SAR TEST REPORT

For

Trackimo LLC.

GPS Tracker

Model No.: TRKM010

Additional Model No.: TRKM011, TRKM012, TRKM013

Prepared for	:	Trackimo LLC.
Address	:	350NE 24th Street, Unit 104, Miami, Florida 33137, United States

Prepared by	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Address	:	1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China
Tel	:	(86)755-82591330
Fax	:	(86)755-82591332
Web	:	www.LCS-cert.com
Mail	:	webmaster@LCS-cert.com

Date of receipt of test sample	:	October 12, 2015
Number of tested samples	:	1
Serial number	:	Prototype
Date of Test	:	April 05, 2017~April 06, 2017
Date of Report	:	April 10, 2017

SAR TEST REPORT

Report Reference No. ....:	**LCS1510200864E**
Date Of Issue ....:	April 10, 2017
Testing Laboratory Name........:	**Shenzhen LCS Compliance Testing Laboratory Ltd.**
Address ....:	1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China
Testing Location/ Procedure.......:	Full application of Harmonised standards ■ Partial application of Harmonised standards □ Other standard testing method □
Applicant's Name......................:	**Trackimo LLC.**
Address ....:	350NE 24th Street, Unit 104, Miami, Florida 33137, United States
Test Specification:	
Standard ....:	IEEE 1528:2013/ KDB 447498/ KDB 941225 47CFR §2.1093
Test Report Form No. ....:	LCSEMC-1.0
TRF Originator ....:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Master TRF ....:	Dated 2014-09

Test Item Description. ....:	**GPS Tracker**
Trade Mark ....:	trackimo always there
Model/Type Reference ....:	TRKM010
Operation Frequency ....:	GSM 850/PCS1900, WCDMA Band II/V Bluetooth4.0(BLE Only)
Modulation Type ....:	GSM(GMSK, 8PSK), WCDMA/HSDPA/HSUPA(QPSK), Bluetooth(GFSK)
Ratings ....:	DC 3.7V by Li-ion battery(600mAh) Recharge Voltage: DC 5V/0.5A
Result ....:	**Positive**

Compiled by:	Supervised by:	Approved by:
Linda He		Gavin Liang
Linda He/ File administrators	Glin Lu/ Technique principal	Gavin Liang/ Manager

SAR -- TEST REPORT

Test Report No. : LCS1510200864E	April 10, 2017 Date of issue

Type / Model.........................	:	TRKM010
EUT.......................................	:	GPS Tracker
Applicant.............................	**:**	**Trackimo LLC.**
Address..................................	:	350NE 24th Street, Unit 104, Miami, Florida 33137, United States
Telephone.............................	:	/
Fax..	:	/
Manufacturer.......................	**:**	**Huizhou Light Of Science Technology Co.,LTD**
Address..................................	:	5/F., 85# Yangli Xincun, Zhongkai High Tech Development Zones, Huizhou City, Guangdong, China.
Telephone.............................	:	/
Fax..	:	/
Factory.................................	**:**	**Huizhou Light Of Science Technology Co.,LTD**
Address..................................	:	5/F., 85# Yangli Xincun, Zhongkai High Tech Development Zones, Huizhou City, Guangdong, China.
Telephone.............................	:	/
Fax..	:	/

Test Result	**Positive**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Revison History

Revision	Issue Date	Revisions	Revised By
00	April 10, 2017	Initial Issue	Gavin Liang

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1.TEST STANDARDS AND TEST DESCRIPTION

1.1. Test Standards

IEEE Std C95.1, 2005: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 KHz to 300 GHz. It specifies the maximum exposure limit of 1.6 W/kg as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.
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.
FCC Part 2.1093 Radiofrequency Radiation Exposure Evaluation:Portable Devices
KDB447498 D01 General RF Exposure Guidance v06 : Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies
KDB648474 D04, Handset SAR v01r03: SAR Evaluation Considerations for Wireless Handsets
KDB865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04 : SAR Measurement Requirements for 100 MHz to 6 GHz
KDB865664 D02 RF Exposure Reporting v01r02: RF Exposure Compliance Reporting and Documentation Considerations
KDB941225 D01 3G SAR Procedures v03r01: 3G SAR MEAUREMENT PROCEDURES

1.2. Test Description

The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power . And Test device is identical prototype.

1.3. General Remarks

Date of receipt of test sample	:	October 12, 2015
Testing commenced on	:	April 05, 2017
Testing concluded on	:	April 06, 2017

1.4. Product Description

The **Bluebird Inc.'s** Model: TRKM010 or the "EUT" as referred to in this report; more general information as follows, for more details, refer to the user's manual of the EUT.

General Description	
Product Name:	GPS Tracker
Trade Mark:	trackimo always there
Model/Type reference:	TRKM010
Listed Model(s):	TRKM010, TRKM011, TRKM012, TRKM013
Modulation Type:	GMSK for GSM;QPSK for WCDMA; GFSK for Bluetooth
Device category:	Portable Device
Exposure category:	General population/uncontrolled environment
EUT Type:	Production Unit
IMEI Number – Conducted power measurement	359074051336032
IMEI Number – SAR measurement	359074051336917
Hardware Version	/
Software Version:	/
Power supply:	DC 3.7V by Li-ion Battery(600mAh) Recharge Voltage: DC 5V/0.5A
Hotspot:	Supported, power not reduced when Hotspot open
The EUT is GSM,WCDMA, GPS Tracker. the GPS Tracker is intended for speech and Multimedia Message Service (MMS) transmission. It is equipped with GPRS class 12 for GSM850, PCS1900, WCDMA Band II, Band V, Bluetooth, and camera functions. For more information see the following datasheet	

Technical Characteristics	
GSM	
Support Networks	GSM, GPRS, 8PSK only Downlink for EDGE
Support Band	GSM850, PCS1900
Frequency	GSM850: 824.2~848.8MHz GSM1900: 1850.2~1909.8MHz
Power Class:	GSM850:Power Class 4 PCS1900:Power Class 1
Modulation Type:	GMSK for GSM/GPRS; 8PSK
Antenna Type	Internal Antenna, 1.0dBi(Max.)
GSM Release Version	R99
GPRS Multislot Class	12
EGPRS Multislot Class	Supported, onlyt downlink
DTM Mode	Not Supported
UMTS	
Support Networks	WCDMA RMC12.2K,HSDPA,HSUPA
Operation Band:	WCDMA Band II, Band V
Frequency Range	WCDMA Band II: 1852.4 ~ 1907.6MHz WCDMA Band V: 826.4 ~ 846.6MHz
Modulation Type:	QPSK for WCDMA/HSUPA/HSDPA
Power Class:	Class 3
WCDMA Release Version:	R99
HSDPA Release Version:	R8
HSUPA Release Version:	R6
DC-HSUPA Release Version:	Not Supported
Antenna Type	Internal Antenna, 1.0dBi(Max.)

Bluetooth	
Bluetooth Version:	V4.0(BLE Only)
Modulation:	GFSK(1Mbps)
Operation frequency:	2402MHz~2480MHz
Channel number:	40
Channel separation:	2MHz
Antenna Description	Integral Antenna, -3.0dBi(Max.)

