



SAR Test Report

FOR:

Manufacturer:
UTC Fire & Security Americas Corporation, Inc

Model Name: XpressKEY
Model Number: 002210

FCC ID: TCZ-10103379G1
IC Certification Number: 1175F-10103379G1

Test Report #: SAR-UTCFI-008-15001-FCC

Date of Report: 2015-11-25



A2LA Accredited
FCC Recognized

IC Recognized #
3462B-1

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

1. Assessment	4
2. Administrative Data	5
2.1. Identification of the Testing Laboratory Issuing the SAR Test Report	5
2.2. Identification of the Client and Manufacturer	5
3. Equipment under Test (EUT)	6
3.1. General Specification of the Equipment under Test	6
3.2. Antenna Information	7
3.3. Technical Specification of Supported Radios	7
3.4. Identification of the Equipment Under Test (EUT)	8
3.5. Identification of Accessory equipment	8
3.6. Maximum SAR values	8
4. Subject of Investigation	9
4.1. The IEEE Standard C95.1 , FCC Exposure Criteria, and IC Exposure Criteria	9
4.2. SAR Limit	9
5. Measurement Procedure	10
5.1. General Requirements	10
5.2. Body-worn and Other Configurations	10
5.3. Procedure for assessing the peak spatial-average SAR	11
5.4. Determination of the largest peak spatial-average SAR	12
6. The Measurement System	13
6.1. Robot system specification	13
6.2. Isotropic E-Field Probe for Dosimetric Measurements	14
6.3. Data Acquisition Electronics	14
6.4. Phantoms	14
6.5. Interpolation and Extrapolation schemes	14
7. Uncertainty Assessment	15
7.1. Measurement Uncertainty Budget According to IEEE 1528:2013	15
7.1. Measurement Uncertainty Budget According to EN 62209	16
8. Test results summary	17
8.1. Measured Conducted Average Output Power	17
8.2. Stand-Alone SAR Evaluation Exclusion	19

8.3.	Test Positions and Configurations	20
8.4.	Device Related information.....	21
8.5.	SAR Results for Body	22
8.6.	SAR Measurement Variability	22
8.7.	Dipole verification	23
9.	References	24
10.	Report History.....	25

- 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 4 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 #
UTC Fire & Security Americas Corporation, Inc	Electronic Access Key for Real Estate Professionals	002210

Responsible for Testing Laboratory:

2015-11-25	Compliance	Josie Sabado (SAR Lab Manager)	
Date	Section	Name	Signature

Responsible for the Report:

2015-11-25	Compliance	James Donnellan (Sr. EMC Engineer)	
Date	Section	Name	Signature

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
Test Lab Manager	Josie Sabado
Responsible Project Manager	Laith Saman

2.2. Identification of the Client and Manufacturer

	Client	Manufacturer
Company	UTC Fire & Security Americas Corporation, Inc	UTC Fire & Security Americas Corporation, Inc
Street Address	4001 Fairview Industrial Dr SE	4001 Fairview Industrial Dr SE
City/Zip Code	Salem, Oregon 97302	Salem, Oregon 97302
Country	USA	USA

3. Equipment under Test (EUT)

3.1. General Specification of the Equipment under Test

Model No:	002210
FCC ID:	TCZ-10103379G1
IC Certification Number:	1175F-10103379G1
Product Marketing Name (PMN):	XpressKEY
Hardware Version Identification Number (HVIN):	002210
Firmware Version Identification Number (FVIN):	N/A
Host Marketing Name (HMN):	N/A
Product Type:	Portable
Prototype/Production:	Production
RF Exposure Environment:	General / Uncontrolled
Dimensions:	Length: 85mm, Width: 57mm, Depth: 18mm
Exposure Conditions:	Body worn / Body Supported
Supported Radios:	Gemalto PHS8-P : GSM/GPRS/EGPRS, MS Class 10, Power Class 4/1, Mobile Class B WCDMA/HSDPA /HSUPA/HSPA+, Power Class 3, HSDPA Cat.8 / HSUPA Cat.6 data rates DL: max. 7.2 Mbps, UL: max. 5.76 Mbps GPS ¹ receiver at 1.575 MHz
Power Back-Off Modes:	N/A
Simultaneous Transmission Configurations:	Cellular Only
Date of Testing:	2015-10-02 - 2015-11-19

NOTES: 1 GPS is a Receive only Radio.

