	12	699-716	22.8	24.0
LTE	100%	QPSK	13	777-787	22.93	24.0
Wifi	99%	80211b	2.4GHz	2400-2483.5	17.7	19
	92%	80211g		2400-2483.5	15.74	18
	90%	80211n		2400-2483.5	14.98	17
BT	77.1%	GFSK	2.4GHz	2400-2483.5	9.82	-
	77.3%	DQPSK		2400-2483.5	8.42	-
	77.3%	8-DPSK		2400-2483.5	8.38	-
BTLE	85.7%	GFSK	2.4GHz	2400-2483.5	7.02	-

NOTE: See section 8.1 for additional output power information.

3.4 Identification of the Equipment Under Test (EUT)

EUT #	Serial Number	HW Version	SW Version	Comment
1	395170128 / 356961072228060	0	2.30	Sar Tested Unit
2	39F003867	0	2.30	Conducted Check Unit

3.5 Identification of Accessory equipment

AE #	Type	Manufacturer	Model	Serial Number	Comments
1	AC/DC Adapter	Garmin / Tamura Pacific	FSY120100UU15-3	-	Used to charge Eut

3.6 Maximum SAR values

Equipment Class	Exposure Condition	Maximum Reported 1g SAR[1] (W/kg)
Licensed	Near the body	0.990
DTS	Near the body	0.512
Simultaneous Transmission	Near the body	1.502

NOTES:

1. Measured 1g SAR scaled to manufacturer stated output power upper tolerance limit.

Equipment Class	Exposure Condition	Maximum Reported 10g SAR1 (W/kg)
Licensed	Extremity (Touch with Hand)	2.417
DTS	Extremity (Touch with Hand)	0.166
Simultaneous Transmission	Extremity (Touch with Hand)	2.582

NOTES:

1. Measured 10g SAR scaled to manufacturer stated output power upper tolerance limit.

4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was the dosimetric assessment of the EUT described in section 3. The tests were performed in configurations for devices operated next to a person's body. The examinations were carried out with the dosimetric assessment system DASY52 described in Section 6.

4.1 The IEEE Standard C95.1 , FCC Exposure Criteria, and IC Exposure Criteria

The FCC limits are set by CFR 47 FCC rule parts 1.1307 and 2.1093. The IC limits are set by RSS 102, Issue 5 and Safety Code 6 (2015). The limits are derived from the recommendations in IEEE C95.1-1999 (ANSI/IEEE C95.1-1999), "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz."

4.2 SAR Limit

In this report the comparison between the exposure limits and the SAR data is made using the spatial peak SAR.

Having in mind a worst case consideration, the SAR limit is valid for uncontrolled environment and portable transmitters. The SAR values have to be averaged over a mass of 1g (SAR1g) and 10g (SAR10g) with the shape of a cube.

Standard	Exposure Condition	Average SAR (W/kg)	Mass Average (g)
FCC CFR 47 Part 2.1093 (d)(2)	Partial-Body	1.6	1
FCC CFR 47 Part 2.1093 (d)(2)	Hands, Wrists, Feet and Ankles	4.0	10
RSS 102, Issue 5 Safety Code 6 (2015)	Localized Head and Trunk	1.6	1
RSS 102, Issue 5 Safety Code 6 (2015)	Localized Limbs	4.0	10

5 Measurement Procedure

The Federal Communications Commission (FCC) requires routine dosimetric assessment of mobile telecom-communications devices, either by laboratory measurement techniques or by computational modeling, prior to equipment authorization or use. The measurement procedure shall be performed according to IEEE 1528:2013. The following KDB publications have additionally been applied:

447498 D01 V06 – General RF Exposure Guidance
865664 D01 V01R04 – SAR measurement 100 MHz to 6 GHz
941225 D01 V03R01 – SAR Measurement Procedures for 3G Devices

Industry Canada (IC) requirements and measurement techniques regarding RF exposure are described in RSS-102, Issue 5, which refers to the latest version of IEEE 1528 and IEC 62209. IC follows many of the same procedures as applied for compliance with FCC requirements regarding EUT specific technologies and form factors. IC allows the use of the above listed KDBs in most aspects as described in IC Notice 2012-DRS1203 regarding Applicability of Latest FCC RF Exposure KDB Procedures (Publication Date: October 24, 2012) and Other Procedures. Additionally the following guideline is used:

5.1 General Requirements

SAR evaluation was performed in a laboratory with an environment which avoids influence on SAR measurements by ambient EM sources and any reflection from the environment itself. The ambient temperature was in the range of 18°C to 25°C and 30-70% humidity. Simulating liquid temperature did not deviate more than 2°C throughout SAR evaluation.

5.2 Body-worn and Other Configurations

Test Position
The body-worn configurations shall be tested with the supplied accessories (belt-clips, holsters, etc.) attached to the device in normal use configuration. Devices with a headset output shall be tested with a connected headset.

Test to be Performed
For purpose of determining test requirements, accessories may be divided into two categories: those that do not contain metallic components and those that do. For multiple accessories that do not contain metallic components, the device may be tested only with that accessory which provides the closest spacing to the body. For multiple accessories that contain metallic components, the device must be tested with each accessory that contains a unique metallic component. If multiple accessories share an identical metallic component, only the accessory that provides the closest spacing to the body must be tested. If the manufacturer provides none body-worn accessories a separation distance of 1.5 cm between the back of the device and the flat phantom is recommended. Other separation distances may be used, but they shall not exceed 2.5 cm. In these cases, the device may use body-worn accessories that provide a separation distance greater than that tested for the device provided however that the accessory contains no metallic components.

For devices with retractable antenna the SAR test shall be performed with the antenna fully extended and fully retracted. Other factors that may affect the exposure shall also be tested. For example, optional antennas or optional battery packs which may significantly change the volume, lengths, flip open/closed, etc. of the device, or any other accessories which might have the potential to considerably increase the peak spatial-average SAR value.

5.3 System Check

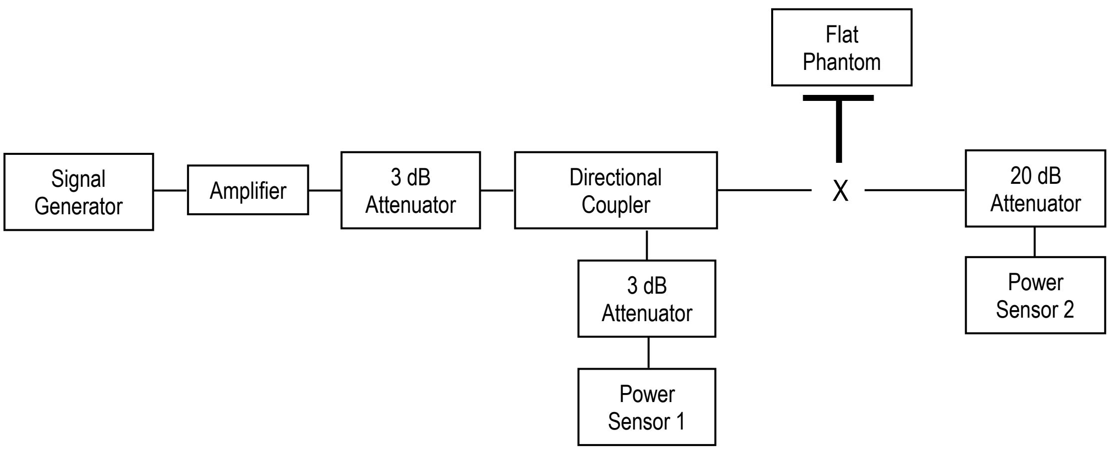
The purpose of the system check is to verify that the system operates within its specifications. System check is performed within 24 hours prior to compliance testing for each liquid type and frequency band. The system check result is verified to be within ±10% of the reference dipole source as measured during calibration of the dipole.

Phantom Set-Up
A flat phantom is used with the same tissue-equivalent liquid that will be used during compliance testing. The dipole feed point is placed at the center of the flat phantom and the dipole arms are aligned with the major axis.

Standard Source
A reference dipole source is used to irradiate the phantom. The dipole is placed under the bottom of the phantom and centred with its axis parallel to the longest dimension of the phantom. A low loss spacer is used to establish the correct distance between the top surface of the dipole and the bottom surface of the phantom. For frequencies below 1 GHz, a spacing of 15 mm is used. For frequencies above 1 GHz, a spacing of 10 mm is used. The dipole has a return loss of less than -20 dB at the resonant frequency.