1.5. Statement of Compliance

The maximum of results of SAR found during testing for TRKM010 are follows:

<Highest Reported standalone SAR Summary>

Classment Class	Frequency Band	Body-worn (Report 1g SAR(W/Kg)
PCB	GSM 850	0.746
	GSM1900	**0.904**
	WCDMA Band V	0.847
	WCDMA Band II	0.669

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-2005, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.

<Highest Reported simultaneous SAR Summary>

Exposure Position	Frequency Band	Reported SAR_{1-g} (W/kg)	Classment Class	Highest Reported Simultaneous Transmission SAR_{1-g} (W/Kg)
Body	GSM1900	0.904	PCB	**0.956**
	Bluetooth	0.052	DTS	

2.TEST ENVIRONMENT

2.1. Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

Site Description

EMC Lab. : CNAS Registration Number. is L4595.
FCC Registration Number. is 899208.
Industry Canada Registration Number. is 9642A-1.
ESMD Registration Number. is ARCB0108.
UL Registration Number. is 100571-492.
TUV SUD Registration Number. is SCN1081.
TUV RH Registration Number. is UA 50296516-001.

2.2. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	18-25 ° C
Humidity:	40-65 %
Atmospheric pressure:	950-1050mbar

2.3. SAR Limits

FCC Limit (1g Tissue)

EXPOSURE LIMITS	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	(Occupational / Controlled Exposure Environment)
Spatial Average(averaged over the whole body)	0.08	0.4
Spatial Peak(averaged over any 1 g of tissue)	1.6	8.0
Spatial Peak(hands/wrists/ feet/anklesaveraged over 10 g)	4.0	20.0

Population/Uncontrolled Environments are defined as locations where there is the exposure of individual who have no knowledge or control of their exposure.

Occupational/Controlled Environments are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure (i.e. as a result of employment or occupation).

2.4. Equipments Used during the Test

Test Equipment	Manufacturer	Type/Model	Serial Number	Calibration	
				Calibration Date	Calibration Due
PC	Lenovo	G5005	MY42081102	N/A	N/A
Signal Generator	Angilent	E4438C	MY42081396	09/25/2016	09/24/2017
Multimeter	Keithley	MiltiMeter 2000	4059164	10/01/2016	09/30/2017
S-parameter Network Analyzer	Agilent	8753ES	US38432944	09/25/2016	09/24/2017
Wireless Communication Test Set	R & S	CMU200	105988	09/25/2016	09/24/2017
Power Meter	R & S	NRVS	100469	09/25/2016	09/24/2017
Power Sensor	R & S	NRV-Z81	100458	09/25/2016	09/24/2017
Power Sensor	R & S	NRV-Z32	10057	09/25/2016	09/24/2017
E-Field PROBE	SATIMO	SSE2	SN 34/15 EPGO265	09/15/2016	09/14/2017
DIPOLE 835	SATIMO	SID 835	SN 07/14 DIP 0G835-303	10/01/2015	09/30/2018
DIPOLE 1900	SATIMO	SID 1900	SN 30/14 DIP 1G900-333	10/01/2015	09/30/2018
COMOSAR OPEN Coaxial Probe	SATIMO	OCPG 68	SN 40/14 OCPG68	10/01/2016	09/30/2017
Communication Antenna	SATIMO	ANTA57	SN 39/14 ANTA57	10/01/2016	09/30/2017
Mobile Phone POSITIONING DEVICE	SATIMO	MSH98	SN 40/14 MSH98	N/A	N/A
DUMMY PROBE	SATIMO	DP60	SN 03/14 DP60	N/A	N/A
SAM PHANTOM	SATIMO	SAM117	SN 40/14 SAM117	N/A	N/A
6 AXIS ROBOT	KUKA	KR6-R900	501217	N/A	N/A
High Power Solid State Amplifier (80MHz~1000MHz)	Instruments for Industry	CMC150	M631-0627	09/25/2016	09/24/2017
Medium Power Solid State Amplifier (0.8~4.2GHz)	Instruments for Industry	S41-25	M629-0539	09/25/2016	09/24/2017
Wave Tube Amplifier 48 GHz at 20Watt	Hughes Aircraft Company	1277H02F000	102	09/25/2016	09/24/2017

Note:

1) Per KDB865664D01 requirements for dipole calibration, the test laboratory has adopted three year extended calibration interval. Each measured dipole is expected to evalute with following criteria at least on annual interval.
a) There is no physical damage on the dipole;
b) System check with specific dipole is within 10% of calibrated values;
c) The most recent return-loss results,measued at least annually,deviates by no more than 20% from the previous measurement;
d) The most recent measurement of the real or imaginary parts of the impedance, measured at least annually is within 5Ω from the provious measurement.
2) Network analyzer probe calibration against air, distilled water and a shorting block performed before measuring liquid parameters.

3.SAR MEASUREMENTS SYSTEM CONFIGURATION

3.1. SARMeasurement Set-up

The OPENSAR system for performing compliance tests consist of the following items:

A standard high precision 6-axis robot (KUKA) with controller and software.

KUKA Control Panel (KCP)

A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with a Video Positioning System(VPS).

The stress sensor is composed with mechanical and electronic when the electronic part detects a change on the electro-mechanical switch,It sends an “Emergency signal” to the robot controller that to stop robot’s moves

A computer operating Windows XP.

OPENSAR software

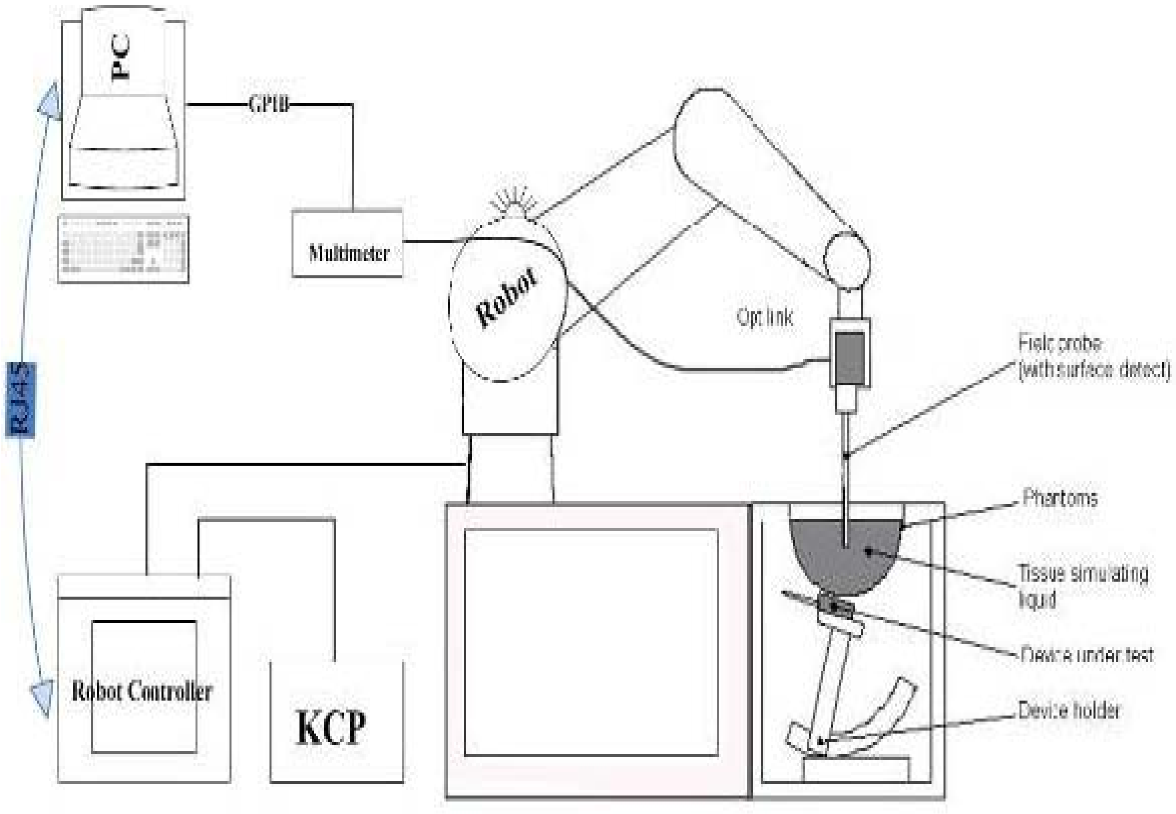
Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.