3.2. Antenna Information

Antenna	Type	Internal / External	Frequency (MHz)	Manufacturer Stated Max Peak Gain (dBi)
1	Isolated Magnetic Dipole trace antenna	Internal	850 MHz	-0.6 dBi
			1900MHz	-0.6 dBi

3.3. Technical Specification of Supported Radios

Signal Type	Worst Case For Time Averaged Power Timeslots / Duty Cycle		Type(s) of Modulation	Band	Uplink Transmit Frequency Range (MHz)	Measured Maximum Conducted Output Power (dBm)
GSM GPRS	2	25 %	GMSK	GSM 850	824 – 849	28.8
GSM GPRS	2	25 %		PCS 1900	1850 - 1910	24.8
GSM EGPRS	2	25 %	GMSK, 8PSK	GSM 850	824 – 849	28.8
GSM EGPRS	2	25 %		PCS 1900	1850 - 1910	24.8
WCDMA	100 %		QPSK	FDD II	1850 - 1910	22.2
				FDD V	824 – 849	22.2
GPS ¹	N/A		N/A	L1	N/A	N/A

NOTES:

1. Bands are supported by the EUT, but outside of the scope of this test report.

3.4. Identification of the Equipment Under Test (EUT)

EUT #	IMEI / Serial Number	HW Version	SW Version
1	357330050619840.10	10103379G1 Rev A	2.0.0
2	12000622	10103379G1 Rev A	2.0.0

3.5. Identification of Accessory equipment

AE #	Type	Manufacturer	Model	Serial Number	Comments
1	Battery	-	Li-Ion 4.2VDC PN 101035001-	-	Rechargeable

3.6. Maximum SAR values

Per an inquiry to the FCC relating to SAR testing of this device, SAR values are scaled to 40% due to the low transmission duty cycle of this device.

Equipment Class	Exposure Condition	Measured 1g SAR (W/kg)	Maximum Reported 1g SAR ¹ (W/kg)	With 40% Duty Cycle Scaling Per FCC Inquiry 1g SAR W/Kg
PCT	Near the body	3.04	3.92	1.57

NOTES:

1. Measured 1g 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 4. 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 (SAR_{1g}) 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
RSS 102, Issue 4	Localized Head and Trunk	1.6	1

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 4, 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.

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. 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 ± 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).

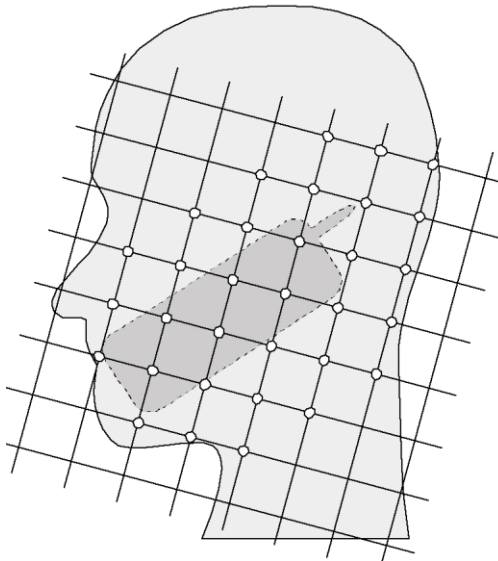


Figure 4 – Example of an area scan including the position of the handset. The scanned area (white dots) should be larger than the area projected by the handset and antenna.

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 $\pm 30^\circ$ (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 ($<30^\circ$).

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 $\pm 5\%$. 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.

5.4. 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 (f_c) 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., $N_c > 3$), 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.