5.4 System Check Procedure

The test set-up is as follows:



1. The cable at the output of the directional coupler is connected to the 20 dB attenuator.
2. The signal generator is adjusted until the desired input power to the dipole is measured at power sensor 2. The forward power of the directional coupler is measured with power sensor 1 and noted for step 4.
3. The cable at the output of the directional coupler is connected to the dipole source.
4. The signal generator is adjusted until power sensor 1 measures the same power as in step 2.
5. A SAR measurement is performed with the dipole source radiating.
6. During the system check test, the power measured by power sensor 1 is monitored to ensure the power does not drift.
7. At the conclusion of the SAR measurement, the SAR result is normalized to a dipole input power of 1 W and compared to the 1 W reference SAR value in the dipole calibration report. The difference between the measured SAR and the reference SAR is verified to be within ±10%.

5.5 Procedure for assessing the peak spatial-average SAR

Step 1: Power reference measurement:

Prior to the SAR test, a local SAR measurement should be taken at a user-selected spatial reference point to monitor power variations during testing.

Step 2: Area scan

The measurement procedures for evaluating SAR associated with wireless handsets typically start with a coarse measurement grid in order to determine the approximate location of the local peak SAR values. This is referred to as the "area scan" procedure. The SAR distribution is scanned along the inside surface of typically half of the head of the phantom but at least larger than the areas projected (normal to the phantom's surface) by the handset and antenna. An example grid is given in Figure 4. The distance between the measured points and phantom surface should be less than 8 mm, and should remain constant (variation less than $\pm$ 1 mm) during the entire scan in order to determine the locations of the local peak SAR with sufficient precision. The distance between the measurement points should enable the detection of the location of local maximum with an accuracy of better than half the linear dimension of the tissue cube after interpolation. The approximate locations of the peak SARs should be determined from area scan. Since a given amplitude local peak with steep gradients may produce lower spatial-average SAR than slightly lower amplitude peaks with less steep gradients, it is necessary to evaluate the other peaks as well. However, since the spatial gradients of local SAR peaks are a function of wavelength inside the tissue simulating liquid and incident magnetic field strength, it is not necessary to evaluate peaks that are less than –2dB of the local maximum. Two-dimensional spline algorithms [Press, et al, 1996], [Brishoual, 2001] are typically used to determine the peaks and gradients within the scanned area. If the peak is closer than one-half of the linear dimension of the 1 g or 10 g tissue cube to the scan border, the measurement area should be enlarged if possible, e.g., by tilting the probe or the phantom (see Figure 5).

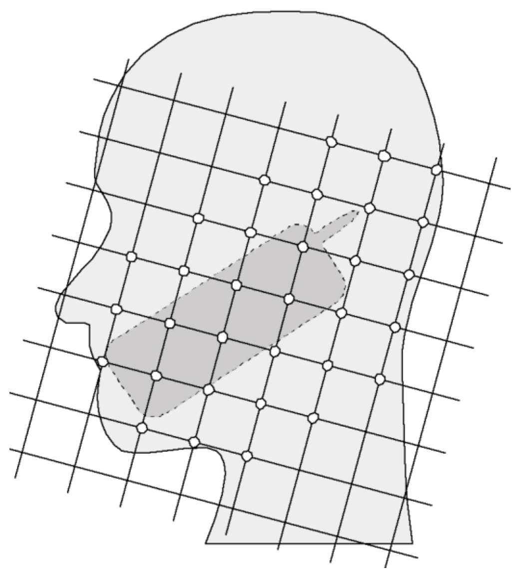


Figure 4 – Example of an area scan including the position of the handset. The scanned area (white dots) should be larger than the area projected by the handset and antenna.

The SPEAG DASY SAR system uses a mechanical sensor detection to find the phantom surface. To decrease test time, the DASY software allows the operator to choose an option where the SAR probe will reuse measurement locations from a previous identical area scan. With this option enabled, the DASY system will not use mechanical sensor detection to find the phantom surface. Locations of each measurement point of the area scan is taken at the same locations as an identical area scan if one is available. Area scans that reused location of measurement points is noted in the result plots under DASY Configuration > Sensor-Surface.

Step 3: Zoom scan

In order to assess the peak spatial SAR values averaged over a 1 g and 10 g cube, fine resolution volume scans, called "zoom scans", are performed at the peak SAR locations determined during the "area scan." The zoom scan volume should have at least 1.5 times the linear dimension of either a 1 g or a 10 g tissue cube for whichever peak spatial-average SAR is being evaluated. The peak local SAR locations that were determined in the area scan (interpolated value) should be on the centerline of the zoom scans. The centerline is the line that is normal to the surface and in the center of the volume scan. If this is not possible, the zoom scan can be shifted but not by more than half the dimension of the 1 g or a 10 g tissue cube.

The maximum spatial-average SAR is determined by a numerical analysis of the SAR values obtained in the volume of the zoom scan, whereby interpolation (between measured points) and extrapolation (between surface and closest measured points) routines should be applied. A 3-D-spline algorithm [Press, et al, 1996], [Kreyszig, 1983], [Brishoual, 2001] can be used for interpolation and a trapezoidal algorithm for the integration (averaging). Scan resolutions of larger than 2 mm can be used provided the uncertainty is evaluated according to E (see E.5).

In some areas of the phantom, such as the jaw and upper head region, the angle of the probe with respect to the line normal to the surface might become large, e.g., at angles larger than ± 30º (see Figure 5), which may increase the boundary effect to an unacceptable level. In these cases, a change in the orientation of the probe and/or the phantom is recommended during the zoom scan so that the angle between the probe housing tube and the line normal to the surface is significantly reduced (<30º).

Step 4: Power reference measurement

The local SAR should be measured at exactly the same location as in Step 1. The absolute value of the measurement drift (the difference between the SAR measured in Step 4 and Step 1) should be recorded in the uncertainty budget. It is recommended that the drift be kept within ± 5%. If this is not possible, even with repeat testing, additional information may be used to demonstrate the power stability during the test. Power reference measurements can be taken after each zoom scan, if more than one zoom scan is needed. However, the drift should always be referred to the initial state with fully charged battery.

5.6 Determination of the largest peak spatial-average SAR

In order to determine the largest value of the peak spatial-average SAR of a handset, all device positions, configurations and operational modes should be tested for each frequency band according to steps 1 to 3 below.

Step 1: The tests of 6.4 should be conducted at the channel that is closest to the center of the transmit frequency band (*fc*) for:

a) all device positions (cheek and tilt, for both left and right sides of the SAM phantom,

b) all configurations for each device position in (a), e.g. antenna extended and retracted, and

c) all operational modes for each device position in (a) and configuration in (b) in each frequency band, e.g. analog and digital.

If more than three frequencies need to be tested, (i.e., Nc > 3), then all frequencies, configurations and modes must be tested for all of the above positions.

Step 2: For the condition providing highest spatial peak SAR determined in Step 1 conduct all tests of 6.4 at all other test frequencies, e.g. lowest and highest frequencies. In addition, for all other conditions (device position, configuration and operational mode) where the spatial peak SAR value determined in Step 1 is within 3dB of the applicable SAR limit, it is recommended that all other test frequencies should be tested as well.

Step 3: Examine all data to determine the largest value of the peak spatial-average SAR found in Steps 1 to 2.

5.7 SAR Scaling Using the Tune-Up Scaling Factor

Conducted output power is tested to check if the EUT is transmitting at the maximum power allowed according to the declared maximum power including tune-up power tolerances. When the conducted output power is less than the maximum output power including tolerance, the measured SAR values are scaled up to the maximum output power including tolerance to ensure all production units are within SAR limits.