The SAM phantom enabling testing left-hand right-hand and body usage.

The Position device for handheld EUT

Tissue simulating liquid mixed according to the given recipes .

System validation dipoles to validate the proper functioning of the system.



3.2. OPENSAR E-field Probe System

The SAR measurements were conducted with the dosimetric probe EP220 (manufactured by SATIMO), designed in the classical triangular configuration and optimized for dosimetric evaluation.

Probe Specification

ConstructionSymmetrical design with triangular core
Interleaved sensors
Built-in shielding against static charges
PEEK enclosure material (resistant to organic solvents, e.g., DGBE)

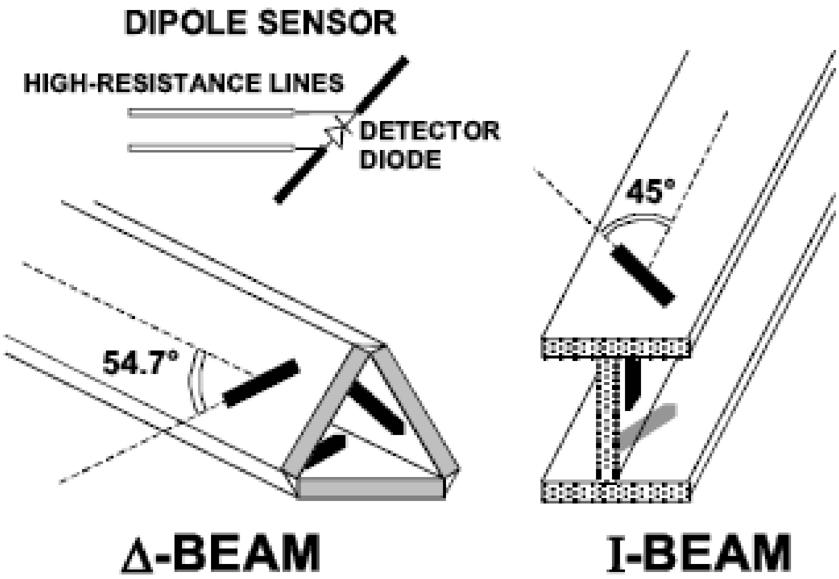
CalibrationISO/IEC 17025 calibration service available.

Frequency	700 MHz to 3 GHz; Linearity:0.25dB(700 MHz to 3GHz)
Directivity	0.25 dB in HSL (rotation around probe axis) 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	0.01W/kg to > 100 W/kg; Linearity: 0.25 dB
Dimensions	Overall length: 330 mm (Tip: 16mm) Tip diameter: 5 mm (Body: 8 mm) Distance from probe tip to sensor centers: 2.5 mm
Application	General dosimetry up to 3 GHz Dosimetry in strong gradient fields Compliance tests of Mobile Phones

Isotropic E-Field Probe

The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change.

The E-Field probe utilizes a triangular sensor arrangement as detailed in the diagram below:



3.3. Phantoms

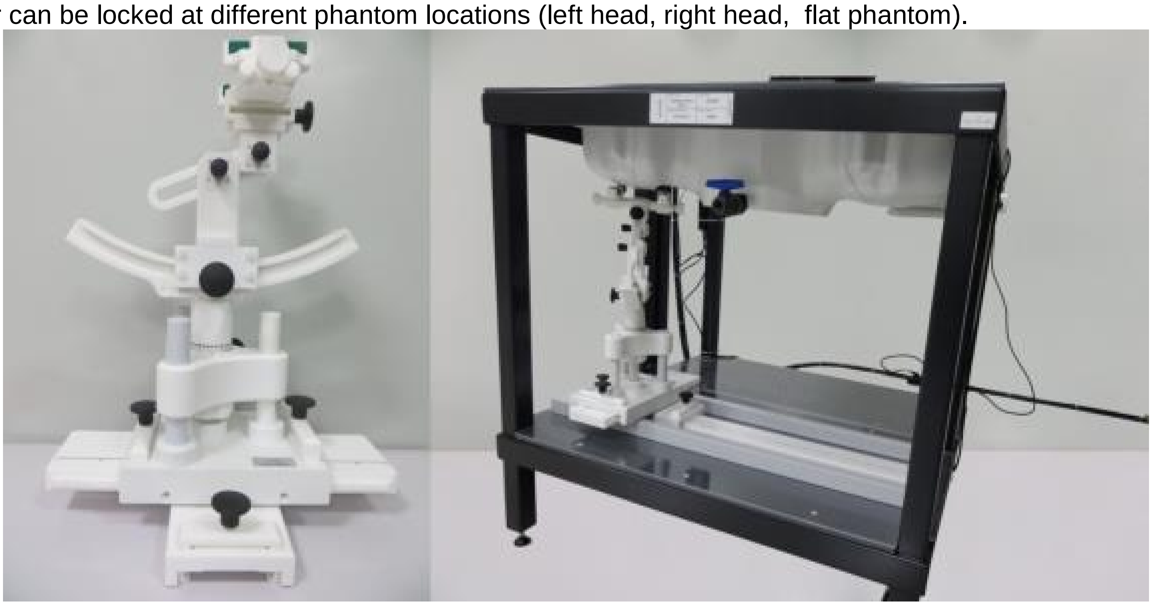
The SAM Phantom SAM117 is constructed of a fiberglass shell ntegrated in a wooden table. The shape of the shell is in compliance with the specification set in IEEE P1528 and CENELEC EN62209-1 , EN62209-2:2010.The phantom enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. Reference markings on the Phantom allow the complete setup of allpredefined phantom positions and measurement grids by manually teaching three points in the robo

System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.

SAM Twin Phantom

3.4. Device Holder

In combination with the Generic Twin PhantomSAM117, the Mounting Device enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation points is the ear opening. The devices can be easily, accurately, and repeatedly positioned according to the FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).



Device holder supplied by SATIMO

3.5. Scanning Procedure

The procedure for assessing the peak spatial-average SAR value consists of the following steps

Power Reference Measurement

The reference and drift jobs are useful jobs for monitoring the power drift of the device under test in the batch process. Both jobs measure the field at a specified reference position, at a selectable distance from the phantom surface. The reference position can be either the selected section's grid reference point or a user point in this section. The reference job projects the selected point onto the phantom surface, orients the probe perpendicularly to the surface, and approaches the surface using the selected detection method.

Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values before running a detailed measurement around the hot spot.Before starting the area scan a grid spacing of 15 mm x 15 mm is set. During the scan the distance of the probe to the phantom remains unchanged. After finishing area scan, the field maxima within a range of 2 dB will be ascertained.

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 mm ± 1 mm	½·δ·ln(2) mm ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

Zoom Scan

Zoom Scans are used to estimate the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan is done by 7x7x7 points within a cube whose base is centered around the maxima found in the preceding area scan.

Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ 1.5·$\Delta z_{Zoom}(n-1)$ mm	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.

* When zoom scan is required and the <u>*reported*</u> SAR from the *area scan based 1-g SAR estimation* procedures of KDB Publication 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

Power Drift measurement
The drift job measures the field at the same location as the most recent reference job within the same procedure, and with the same settings. The drift measurement gives the field difference in dB from the reading conducted within the last reference measurement. Several drift measurements are possible for one reference measurement. This allows a user to monitor the power drift of the device under test within a batch process. In the properties of the Drift job, the user can specify a limit for the drift and have OPENSAR software stop the measurements if this limit is exceeded.

3.6. Data Storage and Evaluation

Data Storage
The OPENSAR software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files . The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

Data Evaluation
The OPENSAR software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters:	- Sensitivity	Normi, ai0, ai1, ai2
	- Conversion factor	ConvFi
	- Diode compression point	Dcpi
Device parameters:	- Frequency	f
	- Crest factor	cf
Media parameters:	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the OPENSAR components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics.If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

With Vi = compensated signal of channel i (i = x, y, z)
Ui = input signal of channel i (i = x, y, z)
cf = crest factor of exciting field
dcpi = diode compression point

From the compensated input signals the primary field data for each channel can be evaluated:

$$\mathrm{E-fieldprobes:} \qquad E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

$$\mathrm{H-fieldprobes:} \qquad H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1} f + a_{i2} f^2}{f}$$

With Vi = compensated signal of channel i (i = x, y, z)
Normi = sensor sensitivity of channel i (i = x, y, z)
[mV/(V/m)2] for E-field Probes
ConvF = sensitivity enhancement in solution

aij = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
Ei = electric field strength of channel i in V/m
Hi = magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

with SAR = local specific absorption rate in mW/g
Etot = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

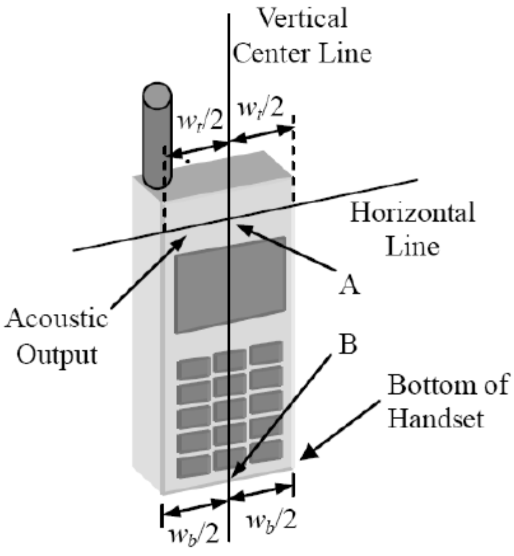
3.7. Position of the wireless device in relation to the phantom

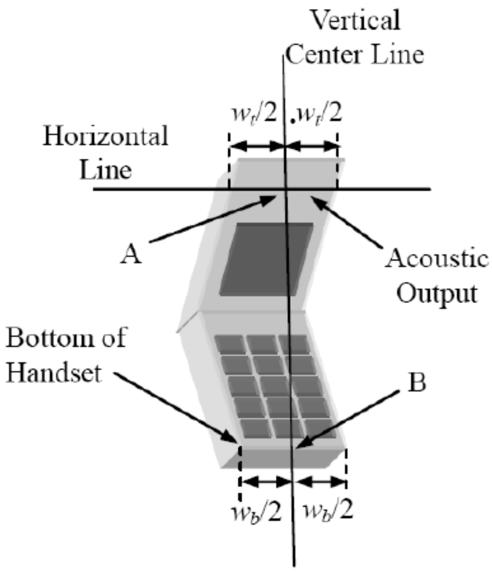
General considerations
This standard specifies two handset test positions against the head phantom – the "cheek" position and the "tilt" position.

The power flow density is calculated assuming the excitation field as a free space field

$$P_{(pwe)} = \frac{E_{tot}^2}{3770} \text{ or } P_{(pwe)} = H_{tot}^2 .37.7$$

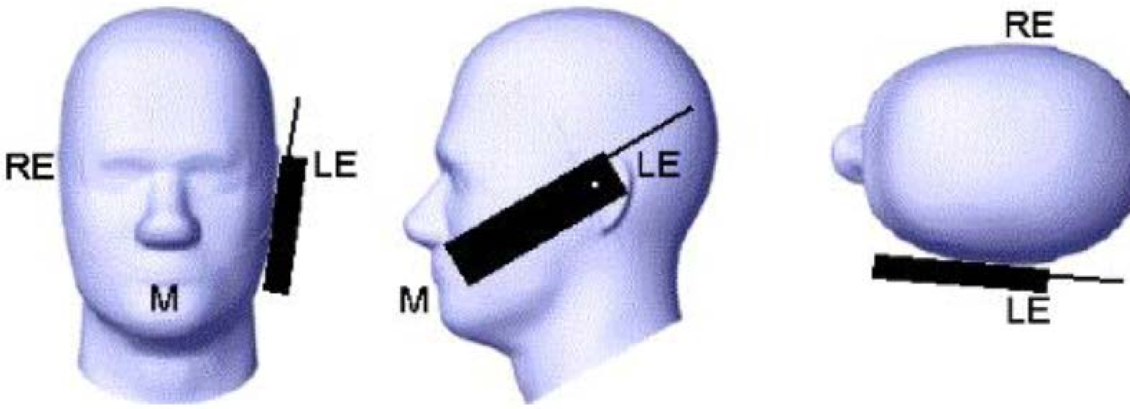
Where P_{pwe}=Equivalent power density of a plane wave in mW/cm2
E_{tot}=total electric field strength in V/m
H_{tot}=total magnetic field strength in A/m



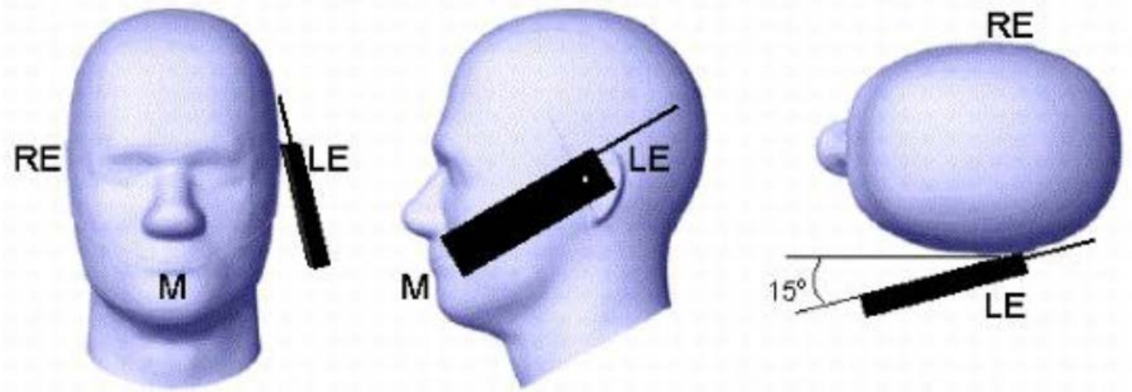


W_t Width of the handset at the level of the acoustic
W_b Width of the bottom of the handset
A Midpoint of the width w_t of the handset at the level of the acoustic output
B Midpoint of the width w_b of the bottom of the handset