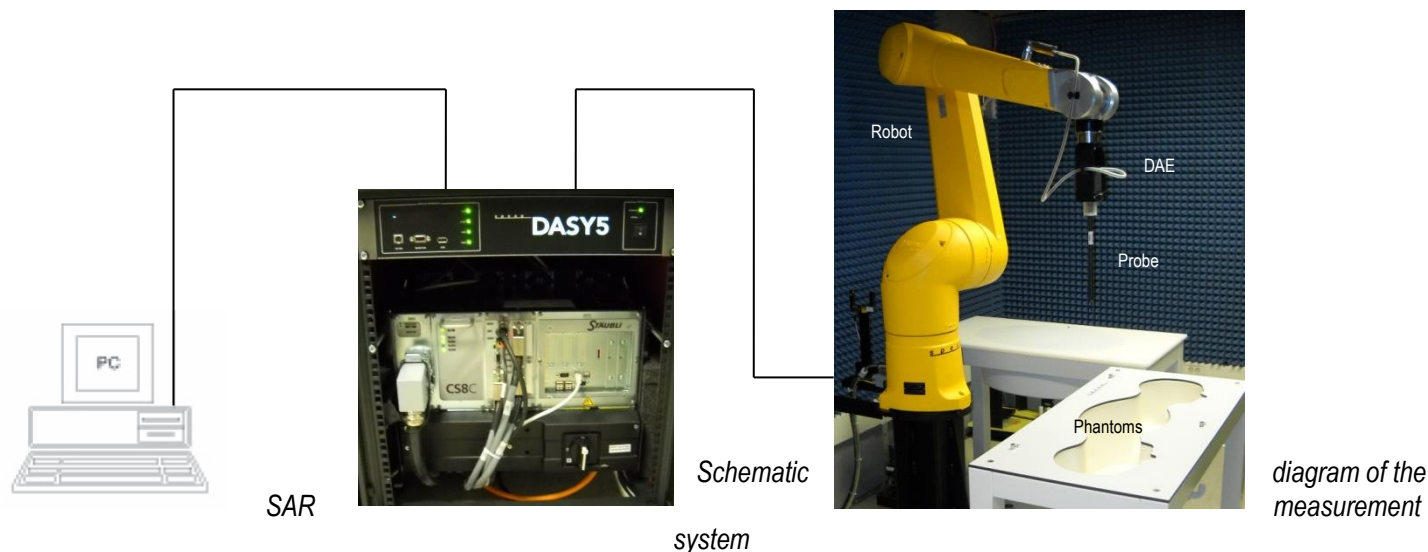
Step 3: Examine all data to determine the largest value of the peak spatial-average SAR found in Steps 1 to 2.

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.



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 modified 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 $\geq 1.5\text{W/kg}$ 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)*.

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e = f(d,k)</i>	<i>f</i>	<i>g = c x f / e</i>	<i>k</i>
Uncertainty Component	Sec.	Tol. ($\pm \%$)	Prob. Dist.	Div.	<i>c_i</i> (1-g)	1-g <i>u_i</i> ($\pm \%$)	<i>v_i</i>
Measurement System							
Probe Calibration	E2.1	5.5	N	1	1	5.5	∞
Axial Isotropy	E2.2	4.7	R	$\sqrt{3}$	0.7	1.9	∞
Hemispherical Isotropy	E2.2	9.6	R	$\sqrt{3}$	0.7	3.9	∞
Boundary Effect	E2.3	1.0	R	$\sqrt{3}$	1	0.6	∞
Linearity	E2.4	4.7	R	$\sqrt{3}$	1	2.7	∞
System Detection Limits	E2.5	1.0	R	$\sqrt{3}$	1	0.6	∞
Readout Electronics	E2.6	0.3	N	1	1	0.3	∞
Response Time	E2.7	0.8	R	$\sqrt{3}$	1	0.5	∞
Integration Time	E2.8	2.6	R	$\sqrt{3}$	1	1.5	∞
RF Ambient Noise	E6.1	3.0	R	$\sqrt{3}$	1	1.7	∞
RF Ambient Reflections	E6.1	3.0	R	$\sqrt{3}$	1	1.7	∞
Probe Positioner Mechanical Tolerance	E6.2	0.4	R	$\sqrt{3}$	1	0.2	∞
Probe Positioning with respect to Phantom Shell	E6.3	2.9	R	$\sqrt{3}$	1	1.7	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E5.2	1.0	R	$\sqrt{3}$	1	0.6	∞
Test sample Related							
Test Sample Positioning	E4.2	2.9	N	1	1	2.9	145
Device Holder Uncertainty	E4.1	3.6	N	1	1	3.6	5
Output Power Variation - SAR drift measurement	6.6.2	5.0	R	$\sqrt{3}$	1	2.9	∞
Phantom and Tissue Parameters							
Phantom Uncertainty (shape and thickness tolerances)	E3.1	4.0	R	$\sqrt{3}$	1	2.3	∞
Liquid Conductivity Target - tolerance	E3.2	5.0	R	$\sqrt{3}$	0.7	1.8	∞
Liquid Conductivity - measurement uncertainty	E3.3	2.5	N	1	0.7	1.6	∞
Liquid Permittivity Target tolerance	E3.2	5.0	R	$\sqrt{3}$	0.6	1.7	∞
Liquid Permittivity - measurement uncertainty	E3.3	2.5	N	1	0.6	1.5	∞
Combined Standard Uncertainty			RSS			$\pm 10.7\%$	
Expanded Uncertainty (95% CONFIDENCE INTERVAL)			<i>k</i> = 2.00705			$\pm 21.4\%$	