The tune-up power scaling factor is a multiplicative factor. The tune-up power scaling factor is calculated as:

10 ^ [(Maximum Output Power Including Tolerance – Measured Conducted Output Power) / 10]

Where

Maximum Output Power Including Tolerance: dBm

Measured Conducted Output Power: dBm

Example SAR scaling calculation:

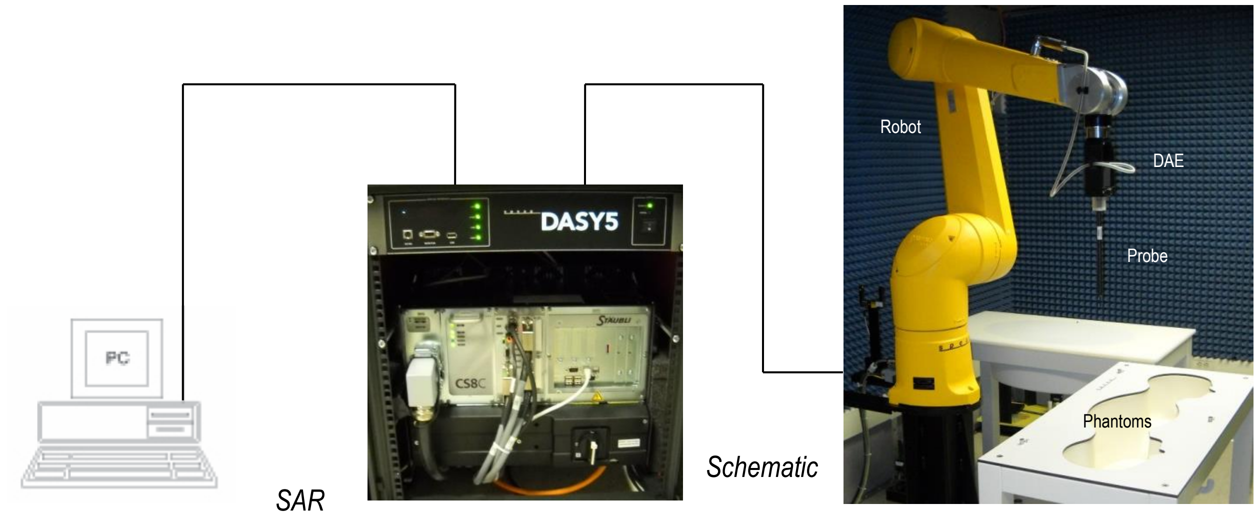
Measured Conducted Output Power (dBm)	Maximum Output Power Including Tolerance (dBm)	Tune-Up Power Scaling Factor	Measured 1g SAR (W/kg)	Scaled/Reported SAR value (W/kg)
32.0	32.5	1.12	1.0	1.12

6 The Measurement System

6.1 Robot system specification

The SAR measurement system being used is the SPEAG DASY52 system, which consists of a Stäubli TX90XL 6-axis robot arm and CS8c controller, SPEAG SAR Probe, Data Acquisition Electronics, and SAM Twin Phantom. The robot is used to articulate the probe to programmed positions inside the phantom to obtain the SAR readings from the EUT.

The system is controlled remotely from a PC, which contains the software to control the robot and data acquisition equipment. The software also displays the data obtained from test scans.



Schematic diagram of the SAR measurement system

In operation, the system first does an area (2D) scan at a fixed depth within the liquid from the inside wall of the phantom. When the maximum SAR point has been found, the system will then carry out a 3D scan centered at that point to determine volume averaged SAR level.

6.2 Isotropic E-Field Probe for Dosimetric Measurements

The probes are constructed using three orthogonal dipole sensors arranged on an interlocking, triangular prism core. The probes have built-in shielding against static charges and are contained within a PEEK cylindrical enclosure material at the tip. Probe calibration is described in the probe's calibration certificate.

6.3 Data Acquisition Electronics

The DAE contains a signal amplifier, multiplexer, 16bit A/D converter and control logic. It uses an optical link for communication with the DASY5 system. The DAE has a dynamic range of -100 to 300 mV. It also contains a two step probe touch detector for mechanical surface detection and emergency robot stop.

6.4 Phantoms

The Twin SAM V4.0 Phantom is designed to specifications defined in IEEE 1528 and IEC/EN 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. The material shell thickness is 2mm +/- 0.2 mm at the flat section and 6mm +/- 0.2 mm at the ear reference point. The relative permativity is 3.5 +/- 0.5 and the loss tangent is ≤ 0.05 for frequencies ≤ 6 GHz.

Additionally, the Oval Flat ELI V4.0 Phantom is designed to specification defined in IEEE 1528 and IEC/EN 62209-2. It enables the dosimetric evaluation of body mounted usage. The material thickness is 2mm +/- 0.2 mm. For frequencies ≤ 6 GHz, the relative permativity is 4 +/- 1 and the loss tangent is ≤ 0.05. The bottom plate is 600 x 400 mm elliptical shape with a depth of 190 mm.

6.5 Interpolation and Extrapolation schemes

The interpolation, extrapolation and maximum search routines are all based on the modifed
Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation. The routines construct a once-continuously differentiable function that interpolates the measurement values.

7 Uncertainty Assessment

The uncertainty budget is included as required by Industry Canada RSS-102. and as applicable for the FCC when The highest measured SAR in a band is ≥ 1.5W/kg per KDB 865664 section 2.8.2.

7.1 Measurement Uncertainty Budget According to IEEE 1528:2013

The uncertainty values for components specified were evaluated according to the procedures of *IEEE 1528-2013, NIST 1297 1994 edition and ISO Guide to the Expression of Uncertainty in Measurements (GUM)*.

a	*b*	*c*	*d*	*e = f(d,k)*	*f*	*g*	*h = c x f / e*	*i = c x f / e*	*k*
Uncertainty Component	**Sec.**	**Tol. (± %)**	**Prob. Dist.**	**Div.**	**c_i (1-g)**	**c_i (10-g)**	**1-g u_i (±%)**	**10-g u_i (±%)**	**v_i**
Measurement System									
Probe Calibration	E2.1	6.55	N	1	1	1	6.55	6.55	∞
Axial Isotropy	E2.2	4.7	R	√3	0.7	0.7	1.9	1.9	∞
Hemispherical Isotropy	E2.2	9.6	R	√3	0.7	0.7	3.9	3.9	∞
Boundary Effect	E2.3	2	R	√3	1	1	1.2	1.2	∞
Linearity	E2.4	4.7	R	√3	1	1	2.7	2.7	∞
System Detection Limits	E2.4	1	R	√3	1	1	0.6	0.6	∞
Probe Modulation Response	E2.5	2.4	R	√3	1	1	1.4	1.4	∞
Readout Electronics	E2.6	0.3	N	1	1	1	0.3	0.3	∞
Response Time	E2.7	0.8	R	√3	1	1	0.5	0.5	∞
Integration Time	E2.8	2.6	R	√3	1	1	1.5	1.5	∞
RF Ambient Noise	E6.1	3	R	√3	1	1	1.7	1.7	∞
RF Ambient Reflections	E6.1	3	R	√3	1	1	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E6.2	0.8	R	√3	1	1	0.5	0.5	∞
Probe Positioning with respect to Phantom Shell	E6.3	6.7	R	√3	1	1	3.9	3.9	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E5.2	4	R	√3	1	1	2.3	2.3	∞
Test sample Related									
Test Sample Positioning	E4.2	2.9	N	1	1	1	2.9	2.9	*145*
Device Holder Uncertainty	E4.1	3.6	N	1	1	1	3.6	3.6	*5*
Output Power Variation - SAR drift measurement	E2.9	5	R	√3	1	1	2.9	2.9	∞
SAR Power Scaling	E.6.5	0	R	√3	1	1	0.0	0.0	∞
Phantom and Tissue Parameters									
Phantom Uncertainty (shape and thickness tolerances)	E3.1	6.6	R	√3	1	1	3.8	3.8	∞
Uncertainty in SAR Correction	E.3.2	1.9	R	√3	1	0.84	1.9	1.6	∞
Liquid Conductivity Target - tolerance	E3.3	2.5	R	√3	0.78	0.71	2.0	1.8	∞
Liquid Permittivity Target tolerance	E3.3	2.5	R	√3	0.26	0.26	0.7	0.7	∞
Liquid Conductivity - Temp uncertainty	E3.4	3.4	N	√3	0.78	0.71	2.7	2.4	∞
Liquid Permittivity - Temp uncertainty	E3.4	0.4	N	√3	0.23	0.26	0.1	0.1	∞
Combined Standard Uncertainty			RSS				**12.7**	12.6	748
Expanded Uncertainty (95% CONFIDENCE INTERVAL)			*k*= 2.00705				**25.4**	25.2	

7.2 Measurement Uncertainty Budget According to EN 62209-2

A measurement uncertainty assessment has been undertaken following guidance given in IEC/EN-622090-2. Some of the uncertainty contributions are site-specific and, for these, CETECOM, Inc. has assessed the uncertainty contributions arising from local environmental and procedural factors. The resultant uncertainty budget, following the assessment template given IEC/EN-62209-2 is shown below:

Uncertainty Component	Sec.	Tol. (± %)	Prob. Dist.	Div.	c_i (1-g)	c_i (10-g)	1-g u_i (±%)	10-g u_i (±%)	v_i
Measurement System									
Probe Calibration	7.2.2.1	6.55	N	1	1	1	6.55	6.55	∞
Axial Isotropy	7.2.2.2	4.7	R	√3	0.7	0.7	1.9	1.9	∞
Hemispherical Isotropy	7.2.2.2	9.6	R	√3	0.7	0.7	3.9	3.9	∞
Boundary Effect	7.2.2.6	2.0	R	√3	1	1	1.2	1.2	∞
Linearity	7.2.2.3	4.7	R	√3	1	1	2.7	2.7	∞
Probe Modulation Response	7.2.2.4	2.4	R	√3	1	1	1.4	1.4	∞
System Detection Limits	7.2.2.5	1.0	R	√3	1	1	0.6	0.6	∞
Readout Electronics	7.2.2.7	0.3	N	1	1	1	0.3	0.3	∞
Response Time	7.2.2.8	0.8	R	√3	1	1	0.5	0.5	∞
Integration Time	7.2.2.9	2.6	R	√3	1	1	1.5	1.5	∞
RF Ambient Noise	7.2.4.5	3.0	R	√3	1	1	1.7	1.7	∞
RF Ambient Reflections	7.2.4.5	3.0	R	√3	1	1	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	7.2.3.1	0.8	R	√3	1	1	0.5	0.5	∞
Probe Positioning with respect to Phantom Shell	7.2.3.3	6.7	R	√3	1	1	3.9	3.9	∞
Post Processing	7.2.5	4.0	R	√3	1	1	2.3	2.3	∞
Test sample Related									
Test Sample Positioning	7.2.3.4.3	2.9	N	1	1	1	2.9	2.9	145
Device Holder Uncertainty	7.2.3.4.2	3.6	N	1	1	1	3.6	3.6	5
Power Scaling	L.3	0	R	√3	1	1	0.0	0..0	∞
Output Power Variation - SAR drift measurement	7.2.2.10	5.0	R	√3	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty (shape and thickness tolerances)	7.2.3.2	7.9	R	√3	1	1	4.6	4.6	∞
Algorithm for correcting SAR for deviations in permittivity and conductivity	7.2.4.3	1.9	R	√3	1	0.84	1.1	0.9	∞
Liquid Conductivity - measurement uncertainty	7.2.4.3	2.5	R	√3	0.78	0.71	1.1	1.0	∞
Liquid Permittivity - measurement uncertainty	7.2.4.3	2.5	R	√3	0.26	0.26	0.3	0.4	∞
Temperature Uncertainty – Conductivity	7.2.4.4	3.4	R	√3	0.78	0.71	1.5	1.4	∞
Temperature Uncertainty – Permittivity	7.2.4.4	0.4	R	√3	0.23	0.26	0.1	0.1	∞
Combined Standard Uncertainty			RSS				**12.5**	12.5	748
Expanded Uncertainty (95% CONFIDENCE INTERVAL)			k= 2.00705				**25.1**	25.0	

8 Test Results Summary

8.1 Measured Conducted Average Output Power

Measurement uncertainty for conducted measurements is ±0.5dB
Upper Power Tolerance Limits are from the Operational Description of this product.

2.4 GHz WLAN – 802.11 b/g/n HT20

Average power measured using Power Sensor.

Channel	Frequency [MHz]	Average Power [dBm]		
		802.11b	802.11g	802.11n, HT20
1	2412	17.69	15.2	14.38
6	2437	17.7	15.53	14.6
7	2442	17.52	15.51	14.51
11	2462	17.3	14.78	13.78
13	2472	17.34	14.9	13.9
Upper Power Tolerance Limit		19	18	17

Bluetooth v2.1 + EDR
Average power measured using Power Sensor..

Channel	Frequency [MHz]	Average Power [dBm]		
		GFSK	π/4 DQPSK	8-DPSK
0	2402	9.47	7.69	7.92
39	2441	9.71	8.25	8.19
78	2480	9.82	8.42	8.38

Bluetooth v4.0 – Low Energy
Average power measured using Power Sensor.

Channel	Frequency [MHz]	Average Power [dBm]
		GFSK
0	2402	6.39
20	2442	6.78
39	2480	7.02

WCDMA
Average Power Measured using the CMU

Band	Channel	Frequency [MHz]	12.2kbps RMC Average Power [dBm]	Factory Upper Tolerance
WCDMA FDD V	4132	826.4	23.42	24.5
	4183	836.6	23.45	
	4233	846.6	23.56	
WCDMA FDD II	9262	1852.4	23.2	24.5
	9400	1880	23.21	
	9538	1907.6	23.11	

HSDPA

Settings are according to FCC KDB 941225 D01, "SAR Measurement Procedures for 3G Devices" section "Release 5 HSDPA Data Devices"

Average power measured using a Rhode and Schwarz CMU 200. Reference Rhode and Schwarz application note 1CM72: Operation Guide for HSDPA Test Setup according to 3GPP TS 34.121, section 2.2.

The following measurements and the measurements in Sections 8.2 and 8.3 were taken from the Cellular module filing reports

Report Number 1506FR22-01 issued by A Test Lab Techno Corp. Issued Aug. 03, 2015 and

Report Number 1506FR21-01 issued by A Test Lab Techno Corp. Issued Aug. 04, 2015 for FCC-ID: RI7LE910NAV2

HSDPA

Band	Channel	Frequency [MHz]	Sub-test 1	Sub-test 2	Sub-test 3	Sub-test 4
			Average Power [dBm]	Average Power [dBm]	Average Power [dBm]	Average Power [dBm]
WCDMA FDD V	4132	826.4	22.51	22.36	21.98	21.93
	4183	836.6	22.56	22.41	22.05	21.99
	4233	846.6	22.4	22.23	21.86	21.78
WCDMA FDD II	9262	1852.4	22.61	22.48	22.08	22.4
	9400	1880	22.57	22.42	22.01	21.96
	9538	1907.6	22.49	22.32	21.91	21.86

HSPA

Settings are according to FCC KDB 941225 D01, "SAR Measurement Procedures for 3G Devices" section "Release 6 HSPA Data Devices"

Average power measured using a Rhode and Schwarz CMU 200. Reference Rhode and Schwarz application note 1CM73: Operation Guide for HSUPA Test Setup according to 3GPP TS 34.121, section 2.1 and 2.2.

Band	Channel	Frequency [MHz]	Average Power [dBm]				
			Sub-test 1	Sub-test 2	Sub-test 3	Sub-test 4	Sub-test 5
FDD V	4132	826.4	21.84	19.8	20.78	19.75	21.69
	4175	835	21.88	19.86	20.84	19.81	21.75
	4233	846.6	21.71	19.65	20.62	119.58	21.54
FDD II	9262	1852.4	21.98	19.95	20.92	19.92	21.87
	9400	1880	21.91	19.87	20.82	19.83	21.77
	9538	1907.6	21.81	19.76	20.7	19.72	21.65