Picture 1-a Typical "fixed" case handset Picture 1-b Typical "clam-shell" case handset



Picture 2 Cheek position of the wireless device on the left side of SAM



Picture 3 Tilt position of the wireless device on the left side of SAM

For body SAR test we applied to FCC KDB941225 D03, KDB447498 D0.

3.8. Tissue Dielectric Parameters for Head and Body Phantoms

The liquid is consisted of water,salt,Glycol,Sugar,Preventol and Cellulose.The liquid has previously been proven to be suited for worst-case.It's satisfying the latest tissue dielectric parameters requirements proposed by the KDB865664.

The composition of the tissue simulating liquid

Ingredient	835MHz		1900 MHz	
(% Weight)	Head	Body	Head	Body
Water	41.45	52.5	54.9	40.4
Preventol	0.10	0.10	0.00	0.00
HEC	1.00	1.00	0.00	0.00
DGBE	0.00	0.00	44.92	59.10
Triton X-100	0.00	0.00	0.00	0.00

Target Frequency (MHz)	**Head**		**Body**	
	ε_r	$\sigma(S/m)$	ε_r	$\sigma(S/m)$
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800-2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
2600	39.0	1.96	52.5	2.16
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

3.9. Tissue equivalent liquid properties

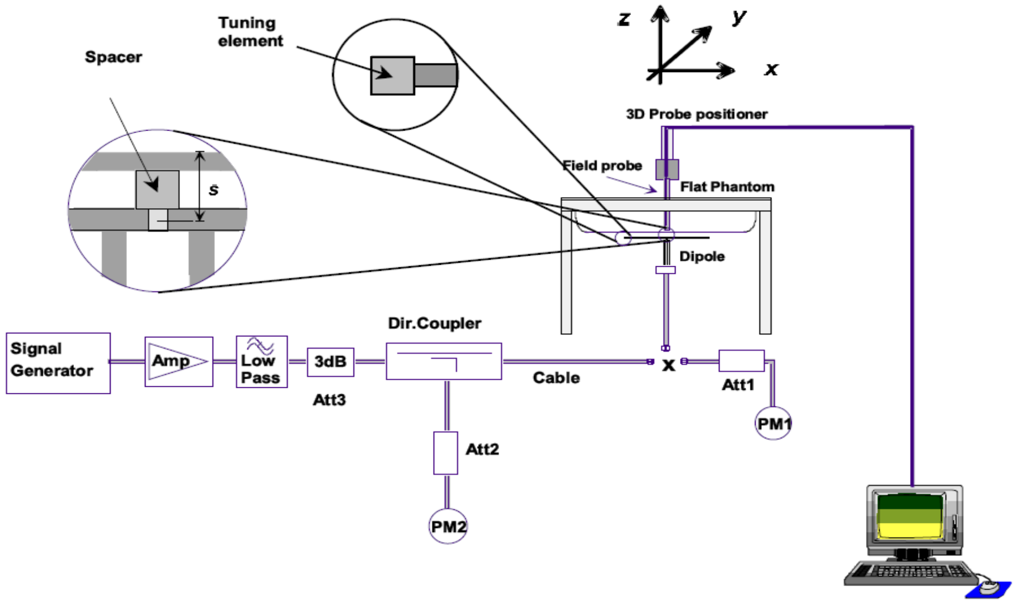
Dielectric Performance of Head and Body Tissue Simulating Liquid

Tissue Type	Measured Frequency (MHz)	Target Tissue		Measured Tissue				Temp.(℃)	Test Data
		εr	σ	εr	Dev.	σ	Dev.		
835B	835	0.97	55.2	0.93	-4.12	53.19	-3.64	22.4	04/05/2017
1900B	1900	1.52	53.3	1.51	-0.66	54.31	1.89	22.4	04/06/2017

3.10. System Check

The purpose of the system check is to verify that the system operates within its specifications at the decice test frequency.The system check is simple check of repeatability to make sure that the system works correctly at the time of the compliance test;

System check results have to be equal or near the values determined during dipole calibration with the relevant liquids and test system (±10 %).



The output power on dipole port must be calibrated to 20 dBm (100mW) before dipole is connected.

Photo of Dipole Setup

Justification for Extended SAR Dipole Calibrations

Referring to KDB 865664D01V01r04, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.While calibration intervals not exceed 3 years.

SID835 SN 07/14 DIP 0G835-303 Extend Dipole Calibrations

Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2015-10-01	-24.46		55.4		2.4	
2016-09-30	-25.53	-4.374	56.1	0.7	1.352	-1.048

SID1900 SN 30/14 DIP 1G900-333 Extend Dipole Calibrations

Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2015-10-01	-23.68		51.2		6.4	
2016-09-30	-24.19	-2.154	50.179	-1.021	3.521	-2.879

Mixture Type	Frequency (MHz)	Power	SAR_{1g} (W/Kg)	SAR_{10g} (W/Kg)	Drift (%)	1W Target		Difference percentage		Temp. (℃)	Date
						SAR_{1g} (W/Kg)	SAR_{10g} (W/Kg)	1g	10g		
Body	835	100 mW	0.981	0.645	-2.34	9.90	6.39	-0.91	2.35	22.4	04/05/2017
		Normalize to 1 Watt	9.81	6.45							
Body	1900	100 mW	4.416	2.209	0.85	43.33	21.59	1.92	2.32	22.4	04/06/2017
		Normalize to 1 Watt	44.16	22.09							

3.11. SAR measurement procedure

The measurement procedures are as follows:

3.11.1 Conducted power measurement

a. For WWAN power measurement, use base station simulator connection with RF cable, at maximum power in each supported wireless interface and frequency band.
b. Read the WWAN RF power level from the base station simulator.
c. For BT power measurement, use engineering software to configure EUT BT continuously Transmission, at maximum RF power in each supported wireless interface and frequency band.
d. Connect EUT RF port through RF cable to the power meter, and measure BT output power.

3.11.2 GSM Test Configuration

SAR tests for GSM 850 and GSM 1900, a communication link is set up with a System Simulator (SS) by air link. Using CMU200 the power level is set to “5” for GSM 850, set to “0” for GSM 1900. Since the GPRS class is 12 for this EUT, it has at most 4 timeslots in uplink and at most 4 timeslots in downlink, the maximum total timeslots is 5.