7.1. Measurement Uncertainty Budget According to EN 62209

A measurement uncertainty assessment has been undertaken following guidance given in IEC/EN-62209. 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 is shown below:

a	b	c	d	e = f(d,k)	f	g = c x f / e	k
Uncertainty Component	Sec.	Tol. (± %)	Prob. Dist.	Div.	c_i (1-g)	1-g u_i (±%)	v_i
Measurement System							
Probe Calibration	E2.1	5.5	N	1	1	5.5	∞
Axial Isotropy	E2.2	4.7	R	√3	0.7	1.9	∞
Hemispherical Isotropy	E2.2	9.6	R	√3	0.7	3.9	∞
Boundary Effect	E2.3	1.0	R	√3	1	0.6	∞
Linearity	E2.4	4.7	R	√3	1	2.7	∞
System Detection Limits	E2.5	1.0	R	√3	1	0.6	∞
Readout Electronics	E2.6	0.3	N	1	1	0.3	∞
Response Time	E2.7	0.8	R	√3	1	0.5	∞
Integration Time	E2.8	2.6	R	√3	1	1.5	∞
RF Ambient Noise	E6.1	3.0	R	√3	1	1.7	∞
RF Ambient Reflections	E6.1	3.0	R	√3	1	1.7	∞
Probe Positioner Mechanical Tolerance	E6.2	0.4	R	√3	1	0.2	∞
Probe Positioning with respect to Phantom Shell	E6.3	2.9	R	√3	1	1.7	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E5.2	1.0	R	√3	1	0.6	∞
Test sample Related							
Test Sample Positioning	E4.2	2.9	N	1	1	2.9	145
Device Holder Uncertainty	E4.1	3.6	N	1	1	3.6	5
Output Power Variation - SAR drift measurement	6.6.2	5.0	R	√3	1	2.9	∞
Phantom and Tissue Parameters							
Phantom Uncertainty (shape and thickness tolerances)	E3.1	4.0	R	√3	1	2.3	∞
Liquid Conductivity Target - tolerance	E3.2	5.0	R	√3	0.43	1.2	∞
Liquid Conductivity - measurement uncertainty	E3.3	2.5	N	1	0.43	1.1	∞
Liquid Permittivity Target tolerance	E3.2	5.0	R	√3	0.49	1.4	∞
Liquid Permittivity - measurement uncertainty	E3.3	2.5	N	1	0.49	1.2	∞
Combined Standard Uncertainty			RSS			± 10.5%	
Expanded Uncertainty (95% CONFIDENCE INTERVAL)			k= 2.00705			± 21.0%	

8. Test results summary

8.1. Measured Conducted Average Output Power

Measurement uncertainty for conducted measurements is ± 0.5 dB

GSM 850 Band – (E)GPRS

Average power measured using a Rhode and Schwarz CMU 200.