8.2 LTE QPSK

Band	Bandwidth [MHz]	Channel	Frequency [MHz]	# RB / RB Position						
				100% / Low	50% / Low	50% / Mid	50% / High	1 / Low	1 / Mid	1 / High
				Average	Average	Average	Average	Average	Average	Average
2	20	18700	1860	22.17	22.32	22.19	22.19	23.31	23.27	23.22
		18900	1880	22.32	22.44	22.39	22.33	23.41	23.38	23.24
		19100	1900	22.27	22.34	22.32	22.28	23.26	23.15	23.02
	15	18675	1857.5	22.3	22.34	22.32	22.32	23.33	23.29	23.22
		18900	1880	22.39	22.48	22.43	22.4	23.43	23.32	23.28
		19125	1902.5	22.27	22.32	22.31	22.29	23.38	23.14	23.02
	10	18650	1855	22.23	22.33	22.3	22.25	23.3	23.2	23
		18900	1880	22.36	22.41	22.41	22.38	23.29	23.28	23.24
		19150	1905	22.22	23.25	23.17	22.89	23.25	23.17	22.89
	5	18625	1852.5	22.18	22.36	22.35	22.25	23.22	23.16	22.95
		18900	1880	22.32	22.46	22.46	22.44	23.4	23.36	23.21
		19175	1907.5	22.29	22.35	22.34	22.31	23.24	23.17	22.98
	3	18615	1851.5	22.19	22.34	22.32	22.22	23.23	23.21	23.15
		18900	1880	22.37	22.41	22.4	22.39	23.39	23.3	23.26
		19185	1908.5	22.22	22.35	22.32	22.27	23.21	23.1	22.96
	1.4	18607	1850.7	22.39	23.14	23.09	23.07	23.25	23.21	23.17
		18900	1880	22.42	23.31	23.29	23.25	23.38	23.37	23.35
		19193	1909.3	22.22	23.04	23.01	22.99	23.09	23.08	23.05
4	20	20050	1720	22.02	22.08	22.03	22.03	23.08	22.95	22.83
		20175	1732.5	21.91	22.04	21.92	21.91	23.02	22.91	22.73
		20300	1745	21.82	21.96	21.85	21.83	22.99	22.9	22.88
	15	20025	1717.5	21.96	22.06	22.04	21.99	23.11	23.03	22.9
		20175	1732.5	21.95	22.04	22.03	22.02	23.01	22.98	22.86
		20325	1747.5	21.84	22.03	21.99	21.94	23.07	23	22.95
	10	20000	1715	22	22.15	22.06	22.05	23.07	22.93	22.88
		20175	1732.5	21.92	21.96	21.96	21.93	22.88	22.86	22.84
		20350	1750	21.87	21.94	21.91	21.89	22.96	22.86	22.84
	5	19975	1712.5	21.98	22.08	22.04	21.99	23.01	22.97	22.95
		20175	1732.5	21.92	22.03	22.01	22	22.89	22.86	22.79
		20375	1752.5	21.89	22.02	21.96	21.94	22.88	22.85	22.82
	3	19965	1711.5	22.01	22.15	22.14	22.13	22.99	22.97	22.92
		20175	1732.5	21.9	22.04	21.97	21.93	22.89	22.86	22.84
		20385	1753.5	21.84	21.96	21.91	21.87	22.87	22.86	22.84
	1.4	19957	1710.7	22.13	23.05	23.01	22.99	23.12	23.09	23.07
		20175	1732.5	22.01	22.84	22.81	22.82	22.92	22.89	22.87
		20393	1754.3	21.94	22.87	22.86	22.83	22.99	22.9	22.89

5	10	20600	844	21.62	21.72	21.7	21.67	22.77	22.6	22.57
		20525	836.5	21.61	21.73	21.7	21.66	22.76	22.72	22.59
		20450	829	21.68	21.72	21.71	21.71	22.79	22.76	22.64
	5	20625	846.5	21.68	21.8	21.79	21.69	22.74	22.74	22.65
		20525	836.5	21.7	21.78	21.74	21.71	22.61	22.61	22.56
		20425	826.5	21.65	21.84	21.77	21.7	22.77	22.63	22.61
	3	20635	847.5	21.62	21.74	21.7	21.64	22.71	22.68	22.64
		20525	836.5	21.68	21.77	21.76	21.71	22.71	22.71	22.63
		20415	825.5	21.71	21.84	21.82	21.76	22.9	22.78	22.71
	1.4	20643	848.3	21.73	22.7	22.69	22.68	22.74	22.72	22.71
		20525	836.5	21.83	22.67	22.66	22.6	22.76	22.72	22.69
		20407	824.7	21.81	22.76	22.67	22.64	22.81	22.8	22.77
13	10	23230	782	21.72	22.21	22.17	22.12	22.74	22.65	22.59
	5	23205	779.5	21.21	21.93	21.92	21.59	22.82	22.43	22.32
		23230	782	21.45	22.06	21.9	21.47	22.86	22.84	22.35
		23255	784.5	21.44	22.06	21.76	21.48	22.88	22.78	22.75
12	10	23780	709	21.62	21.72	21.7	21.67	22.77	22.6	22.57
		23790	710	21.61	21.73	21.7	21.66	22.76	22.72	22.59
		23800	711	21.68	21.72	21.71	21.71	22.79	22.76	22.64
	5	23755	706.5	21.68	21.8	21.79	21.69	22.74	22.74	22.65
		23790	710	21.7	21.78	21.74	21.71	22.61	22.61	22.56
		23825	713.5	21.65	21.84	21.77	21.7	22.77	22.63	22.61
	3	23745	705.5	21.62	21.74	21.7	21.64	22.71	22.68	22.64
		23790	710	21.68	21.77	21.76	21.71	22.73	22.71	22.63
		23835	714.5	21.71	21.84	21.82	21.76	22.86	22.78	22.71
	1.4	23737	704.7	21.73	22.7	22.69	22.68	22.74	22.72	22.71
		23790	710	21.83	22.67	22.66	22.6	22.76	22.72	22.69
		23843	715.3	21.81	22.76	22.67	22.64	22.81	22.8	22.77

Note: Maximum Tune Up Tolerance for LTE Bands is 24 dBm

8.3 LTE 16 QAM

Band	Bandwidth [MHz]	Channel	Frequency [MHz]	# RB / RB Position						
				100% / Low	50% / Low	50% / Mid	50% / High	1 / Low	1 / Mid	1 / High
				Average	Average	Peak Power	Average	Average	Average	Average
2	20	18700	1860	21.33	21.41	21.35	21.34	22.37	22.22	22.17
		18900	1880	21.35	21.49	21.46	21.43	22.38	22.37	22.28
		19100	1900	21.35	21.44	21.42	21.37	22.77	22.17	22.12
	15	18675	1857.5	21.29	21.52	21.51	21.37	22.25	22.23	22
		18900	1880	21.47	21.53	21.51	21.48	22.59	22.49	22.29
		19125	1902.5	21.45	21.51	21.48	21.46	22.2	22.13	22.09
	10	18650	1855	21.27	21.51	21.51	21.31	22.32	22.19	22.08
		18900	1880	21.42	21.57	21.48	21.44	22.54	22.51	22.15
		19150	1905	21.38	21.43	21.41	21.39	22.42	22.23	21.79
	5	18625	1852.5	21.24	21.44	21.43	21.34	22.46	22.21	22.02
		18900	1880	21.37	21.44	21.41	21.38	22.67	22.28	22.07
		19175	1907.5	21.34	21.53	21.5	21.43	22.49	22.22	21.76
	3	18615	1851.5	21.29	21.4	21.39	21.37	22.47	22.26	22.09
		18900	1880	21.41	21.46	21.43	21.42	22.56	22.22	22.12
		19185	1908.5	21.29	21.38	21.33	21.32	22.37	22.34	21.79
	1.4	18607	1850.7	21.43	22.21	22.2	22.18	22.61	22.35	22.33
		18900	1880	21.5	22.49	22.48	22.17	22.66	22.64	22.5
		19193	1909.3	21.47	22.09	22.06	22.05	22.26	22.12	22.1
4	20	20050	1720	20.93	21.02	20.97	20.95	22.38	22.31	21.54
		20175	1732.5	20.84	21.02	20.99	20.93	22.26	21.96	21.62
		20300	1745	20.83	20.88	20.87	20.86	22.33	22.23	21.78
	15	20025	1717.5	20.92	21.08	21.01	21.01	22.37	22.27	21.91
		20175	1732.5	20.92	21.11	21.06	20.95	21.91	21.72	21.7
		20325	1747.5	20.75	21.02	20.92	20.9	22.35	22.17	22.14
	10	20000	1715	21.03	21.09	21.07	21.06	22.02	21.88	21.71
		20175	1732.5	20.91	21.03	21.02	20.95	22.21	22.05	21.8
		20350	1750	20.77	20.96	20.84	20.83	22.27	22.19	21.82
	5	19975	1712.5	20.97	21.11	21.09	21.04	22.3	22.05	21.85
		20175	1732.5	20.98	21.07	21.01	20.99	22.17	22.06	21.7
		20375	1752.5	20.77	20.98	20.95	20.84	21.86	21.83	21.57
	3	19965	1711.5	20.94	21.17	21.1	21	22.41	21.9	21.73
		20175	1732.5	20.87	21	20.94	20.9	22.22	22.05	21.8
		20385	1753.5	20.83	20.92	20.88	20.88	21.96	21.86	21.61
	1.4	19957	1710.7	21.06	22.04	21.99	21.93	22.42	22.16	22.11
		20175	1732.5	21.07	22.08	21.97	21.75	22.22	22.14	22.11
		20393	1754.3	20.96	21.81	21.77	21.73	21.94	21.92	21.92