SAR test reduction for GPRS and EDGE modes is determined by the source-based time-averaged output power specified for production units, including tune-up tolerance. The data mode with highest specified time-averaged output power should be tested for SAR compliance in the applicable exposure conditions. For modes with the same specified maximum output power and tolerance, the higher number time-slot configuration should be tested. GSM voice and GPRS data use GMSK, which is a constant amplitude modulation with minimal peak to average power difference within the time-slot burst. For EDGE, GMSK is used for MCS 1 – MCS 4 and 8-PSK is used for MCS 5 – MCS 9; where 8-PSK has an inherently higher peak-to-average power ratio. The GMSK and 8-PSK EDGE configurations are considered separately for SAR compliance. The GMSK EDGE configurations are grouped with GPRS and considered with respect to time-averaged maximum output power to determine compliance. The 3G SAR test reduction procedure is applied to 8-PSK EDGE with GMSK GPRS/EDGE as the primary mode.

3.11.3 UMTS Test Configuration

3G SAR Test Reduction Procedure

In the following procedures, the mode tested for SAR is referred to as the primary mode. The equivalent modes considered for SAR test reduction are denoted as secondary modes. Both primary and secondary modes must be in the same frequency band. When the maximum output power and tune-up tolerance specified for production units in a secondary mode is ≤ ¼ dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for the secondary mode.3 This is referred to as the 3G SAR test reduction procedure in the following SAR test guidance, where the primary mode is identified in the applicable wireless mode test procedures and the secondary mode is wireless mode being considered for SAR test reduction by that procedure. When the 3G SAR test reduction procedure is not satisfied, it is identified as “otherwise” in the applicable procedures; SAR measurement is required for the secondary mode.

<u>Output power Verification</u>

Maximum output power is verified on the high, middle and low channels according to procedures described in section 5.2 of 3GPP TS 34.121, using the appropriate RMC or AMR with TPC (transmit power control) set to all “1’s” for WCDMA/HSDPA or by applying the required inner loop power control procedures to maintain maximum output power while HSUPA is active. Results for all applicable physical channel configurations (DPCCH, DPDCHn and spreading codes, HSDPA, HSPA) are requied in the SAR report. All configurations that are not supported by the handset or cannot be measured due to technical or equipment limitations must be clearly identified.

<u>Head SAR</u>

SAR for next to the ear head exposure is measured using a 12.2 kbps RMC with TPC bits configured to all “1’s”. The 3G SAR test reduction procedure is applied to AMR configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for 12.2 kbps AMR in 3.4 kbps SRB (signaling radio bearer) using the highest reported SAR configuration in 12.2 kbps RMC for head exposure.

1)
2) <u>Body-Worn Accessory SAR</u>

SAR for body-worn accessory configurations is measured using a 12.2 kbps RMC with TPC bits configured to all “1’s”. The 3G SAR test reduction procedure is applied to other spreading codes and multiple DPDCHn configurations supported by the handset with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured using an applicable RMC configuration with the corresponding spreaing code or DPDCHn, for the highest reported body-worn accessory exposure SAR configuration in 12.2 kbps RMC. When more than 2 DPDCHn are supported by the handset, it may be necessary to configure additional DPDCHn using FTM (Factory Test Mode) or other chipset based test approaches with parameters similar to those used in 384 kbps and 768 kbps RMC.

3) Handsets with Release 5 HSDPA

The 3G SAR test reduction procedure is applied to HSDPA body-worn accessory configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for HSDPA using the HSDPA body SAR procedures in the “Release 5 HSDPA Data Devices” section of this document, for the highest reported SAR body-worn accessory exposure configuration in 12.2 kbps RMC. Handsets with both HSDPA and HSUPA are tested according to Release 6 HSPA test procedures.

HSDPA should be configured according to the UE category of a test device.The number of HSDSCH/ HS-PDSCHs, HARQ processes, minimum inter-TTI interval, transport block sizes and RV coding sequence are defined by the H-set. To maintain a consistent test configuration and stable transmission conditions, QPSK is used in the H-set for SAR testing. HS-DPCCH should be configured with a CQI feedback cycle of 4 ms with a CQI repetition factor of 2 to maintain a constant rate of active CQI slots. DPCCH and DPDCH gain factors(βc, βd), and HS-DPCCH power offset parameters (ΔACK, ΔNACK, ΔCQI) should be set according to values indicated in the Table below. The CQI value is determined by the UE category, transport block size, number of HS-PDSCHs and modulation used in the H-set.

Table 2: Subtests for UMTS Release 5 HSDPA

Sub-set	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs} (note 1, note 2)	CM(dB) (note 3)	MPR(dB)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 (note 4)	15/15 (note 4)	64	12/15 (note 4)	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note1: Δ_{ACK}, Δ_{NACK} and Δ_{CQI}= 8 ⇔ A_{hs} = β_{hs}/β_c=30/15 ⇔ β_{hs}=30/15*β_c
Note2: CM=1 for β_c/β_d =12/15, β_{hs}/β_c=24/15.
Note3: For subtest 2 the $\beta_c\beta_d$ ratio of 12/15 for the TFC during the measurement period(TF1,TF0) is achieved by setting the signaled gain factors for the reference TFC (TFC1,TF1) to β_c=11/15 and β_d=15/15.

HSUPA Test Configuration

The 3G SAR test reduction procedure is applied to HSPA (HSUPA/HSDPA with RMC) body-worn accessory configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for HSPA using the HSPA body SAR procedures in the “Release 6 HSPA Data Devices” section of this document, for the highest reported body-worn accessory exposure SAR configuration in 12.2 kbps RMC. When VOIP is applicable for next to the ear head exposure in HSPA, the 3G SAR test reduction procedure is applied to HSPA with 12.2 kbps RMC as the primary mode; otherwise, the same HSPA configuration used for body-worn accessory measurements is tested for next to the ear head exposure.

Due to inner loop power control requirements in HSPA, a communication test set is required for output power and SAR tests. The 12.2 kbps RMC, FRC H-set 1 and E-DCH configurations for HSPA are configured according to the β values indicated in Table 2 and other applicable procedures described in the ‘WCDMA Handset’ and ‘Release 5 HSDPA Data Devices’ sections of this document

Table 3: Sub-Test 5 Setup for Release 6 HSUPA

Sub-set	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs}(1)	β_{ec}	β_{ed}	β_{ed} (SF)	β_{ed} (codes)	CM (2) (dB)	MPR (dB)	AG(4) Index	E-TFCI
1	11/15(3)	15/15(3)	64	11/15(3)	22/15	209/225	1039/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed1}:47/15 β_{ed2}:47/15	4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15(4)	15/15(4)	64	15/15(4)	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1: Δ_{ACK}, ΔNACK and Δ_{CQI} = 8 ⇔ A_{hs} = β_{hs}/β_c = 30/15 ⇔ β_{hs}= 30/15 *β_c.
Note 2: CM = 1 for βc/βd =12/15, β_{hs}/β_c =24/15. For all other combinations of DPDCH, DPCCH, HS- DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.
Note 3: For subtest 1 the βc/βd ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to βc = 10/15 and βd = 15/15.
Note 4: For subtest 5 the βc/βd ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to βc = 14/15 and βd = 15/15.
Note 5: Testing UE using E-DPDCH Physical Layer category 1 Sub-test 3 is not required according to TS 25.306 Figure 5.1g.
Note 6: βed can not be set directly; it is set by Absolute Grant Value.