Number of Uplink Timeslots		Modulation	Channel / Frequency [MHz]						Burst Average Upper Power Tolerance Limit
			128 / 824.2		190 / 836.6		251 / 848.8		
			Measured Burst Average Power [dBm]	Calculated Time Average Power [dBm]	Measured Burst Average Power [dBm]	Calculated Time Average Power [dBm]	Measured Burst Average Power [dBm]	Calculated Time Average Power [dBm]	
GPRS	1	GMSK	29.8	20.8	29.8	20.8	29.7	20.7	30.5
	2		28.8	22.8	28.8	22.8	28.6	22.6	29.5
EGPRS	1	GMSK	29.7	20.7	29.8	20.8	29.6	20.6	30.5
	2		28.8	22.8	28.8	22.8	28.6	22.6	29.5
	1	8PSK	23.9	14.9	24	15	23.8	14.8	24.5
	2		23.9	17.9	24	18	23.8	17.8	24.5

PCS 1900 Band - (E)GPRS

Average power measured using a Rhode and Schwarz CMU 200.

Number of Uplink Timeslots		Modulation	Channel / Frequency [MHz]						Burst Average Upper Power Tolerance Limit
			512 / 1850.2		661 / 1880		810 / 1909.8		
			Measured Burst Average Power [dBm]	Calculated Time Average Power [dBm]	Measured Burst Average Power [dBm]	Calculated Time Average Power [dBm]	Measured Burst Average Power [dBm]	Calculated Time Average Power [dBm]	
GPRS	1	GMSK	25.7	16.7	25.7	16.7	25.5	16.5	26.5
	2		24.6	18.6	24.8	18.8	24.5	18.5	25.5
EGPRS	1	GMSK	25.7	16.7	25.6	16.6	25.5	16.5	26.5
	2		24.6	18.6	24.8	18.8	24.5	18.5	25.5
	1	8PSK	21.7	12.7	21.7	12.7	21.5	12.5	22.5
	2		21.8	15.8	21.8	15.8	21.5	15.5	22.5

WCDMA

Average power measured using a Rhode and Schwarz CMU 200.

Band	Channel	Frequency [MHz]	Average Power [dBm]	Upper Power Tolerance Limit
			12.2kbps RMC	
FDD II	9262	1852.4	22.2	22.5
	9400	1880	21.4	22.5
	9538	1907.6	21.5	22.5
FDD V	4132	826.4	22.2	22.5
	4175	835	22.0	22.5
	4233	846.6	21.7	22.5

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.

Band	Channel	Frequency [MHz]	Average Power [dBm]			
			Sub-test 1	Sub-test 2	Sub-test 3	Sub-test 4
WCDMA FDD II	9262	1852.4	20.83	20.89	20.56	20.59
	9400	1880	19.97	20.08	19.79	19.79
	9538	1907.6	20.14	20.23	19.94	19.95
WCDMA FDD V	4132	826.4	21.95	21.97	21.71	21.77
	4175	835	21.76	21.78	21.52	21.52
	4233	846.6	21.48	21.53	21.27	21.27

HSUPA

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
WCDMA FDD II	9262	1852.4	20.72	18.55	19.93	18.54	20.66
	9400	1880	19.85	17.91	19.11	17.87	19.94
	9538	1907.6	20	18.5	19.26	18.66	20
WCDMA FDD V	4132	826.4	21.61	19.4	20.18	19.73	21.62
	4175	835	21.45	19.8	20.71	20.18	21.44
	4233	846.6	21.2	19.7	20.41	19.87	21.2

8.2. Stand-Alone SAR Evaluation Exclusion

Antenna	Operation Mode	SAR Evaluation Exclusion Reason
Cellular	8PSK Modulation	Using KDB 941225 D01, section 2.1, GMSK modulation is the primary mode and 8PSK modulation is the secondary mode. SAR evaluation is not required when the maximum output power and tune-up tolerance for the secondary mode is $\leq \frac{1}{4}$ dB higher than the primary mode.
Cellular	HSDPA/ HSPA/ HSPA+	Using KDB 941225 D01, section 2.1 / Section 4.1 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 $\leq \frac{1}{4}$ dB higher than the primary mode.