5	10	20600	844	20.54	20.63	20.61	20.58	21.59	21.54	21.49
		20525	836.5	20.57	20.64	20.64	20.61	21.92	21.81	21.33
		20450	829	20.56	20.68	20.67	20.64	21.93	21.8	21.64
	5	20625	846.5	20.58	20.71	20.64	20.59	21.93	21.81	21.59
		20525	836.5	20.53	20.63	20.61	20.6	21.9	21.65	21.48
		20425	826.5	20.61	20.92	20.86	20.74	21.95	21.7	21.58
	3	20635	847.5	20.54	20.71	20.57	20.55	21.97	21.52	21.34
		20525	836.5	20.38	20.74	20.68	20.59	21.95	21.7	21.29
		20415	825.5	20.61	20.8	20.69	20.67	21.7	21.61	21.59
	1.4	20643	848.3	20.71	21.63	21.55	21.31	21.77	21.71	21.65
		20525	836.5	20.64	21.68	21.5	21.42	21.86	21.83	21.8
		20407	824.7	20.69	21.69	21.63	21.6	21.94	21.93	21.85
13	10	23230	782	20.58	21.46	21.35	21.01	21.91	21.75	21.55
	5	23205	779.5	20.61	21.06	20.87	20.81	21.96	21.88	21.16
		23230	782	20.33	21.13	20.95	20.56	21.94	21.8	21.66
		23255	784.5	20.49	21.05	21.01	20.86	22.02	21.72	21.64
12	10	23780	709	20.54	20.63	20.61	20.58	21.59	21.54	21.49
		23790	710	20.57	20.64	20.64	20.61	21.92	21.81	21.33
		23800	711	20.56	20.68	20.67	20.64	21.93	21.8	21.64
	5	23755	706.5	20.58	20.71	20.64	20.59	21.93	21.81	21.59
		23790	710	20.53	21.9	21.65	21.48	21.9	21.65	21.48
		23825	713.5	20.61	20.92	20.86	20.74	21.95	21.7	21.58
	3	23745	705.5	20.54	20.71	20.57	20.55	21.97	21.52	21.34
		23790	710	20.38	20.74	20.68	20.59	21.95	21.7	21.29
		23835	714.5	20.61	20.8	20.69	20.67	21.7	21.61	21.59
	1.4	23737	704.7	20.71	21.63	21.55	21.31	21.77	21.71	21.65
		23790	710	20.64	21.68	21.5	21.42	21.86	21.83	21.8
		23843	715.3	20.69	21.69	21.63	21.6	21.94	21.93	21.85

Note: Maximum Tune Up Tolerance for LTE Bands is 24 dBm

Stand-Alone SAR Evaluation Exclusion

Antenna	Operation Mode	SAR Evaluation Exclusion Reason
Cellular	HSDPA, HSPA, HSPA+	Using KDB 941225 D01, section 2.1, WCDMA, Rel 99 is the primary mode and HSDPA, HSPA, and HSPA+ are the secondary modes. SAR evaluation is not required when the maximum output power and tune-up tolerance for the secondary mode is ≤ ¼ dB higher than the primary mode.

8.4 Test Positions and Configurations

Exposure Condition	Distance	Position	Positioning Photo (Appendix B)
Extremity SAR	0 mm	Top Edge	Photo 2
		Front	Photo 3
		Right Edge	Photo 4
Body SAR	0 mm	Back	Photo 5

The unit's typical orientation is on the dash or windshield of a vehicle with the display perpendicular to the dash.
The unit would on occasion be interacted with hand. For good measure a body measurements were done to the back of the unit
To cover the case where a user placed the device on their lap while interacting with it.

Measured SAR values are scaled up to the manufacturer's stated output power. These SAR values are the reported SAR values as described in FCC KDB 447498.

8.5 SAR Results for Extremities

Band	Operation Mode	Position / Distance mm	Ch #	Freq. (MHz)	Measured SAR 1g (W/kg)	Tune Up Power Scaling Factor[1]	Power Drift (dB)	Reported SAR 1g (W/kg)	Results (Appendix A)
FDD II	12.2kbps RMC	Front / 0 mm	9400	1880	1.18	1.35	0	1.593	
FDD II	12.2kbps RMC	Top Edge / 0 mm	9400	1880	1.79	1.35	0.17	2.417	Plot 1
FDD II	12.2kbps RMC	Bottom Edge / 0 mm	9400	1880	0.0139	1.35	0.05	0.019	
FDD II	12.2kbps RMC	Left Edge / 0 mm	9400	1880	0.0148	1.35	0.1	0.020	
FDD II	12.2kbps RMC	Right Edge / 0 mm	9400	1880	0.0521	1.35	0.1	0.070	
FDD II	12.2kbps RMC	Top Edge / 0 mm	9262	1850.4	1.77	1.35	0.13	2.3895	
FDD II	12.2kbps RMC	Top Edge / 0 mm	9538	1907.6	1.65	1.35	0.2	2.2275	
FDD V	12.2kbps RMC	Front / 0 mm	4183	836.6	0.443	1.27	0.18	0.563	
FDD V	12.2kbps RMC	Top Edge / 0 mm	4183	836.6	0.504	1.27	0.04	0.640	Plot 2
FDD V	12.2kbps RMC	Bottom Edge / 0 mm	4183	836.6	0.00715	1.27	0.13	0.009	
FDD V	12.2kbps RMC	Left Edge / 0 mm	4183	836.6	0.0426	1.27	0.17	0.054	
FDD V	12.2kbps RMC	Right Edge / 0 mm	4183	836.6	0.00728	1.27	0.14	0.009	
FDD V	12.2kbps RMC	*Top Edge* / 0 mm	4132	826.4	0.484	1.27	0.16	0.615	
FDD V	12.2kbps RMC	*Top Edge* / 0 mm	4233	846.6	0.496	1.27	0.08	0.630	
LTE B2	10 MHz 1RB Low	Front / 0 mm	18900	1880	1.06	1.29	-0.1	1.367	
LTE B2	10 MHz 1RB Low	Top Edge / 0 mm	18900	1880	1.58	1.29	0.15	2.038	
LTE B2	10 MHz 1RB Low	Bottom Edge / 0 mm	18900	1880	0.0125	1.29	-0.02	0.016	
LTE B2	10 MHz 1RB Low	Left Edge / 0 mm	18900	1880	0.014	1.29	-0.05	0.018	
LTE B2	10 MHz 1RB Low	Right Edge / 0 mm	18900	1880	0.049	1.29	0.2	0.063	
LTE B2	10 MHz 1RB Low	Top Edge / 0 mm	18600	1860	1.66	1.29	0.1	2.141	Plot 3
LTE B2	10 MHz 1RB Low	Top Edge / 0 mm	19150	1905	1.56	1.29	0.09	2.012	
LTE B2	10 MHz 25RB Low	Front / 0 mm	18900	1880	0.782	1.29	0	1.009	
LTE B2	10 MHz 25RB Low	Top Edge / 0 mm	18900	1880	1.19	1.29	0.11	1.535	
LTE B2	10 MHz 25RB Low	Bottom Edge / 0 mm	18900	1880	0.0125	1.29	0.15	0.016	
LTE B2	10 MHz 25RB Low	Left Edge / 0 mm	18900	1880	0.0125	1.29	0.13	0.016	
LTE B2	10 MHz 25RB Low	Right Edge / 0 mm	18900	1880	0.0374	1.29	0.18	0.048	
LTE B2	10 MHz 25RB Low	Top Edge / 0 mm	18600	1860	1.25	1.29	0.07	1.613	
LTE B2	10 MHz 25RB Low	Top Edge / 0 mm	19150	1905	1.17	1.29	-0.08	1.509	
LTE B2	10 MHz 50RB Low	Top Edge / 0 mm	18900	1880	1.15	1.29	-0.1	1.484	
LTE B4	10 MHz 1RB Low	Front / 0 mm	20175	1732.5	0.962	1.26	-0.04	1.212	
LTE B4	10 MHz 1RB Low	Top Edge / 0 mm	20175	1732.5	1.72	1.26	0.12	2.167	
LTE B4	10 MHz 1RB Low	Bottom Edge / 0 mm	20175	1732.5	0.0261	1.26	0.08	0.033	
LTE B4	10 MHz 1RB Low	Left Edge / 0 mm	20175	1732.5	0.0399	1.26	-0.05	0.050	
		right Edge / 0mm	20175		0.0489	1.26	0.06	0.062	
LTE B4	10 MHz 1RB Low	Top Edge / 0 mm	20050	1720	1.75	1.26	0.19	2.205	Plot 4
LTE B4	10 MHz 1RB Low	Top Edge / 0 mm	20300	1745	1.62	1.26	0.03	2.041	
LTE B4	10 MHz 25RB Low	Front / 0 mm	20175	1732.5	0.776	1.26	0.07	0.978	
LTE B4	10 MHz 25RB Low	Top Edge / 0 mm	20175	1732.5	1.33	1.26	0.13	1.676	
LTE B4	10 MHz 25RB Low	Bottom Edge / 0 mm	20175	1732.5	0.0187	1.26	-0.06	0.024	
LTE B4	10 MHz 25RB Low	Left Edge / 0 mm	20175	1732.5	0.0305	1.26	0.16	0.038	
LTE B4	10 MHz 25RB Low	Right Edge / 0 mm	20175	1732.5	0.0393	1.26	0.14	0.050	
LTE B4	10 MHz 25RB Low	Top Edge / 0 mm	20050	1720	1.35	1.26	0.17	1.701	
LTE B4	10 MHz 25RB Low	Top Edge / 0 mm	20300	1745	1.26	1.26	0.11	1.588	
LTE B4	10 MHz 50RB Low	Top Edge / 0 mm	20175	1732.5	1.31	1.26	0.19	1.651	