3.12. Power Reduction

The product without any power reduction.

3.13. 3.13. Power Drift

To control the output power stability during the SAR test, SAR system calculates the power drift by measuring the E-field at the same location at the beginning and at the end of the measurement for each test position. This ensures that the power drift during one measurement is within 5%.

4.TEST CONDITIONS AND RESULTS

4.1. Conducted Power Results

Max Conducted power measurement results and power drift from tune-up tolerance provide by manufacturer:

Conducted power measurement results for GSM850/PCS1900

GSM 850		Burst Conducted power (dBm)			/	Average power (dBm)		
		Channel/Frequency(MHz)				Channel/Frequency(MHz)		
		128/824.2	190/836.6	251/848.8		128/824.2	190/836.6	251/848.8
GPRS (GMSK)	1TX slot	32.33	32.37	32.36	-9.03dB	23.30	23.34	23.33
	2TX slot	30.89	30.93	30.91	-6.02dB	24.87	24.91	24.89
	3TX slot	29.24	29.19	29.17	-4.26dB	**24.98**	**24.93**	**24.91**
	4TX slot	27.73	27.81	27.77	-3.01dB	24.72	24.80	24.76
GSM 1900		Burst Conducted power (dBm)			/	Average power (dBm)		
		Channel/Frequency(MHz)				Channel/Frequency(MHz)		
		512/ 1850.2	661/ 1880	810/ 1909.8		512/ 1850.2	661/ 1880	810/ 1909.8
GPRS (GMSK)	1TX slot	29.15	29.21	29.06	-9.03dB	20.12	20.18	20.03
	2TX slot	28.03	28.06	28.02	-6.02dB	22.01	22.04	22.00
	3TX slot	26.24	26.34	26.38	-4.26dB	**21.98**	**22.08**	**22.12**
	4TX slot	24.91	24.90	24.98	-3.01dB	21.90	21.89	21.97

Notes:
1. Division Factors
To average the power, the division factor is as follows:
1TX-slot = 1 transmit time slot out of 8 time slots=> conducted power divided by (8/1) => -9.00dB
2TX-slots = 2 transmit time slots out of 8 time slots=> conducted power divided by (8/2) => -6.00dB
3TX-slots = 3 transmit time slots out of 8 time slots=> conducted power divided by (8/3) => -4.26dB
4TX-slots = 4 transmit time slots out of 8 time slots=> conducted power divided by (8/4) => -3.00dB
2. According to the conducted power as above, the GPRS measurements are performed with 3Txslot for GPRS850 and 3Txslot GPRS1900.

Conducted Power Measurement Results(WCDMA Band II/V)

Item	band	WCDMA Band II result (dBm)			WCDMA Band V result (dBm)		
		Channel/Frequency(MHz)			Channel/Frequency(MHz)		
	ARFCN	9262/ 1852.4	9400/ 1880	9538/ 1907.6	4132/ 826.4	4183/ 836.6	4233/ 846.6
RMC	12.2kbps RMC	23.35	**23.41**	23.37	23.44	**23.50**	23.47
	64kbps RMC	23.11	23.24	23.19	23.10	23.27	23.30
	144kbps RMC	23.07	23.21	23.24	23.08	23.19	23.21
	384kbps RMC	23.17	23.08	23.20	23.01	23.14	23.16
HSDPA	Sub – Test 1	23.04	23.19	23.10	23.11	23.20	23.17
	Sub – Test 2	22.28	22.39	22.35	22.30	22.45	22.34
	Sub – Test 3	21.71	21.81	21.76	21.71	21.85	21.75
	Sub – Test 4	21.23	21.32	21.27	21.32	21.40	21.37
HSUPA	Sub – Test 1	22.31	22.42	22.36	22.41	22.56	22.44
	Sub – Test 2	22.03	22.07	22.04	22.07	22.14	22.09
	Sub – Test 3	21.73	21.81	21.78	21.79	21.89	21.83
	Sub – Test 4	21.60	21.73	21.65	21.69	21.86	21.75
	Sub – Test 5	22.07	22.23	22.13	22.12	22.26	22.18

Note: When the maximum output power and tune-up tolerance specified for production units in a secondary mode is ≤1/2dB higher than the primary mode (RMC12.2kbps) or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for the secondary mode.

Conducted power measurement of BluetoothV4.0

Mode	channel	Frequency (MHz)	Conducted output power	
			Average (dBm)	Peak (dBm)
BT-LE	0	2402	-0.55	0.38
	19	2440	-0.61	0.43
	39	2480	-0.60	0.41

Per KDB 447498 D01, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] ·[√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

Bluetooth Turn up Power (dBm)	Separation Distance (mm)	Frequency (GHz)	Exclusion Thresholds
1.0	5	2.45	0.4

Per KDB 447498 D01, when the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion. The test exclusion threshold is 0.4 which is < 3, SAR testing is not required.

4.2. Manufacturing tolerance

GSM 850 GPRS (GMSK) (Burst Average Power)				
Channel		128	190	251
1 Txslot	Target (dBm)	32.0	32.0	32.0
	Tolerance ±(dB)	1.0	1.0	1.0
2 Txslot	Target (dBm)	30.0	30.0	30.0
	Tolerance ±(dB)	1.0	1.0	1.0
3 Txslot	Target (dBm)	29.0	29.0	29.0
	Tolerance ±(dB)	1.0	1.0	1.0
4 Txslot	Target (dBm)	27.0	27.0	27.0
	Tolerance ±(dB)	1.0	1.0	1.0
GSM 1900 GPRS (GMSK) (Burst Average Power)				
Channel		512	661	810
1 Txslot	Target (dBm)	29.0	29.0	29.0
	Tolerance ±(dB)	1.0	1.0	1.0
2 Txslot	Target (dBm)	27.5	27.5	27.5
	Tolerance ±(dB)	1.0	1.0	1.0
3 Txslot	Target (dBm)	26.0	26.0	26.0
	Tolerance ±(dB)	1.0	1.0	1.0
4 Txslot	Target (dBm)	24.0	24.0	24.0
	Tolerance ±(dB)	1.0	1.0	1.0