8.3. Test Positions and Configurations

Exposure Condition	Distance	Position	Positioning Photo (Appendix B)
Body SAR	0 mm	Front	Photo 2
		Back	Photo 3

High and low channels are evaluated for the worst case positions at least once for each exposure condition regardless of the SAR value on the middle channel, according to guidance in Industry Canada Notice 2012-DRS1203. FCC only requires high and low channels be evaluated when the SAR value on the middle channel is less than 3 dB below the limit.

For GSM bands, the uplink timeslot configuration with the highest source-based time-averaged output power is used for full SAR evaluation for body exposure positions.

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.

Configurations with multiple SAR values have at least one peak SAR within 2 dB of the primary peak.

8.4. Device Related information.

Per the manufacturers KDB inquiry including the information below the FCC has agreed to apply a duty of 40% to the 0mm SAR values. The details of the KDB inquiry including further documentation on which above decision is based on are filed with this application.

Device Operation Modes Summary Table:

	Scenario Description	Radio Module ON time	Max Occurance	Data Transmitted	Technology	TX slot
Scenario 1: Showing Upload	Agent approaches a lock box. User credentials are current. After IR handshake device sends one SMS message. Radio module is powered for 2 minutes (time based logic).	2 minutes	3-5 times / day	1 SMS: 160 characters	2G / 850 MHz / GSM.GPRS	2 TX slots
					2G / 1900MHz / GSM.GPRS	2 TX slots
					3G / 850 MHz / EDGE + UMTS + HSDPA	
					3G / 1900MHz / EDGE + UMTS + HSDPA	
Scenario 2: End of Showing	After a showing upload, GPS coordinates are monitored. After movement away from the property, an end of showing event is triggered. The radio is powered for 2 minutes and 1 SMS message is sent.	2 minutes	3-5 times / day	1 SMS: 160 characters	2G / 850 MHz / GSM.GPRS	2 TX slots
					2G / 1900MHz / GSM.GPRS	2 TX slots
					3G / 850 MHz / EDGE + UMTS + HSDPA	
					3G / 1900MHz / EDGE + UMTS + HSDPA	
Scenario 3: Credential Check	Twice a day the device checks for security credentials based on time of day. The radio is powered for 2 minutes and 1 SMS message is sent.	2 minutes	2 times / day	1 SMS: 160 characters	2G / 850 MHz / GSM.GPRS	2 TX slots
					2G / 1900MHz / GSM.GPRS	2 TX slots
					3G / 850 MHz / EDGE + UMTS + HSDPA	
					3G / 1900MHz / EDGE + UMTS + HSDPA	
Scenario 4: return to network coverage	The key has been off the network for a week. The user has been entering updates codes. They have shown a lot of property during this time and the key has queued up 100 events. The radio would be powered for 2 minutes and 100 SMS message would be sent.	2 minutes	1 time / 6 months	100 SMS: 16000 characters	2G / 850 MHz / GSM.GPRS	2 TX slots
					2G / 1900MHz / GSM.GPRS	2 TX slots
					3G / 850 MHz / EDGE + UMTS + HSDPA	
					3G / 1900MHz / EDGE + UMTS + HSDPA	
Scenario 5: Firmware Update	Supra sends a FW update to the key. The radio is most likely on a charger and it is late at night. The firmware image only contains the differences between the firmware already in the device and the new firmware. A small change in firmware results in an image of approximately <5kB. A large change to the firmware will result in an image of approximately 100kB.	3 minutes typical 5 minutes maximum	1 time / year	Data Session ACKs	2G / 850 MHz / GSM.GPRS	2 TX slots
					2G / 1900MHz / GSM.GPRS	2 TX slots
					3G / 850 MHz / EDGE + UMTS + HSDPA	
					3G / 1900MHz / EDGE + UMTS + HSDPA	