LTE B5	10 MHz 1RB Low	Front / 0 mm	20525	836.5	0.418	1.43	0.09	0.598	
LTE B5	10 MHz 1RB Low	Top Edge / 0 mm	20525	836.5	0.442	1.43	0.11	0.632	
LTE B5	10 MHz 1RB Low	Bottom Edge / 0 mm	20525	836.5	0.00731	1.43	0.17	0.010	
LTE B5	10 MHz 1RB Low	Left Edge / 0 mm	20525	836.5	0.0379	1.43	-0.13	0.054	
LTE B5	10 MHz 1RB Low	Right Edge / 0 mm	20525	836.5	0.00691	1.43	0.15	0.010	
LTE B5	10 MHz 1RB Low	Top Edge / 0 mm	20450	829	0.45	1.43	0.13	0.644	Plot 5
LTE B5	10 MHz 1RB Low	Top Edge / 0 mm	20600	844	0.413	1.43	0.14	0.591	
LTE B5	10 MHz 25RB Low	Front / 0 mm	20525	836.5	0.329	1.43	0.16	0.470	
LTE B5	10 MHz 25RB Low	Top Edge / 0 mm	20525	836.5	0.349	1.43	0.09	0.499	
LTE B5	10 MHz 25RB Low	Bottom Edge / 0 mm	20525	836.5	0.00675	1.43	0.11	0.010	
LTE B5	10 MHz 25RB Low	Left Edge / 0 mm	20525	836.5	0.0323	1.43	0.13	0.046	
LTE B5	10 MHz 25RB Low	Right Edge / 0 mm	20525	836.5	0.00794	1.43	-0.04	0.011	
LTE B5	10 MHz 25RB Low	Top Edge / 0 mm	20450	829	0.356	1.43	0.02	0.509	
LTE B5	10 MHz 25RB Low	Top Edge / 0 mm	20600	844	0.313	1.43	0.16	0.448	
LTE B12	10 MHz 1RB Low	Front / 0 mm	23095	707.5	0.475	1.31	-0.09	0.622	
LTE B12	10 MHz 1RB Low	Top Edge / 0 mm	23095	707.5	0.49	1.31	0.15	0.642	
LTE B12	10 MHz 1RB Low	Left Edge / 0 mm	23095	707.5	0.0726	1.31	0.05	0.095	
LTE B12	10 MHz 1RB Low	Right Edge / 0 mm	23095	707.5	0.0537	1.31	0.14	0.070	
LTE B12	10 MHz 1RB Low	Top Edge / 0 mm	23010	699	0.451	1.31	0.18	0.591	
LTE B12	10 MHz 1RB Low	Top Edge / 0 mm	23179	716	0.494	1.31	0.49	0.647	Plot 6
LTE B12	10 MHz 25RB Low	Front / 0 mm	23095	707.5	0.383	1.31	0.07	0.502	
LTE B12	10 MHz 25RB Low	Top Edge / 0 mm	23095	707.5	0.392	1.31	0.14	0.514	
LTE B12	10 MHz 25RB Low	Left Edge / 0 mm	23095	707.5	0.0677	1.31	0.11	0.089	
LTE B12	10 MHz 25RB Low	Right Edge / 0 mm	23095	707.5	0.0496	1.31	0.18	0.065	
LTE B12	10 MHz 25RB Low	Top Edge / 0 mm	23010	699	0.368	1.31	0.2	0.482	
LTE B12	10 MHz 25RB Low	Top Edge / 0 mm	23179	716	0.4	1.31	0.1	0.524	
LTE B12	10 MHz 50RB Low	Top Edge / 0 mm	23095	707.5	0.395	1.31	0.11	0.517	
LTE B13	10 MHz 1RB Low	Front / 0 mm	23230	782	0.49	1.2	-0.18	0.588	
LTE B13	10 MHz 1RB Low	Top Edge / 0 mm	23230	782	0.495	1.2	-0.22	0.594	
LTE B13	10 MHz 1RB Low	Left Edge / 0 mm	23230	782	0.0546	1.2	0.11	0.06552	
LTE B13	10 MHz 1RB Low	Right Edge / 0 mm	23230	782	0.0235	1.2	-0.03	0.0282	
LTE B13	10 MHz 1RB Low	Top Edge / 0 mm	23180	777	0.533	1.2	-0.13	0.6396	Plot 7
LTE B13	10 MHz 1RB Low	Top Edge / 0 mm	23279	786.9	0.516	1.2	0.05	0.6192	
LTE B13	10 MHz 25RB Low	Front / 0 mm	23230	782	0.407	1.2	0.06	0.4884	
LTE B13	10 MHz 25RB Low	Top Edge / 0 mm	23230	782	0.399	1.2	0.1	0.4788	
LTE B13	10 MHz 25RB Low	Left Edge / 0 mm	23230	782	0.062	1.2	0.09	0.0744	
LTE B13	10 MHz 25RB Low	Right Edge / 0 mm	23230	782	0.012	1.2	0.03	0.0144	
LTE B13	10 MHz 25RB Low	Top Edge / 0 mm	23180	777	0.394	1.2	0.13	0.4728	
LTE B13	10 MHz 25RB Low	Top Edge / 0 mm	23279	786.9	0.394	1.2	0.18	0.4728	
LTE B13	10 MHz 50RB Low	Top Edge / 0 mm	23095	707.5	0.397	1.2	0.1	0.4764	
2.4 GHz	WLAN 80211b	Front / 0 mm	6	2437	0.0937	1.55	0.11	0.145	
2.4 GHz	WLAN 80211b	Top Edge / 0 mm	6	2437	0.0872	1.55	0.1	0.135	
2.4 GHz	WLAN 80211b	Left Edge / 0 mm	6	2437	0.00865	1.55	-0.16	0.013	
2.4 GHz	WLAN 80211b	Right Edge / 0 mm	6	2437	0.0969	1.55	0.13	0.150	
2.4 GHz	WLAN 80211b	Corner Edge / 0 mm	6	2437	0.0529	1.55	0.1	0.082	
2.4 GHz	WLAN 80211b	Top Edge / 0 mm	1	2412	0.0647	1.55	0.03	0.100	
2.4 GHz	WLAN 80211b	Top Edge / 0 mm	11	2462	0.0969	1.55	0.09	0.150	
2.4 GHz	WLAN 80211b	Top Edge / 0 mm	6	2437	0.0894	1.55	0	0.139	
2.4 GHz	WLAN 80211b	Top Edge / 0 mm	1	2412	0.0637	1.55	0.11	0.099	
2.4 GHz	WLAN 80211b	Top Edge / 0 mm	11	2462	0.107	1.55	-0.01	0.166	Plot 8
2.4 GHz	WLAN 80211g	Top Edge / 0 mm	6	2437	0.0552	1.55	0.03	0.086	