8.5. SAR Results for Body

Band	Operation Mode	Ch. #	Freq. (MHz)	Position / Distance mm	Measured SAR 1g (W/kg)	Reported SAR 1g (W/kg)	40% DC Corrected SAR 1g (W/kg)	Results (Appendix A)
GMS 850	2 TS	190	836.6	Front	0.92	1.09	0.43	Plot 1
GMS 850	2 TS	190	836.6	Back	1.16	1.36	0.55	Plot 2
GMS 850	2 TS	128	824.2	Back	1.28	1.50	0.60	Plot 3
GMS 850	2 TS	251	848.8	Back	1.04	1.28	0.51	Plot 4
GMS 850	2 TS	190	836.6	Back Variability	1.17	1.37	0.55	Plot 5
GSM1900	2 TS	661	1880	Front	0.57	0.67	0.27	Plot 6
GSM1900	2 TS	661	1880	Back	1.07	1.26	0.50	Plot 7
GSM1900	2 TS	512	1850.2	Back	1.13	1.39	0.56	Plot 8
GSM1900	2 TS	810	1909.8	Back	1.10	1.38	0.55	Plot 9
GSM1900	2 TS	661	1880	Back Variability	1.15	1.35	0.54	Plot 10
FDD V	12.2kbps RMC	4183	836.6	Front	0.83	0.93	0.37	Plot 11
FDD V	12.2kbps RMC	4183	836.6	Back	1.10	1.24	0.50	Plot 12
FDD V	12.2kbps RMC	4132	826.4	Back	1.48	1.67	0.67	Plot 13
FDD V	12.2kbps RMC	4233	846.6	Back	1.09	1.23	0.49	Plot 14
FDD V	12.2kbps RMC	4183	836.6	Back Variability	1.11	1.25	0.50	Plot 15
FDD II	12.2kbps RMC	9400	1880	Front	1.26	1.62	0.65	Plot 16
FDD II	12.2kbps RMC	9400	1880	Back	3.04	3.92	1.57	Plot 17
FDD II	12.2kbps RMC	9262	1850.4	Back	3.49	3.78	1.51	Plot 18
FDD II	12.2kbps RMC	9538	1907.6	Back	2.71	3.40	1.36	Plot 19
FDD II	12.2kbps RMC	9400	1880	Back Variability	2.98	3.84	1.54	Plot 20
FDD II	12.2kbps RMC	9400	1880	Back Variability	2.64	3.40	1.36	Plot 21
FDD II	12.2kbps RMC	9400	1880	Back Variability	2.98	3.84	1.54	Plot 22

8.6. 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 $\leq 20\%$ 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%.

Band	Operation Mode	Frequency (MHz)	Position	Measured 1g SAR (W/kg), initial	Repeated 1g SAR (W/kg)	Ratio of max SAR from repeated and initial measurement
FDD II	12.2kbps RMC	1880	Back	3.04	2.98	1.02
FDD II	12.2kbps RMC	1880	Back	3.04	2.64	1.15
FDD II	12.2kbps RMC	1880	Back	3.04	2.98	1.02
GSM 850	2 Timeslots / GMSK	836.6	Back	1.16	1.17	1.01
PCS 1900	2 Timeslots / GMSK	1880	Back	1.07	1.15	1.07
FDD V	12.2kbps RMC	836.6	Back	1.1	1.11	1.01

8.7. Dipole verification

Prior to formal testing at each frequency a 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
10-28-2015	MSL	835	1	9.42	9.3	+1.3%	Plot 23
10-27-2015	MSL	1900	1	37.5	40.2	-6.7%	Plot 24
10-30-2015	MSL	1900	1	36.5	40.2	-9.2%	Plot 25
11-19-2015	MSL	1900	1	38.1	40.2	-5.2%	Plot 26

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 Radiocommunication 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
2015-11-17	SAR-UTCFI-008-15001-FCC	First Version	James Donnellan
2015-11-25	SAR-UTCFI-008-15001-FCC	Added Variability Assessment and Updated based on Review	James Donnellan