8.6 SAR Results for Body

Band	Operation Mode	Position / Distance mm	Ch #	Freq. (MHz)	Measured SAR 1g (W/kg)	Tune Up Power Scaling Factor[1]	Power Drift (dB)	Reported SAR 1g (W/kg)	Results (Appendix A)
FDD II	12.2kbps RMC	Back / 0mm	9400	1880	0.572	1.35	0.01	0.772	
FDD II	12.2kbps RMC	Back / 0mm	9262	1850.4	0.634	1.35	-0.11	0.856	Plot 9
FDD II	12.2kbps RMC	Back / 0mm	9538	1907.6	0.56	1.35	-0.18	0.756	
FDD V	12.2kbps RMC	Back / 0mm	4183	836.6	0.514	1.27	-0.01	0.653	Plot 10
FDD V	12.2kbps RMC	Back / 0mm	4132	826.4	0.513	1.27	0.01	0.652	
FDD V	12.2kbps RMC	Back / 0mm	4233	846.6	0.478	1.27	0.12	0.607	
LTE B2	10 MHz 1RB Low	Back / 0mm	18600	1860	0.647	1.29	-0.07	0.835	Plot 11
LTE B2	10 MHz 1RB Low	Back / 0mm	18900	1880	0.539	1.29	-0.08	0.695	
LTE B2	10 MHz 1RB Low	Back / 0mm	19150	1905	0.552	1.29	-0.06	0.712	
LTE B2	10 MHz 50RB Low	Back / 0mm	18900	1880	0.437	1.29	-0.15	0.695	
LTE B2	10 MHz 50RB Low	Back / 0mm	18900	1880	0.423	1.29	0.13	0.712	
LTE B4	10 MHz 1RB Low	Back / 0mm	20175	1732.5	0.786	1.26	0	0.990	Plot 12
LTE B4	10 MHz 25RB Low	Back / 0mm	20175	1732.5	0.629	1.26	-0.08	0.793	
LTE B5	10 MHz 1RB Low	Back / 0mm	20525	836.5	0.437	1.43	0.04	0.625	Plot 13
LTE B5	10 MHz 25RB Low	Back / 0mm	20525	836.5	0.0303	1.43	0.14	0.043	
LTE B12	10 MHz 1RB Low	Back / 0mm	23095	707.5	0.473	1.31	0.04	0.620	Plot 14
LTE B12	10 MHz 25RB Low	Back / 0mm	23095	707.5	0.381	1.31	.0.00	0.499	
LTE B13	10 MHz 1RB Low	Back / 0mm	23230	782	0.553	1.2	0.07	0.664	Plot 15
LTE B13	10 MHz 25RB Low	Back / 0mm	23230	782	0.548	1.2	-0.03	0.658	
2.4 GHz	WLAN 80211b	Back / 0 mm	6	2437	0.33	1.55	-0.18	0.512	Plot 16
2.4 GHz	WLAN 80211g	Back / 0 mm	6	2437	0.213	1.55	0.1	0.330	

Notes: The tune up power scaling factor is a multiplicative factor. See section 5.7 of this report for more details.

8.7 SAR Measurement Variability

SAR measurement variability is assessed when the initial measured 1g SAR is ≥ 0.80 W/kg. If the measured SAR value of the initial repeated measurement is < 1.45 W/kg with ≤ 20% variation, only one repeated measurement is required to affirm that the results are not expected to have substation variations. A second repeated measurement is required only if the measured results for the initial repeated measurement is within 10% of the SAR limit and vary by more than 20%.
The same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR threshold. Hence for extremity SAR exposure variability is accessed when the initial measured SAR is ≥ 2.0 W/kg.

Note: Max SAR measured for body exposure was less than 0.8 and Max SAR measured for extremity exposure was less than 2.0.

8.8 Simultaneous Transmission SAR

Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneously transmitting antenna. When the sum of 1-g or 10-g SAR of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit, SAR test exclusion applies to that simultaneous transmission configuration. When the sum is greater than the SAR limit, the SAR to peak location separation ratio (SPLSR) procedures for simultaneous transmission SAR test exclusion can be applied.

8.9 Body SAR Simultaneous Transmission

Body SAR Simulations Transmission					
	Cellular Band	Wifi	Sum 1-g SAR	SAR Sum ≤ 1.6 W/kg	SPLSR Required
FDD II + WiFi	0.856	0.512	1.367	Y	N
FDD V + Wifi	0.653	0.512	1.164	Y	N
LTE B2 + Wifi	0.835	0.512	1.346	Y	N
LTE B4 + Wifi	0.990	0.512	1.502	Y	N
LTE B5 + Wifi	0.625	0.512	1.136	Y	N
LTE 12 + Wifi	0.620	0.512	1.131	Y	N
LTE 13 + Wifi	0.664	0.512	1.175	Y	N

Note: The Sum of Reported SAR Simulations Transmissions is below the limit and hence (SPLSR) procedures are not required.

8.10 Extremity SAR Simultaneous Transmission

Extremity SAR Simultaneous Transmission					
	Cellular Band	Wifi	Sum 10-g SAR	SAR Sum ≤ 4.0 W/kg	SPLSR Required
FDD 2 + Wifi	2.417	0.166	2.582	Y	N
FDD V + Wifi	0.640	0.166	0.806	Y	N
LTE B2 + Wifi	2.141	0.166	2.307	Y	N
LTE B4 + Wifi	2.205	0.166	2.371	Y	N
LTE B5 + Wifi	0.644	0.166	0.809	Y	N
LTE B12 + Wifi	0.647	0.166	0.813	Y	N
LTE B13 + Wifi	0.640	0.166	0.805	Y	N

Note: The Sum of Reported SAR Simulations Transmissions is below the limit and hence (SPLSR) procedures are not required.

8.11 Dipole verification

Prior to formal testing at each frequency band, system verification was performed in accordance with IEEE 1528. The 1 Watt reference SAR value is taken from the SPEAG dipole calibration report. All of the testing described in this report was performed within 24 hours of the system verification. The following results were obtained:

Date	Liquid Type	Frequency (MHz)	CW input at dipole feed (Watts)	1g SAR (W/kg)[1]	1 Watt reference SAR value (W/kg)	Difference reference SAR value to normalized SAR	Results (Appendix A)
9/14/2017	MSL	1900	1	35.9	38.8	-7.47%	Plot 17
9/29/2017	MSL	1900	1	35.8	38.8	-7.73%	Plot 18
9/15/2017	MSL	1900	1	35.4	38.8	-8.76%	Plot 19
9/12/2017	MSL	835	1	9.04	9.45	-4.34%	Plot 20
9/27/2017	MSL	835	1	9.37	9.45	-0.85%	Plot 21
9/17/2017	MSL	1750	1	33.3	36.1	-7.76%	Plot 22
10/8/2017	MSL	750	1	8.24	8.57	-3.85%	Plot 23
9/26/2017	MSL	2450	1	48.5	48.8	-0.61%	Plot 24
9/7/2017	MSL	835	1	9.31	9.45	-1.48%	Plot 25

9 References

1. [IEEE 1999] IEEE Std C95.1-1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, Inst. of Electrical and Electronics Engineers, Inc., December 1998.

2. [IEEE 2013] IEEE Std 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. Inst. of Electrical and Electronics Engineers, Inc., June 2013.

3. [NIST 1994] NIST: Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results, Technical Note 1297 (TN1297), United States Department of Commerce Technology Administration, National Institute of Standards and Technology, September 1994.

4. [FCC 20XX] Various FCC KDB Publications, < http://transition.fcc.gov/oet/ea/eameasurements.html#sar>

5. [IC 2015] RSS-102: Radio Frequency (RF) Exposure Compliance of Radio communication Apparatus (All Frequency Bands), Industry Canada, Issue 5, March 2015.

6. [IC 2012] Notice 2012-DRS1203: RE: APPLICABILITY OF LATEST FCC RF EXPOSURE KDB PROCEDURES (PUBLICATION DATE: OCTOBER 24, 2012) AND OTHER PROCEDURES, Industry Canada, December 2012

7. EN 62209-2:2010, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - 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)

10 Report History

Date	Report Name	Changes to Report.	Report Prepared By
2017/11/2	SAR-GARMI-047-17001-FCC	Initial Release	James Donnellan