UMTS

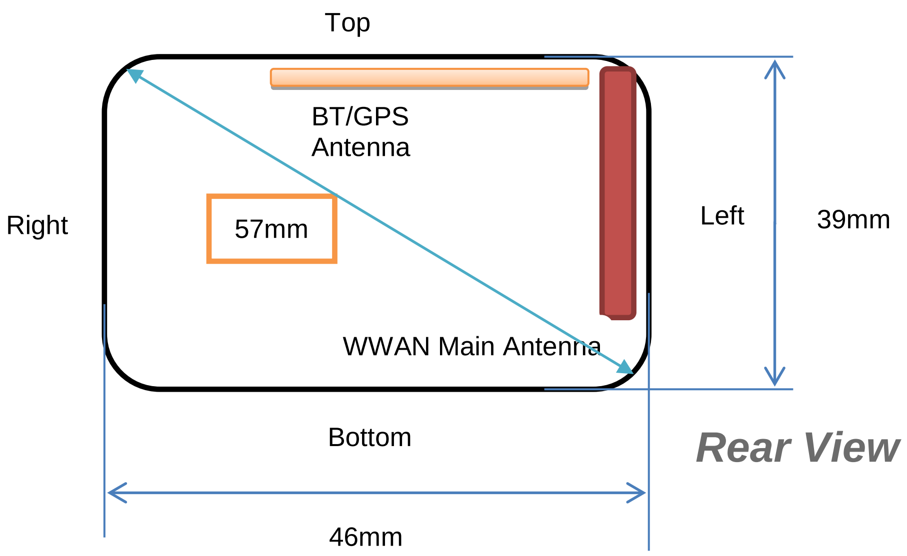
UMTS Band V			
Channel	Channel 4132	Channel 4183	Channel 4233
Target (dBm)	23.0	23.0	23.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band V HSDPA(sub-test 1)			
Channel	Channel 4132	Channel 4183	Channel 4233
Target (dBm)	23.0	23.0	23.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band V HSDPA(sub-test 2)			
Channel	Channel 4132	Channel 4183	Channel 4233
Target (dBm)	22.0	22.0	22.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band V HSDPA(sub-test 3)			
Channel	Channel 4132	Channel 4183	Channel 4233
Target (dBm)	21.0	21.0	21.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band V HSDPA(sub-test 4)			
Channel	Channel 4132	Channel 4183	Channel 4233
Target (dBm)	21.0	21.0	21.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band V HSUPA(sub-test 1)			
Channel	Channel 4132	Channel 4183	Channel 4233
Target (dBm)	22.0	22.0	22.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band V HSUPA(sub-test 2)			
Channel	Channel 4132	Channel 4183	Channel 4233
Target (dBm)	22.0	22.0	22.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band V HSUPA(sub-test 3)			
Channel	Channel 4132	Channel 4183	Channel 4233
Target (dBm)	21.0	21.0	21.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band V HSUPA(sub-test 4)			
Channel	Channel 4132	Channel 4183	Channel 4233
Target (dBm)	21.0	21.0	21.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band V HSUPA(sub-test 5)			
Channel	Channel 4132	Channel 4183	Channel 4233
Target (dBm)	22.0	22.0	22.0
Tolerance ±(dB)	1.0	1.0	1.0

UMTS Band II			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	23.0	23.0	23.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band II HSDPA(sub-test 1)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	23.0	23.0	23.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band II HSDPA(sub-test 2)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	22.0	22.0	22.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band II HSDPA(sub-test 3)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	21.0	21.0	21.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band II HSDPA(sub-test 4)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	21.0	21.0	21.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band II HSUPA(sub-test 1)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	22.0	22.0	22.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band II HSUPA(sub-test 2)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	22.0	22.0	22.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band II HSUPA(sub-test 3)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	21.0	21.0	21.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band II HSUPA(sub-test 4)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	21.0	21.0	21.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band II HSUPA(sub-test 5)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	22.0	22.0	22.0
Tolerance ±(dB)	1.0	1.0	1.0

Bluetooth V4.0

BLE-GFSK (Average)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	0	0	0
Tolerance ±(dB)	1.0	1.0	1.0

4.3. Transmit Antennas and SAR Measurement Position



Antenna information:

WWAN Main Antenna	GSM/UMTS TX/RX
GPS/BT Antenna	BT TX/RX

Distance of The Antenna to the EUT surface and edge (mm)						
Antennas	**Front**	**Back**	**Top Side**	**Bottom Side**	**Left Side**	**Right Side**
WWAN	<5	<5	<5	<5	<5	42
BT	<5	<5	<5	35	14	10

4.4. Standalone SAR Test Exclusion Considerations

Per KDB447498 for standalone 1-g head or body SAR evaluation by measurement or numerical simulation is not required when the corresponding SAR Exclusion Threshold condition, listed below, is satisfied.

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances≤ 50 mm are determined by::

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] ·[√ f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

At 100 MHz to 6 GHz and for test separation distances > 50 mm, the SAR test exclusion threshold is determined according to the following, and as illustrated in Appendix B:

a) [Power allowed at numeric threshold for 50 mm in step 1) + (test separation distance - 50 mm)·(f(MHz)/150)] mW, at 100 MHz to 1500 MHz

b) [Power allowed at numeric threshold for 50 mm in step 1) + (test separation distance - 50 mm) • 10] mW at > 1500 MHz and ≤ 6 GHz

Standalone SAR test exclusion considerations							
Communicatin system	Frequency (MHz)	Configuration	Maximum Average Power (dBm)	Separation Distance (mm)	Calculation Result	SAR Exclusion Thresholds	Standalone SAR Exclusion
GSM850	850	Front Size	25.74	5	69.1	3.0	no
		BackSize	25.74	5	69.1	3.0	no
		Left Size	25.74	5	69.1	3.0	no
		Right Size	25.74	42	8.2	3.0	no
		Top Size	25.74	5	69.1	3.0	no
		Bottom Size	25.74	5	69.1	3.0	no
GSM 1900	1900	Front Size	22.74	5	51.8	3.0	no
		BackSize	22.74	5	51.8	3.0	no
		Left Size	22.74	5	51.8	3.0	no
		Right Size	22.74	42	6.2	3.0	no
		Top Size	22.74	5	51.8	3.0	no
		Bottom Size	22.74	5	51.8	3.0	no
WCDMA Band V	850	Front Size	24.00	5	46.3	3.0	no
		BackSize	24.00	5	46.3	3.0	no
		Left Size	24.00	5	46.3	3.0	no
		Right Size	24.00	42	5.5	3.0	no
		Top Size	24.00	5	46.3	3.0	no
		Bottom Size	24.00	5	46.3	3.0	no
WCDMA Band II	1900	Front Size	24.00	5	69.2	3.0	no
		BackSize	24.00	5	69.2	3.0	no
		Left Size	24.00	5	69.2	3.0	no
		Right Size	24.00	42	8.2	3.0	no
		Top Size	24.00	5	69.2	3.0	no
		Bottom Size	24.00	5	69.2	3.0	no
Bluetooth	2450	Front Size	1.00	5	0.4	3.0	yes
		BackSize	1.00	5	0.4	3.0	yes
		Left Size	1.00	14	0.1	3.0	yes
		Right Size	1.00	5	0.4	3.0	yes
		Top Size	1.00	5	0.4	3.0	yes
		Bottom Size	1.00	35	0.1	3.0	yes

Remark:
1. Maximum average power including tune-up tolerance;
2. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion
3. Body as body use distance is 0mm from manufacturer declaration of user manual.

4.5. SAR Measurement Results

The calculated SAR is obtained by the following formula:

Reported SAR=Measured SAR*10$^{(Ptarget-Pmeasured))/10}$

Scaling factor=10$^{(Ptarget-Pmeasured))/10}$

Reported SAR= Measured SAR* Scaling factor

Where

P_{target} is the power of manufacturing upper limit;

$P_{measured}$ is the measured power;

Measured SAR is measured SAR at measured power which including power drift)

Reported SAR which including Power Drift and Scaling factor

Duty Cycle

Test Mode	Duty Cycle
GPRS850	1:2.67
GPRS1900	1:2.67
UMTS	1:1

4.5.1 SAR Results

SAR Values [GSM 850]

Ch.	Freq. (MHz)	Time slots	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power Drift (%)	Scaling Factor	SAR1-g results(W/kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers - Body (hotspot open, distance 0mm)										
190	836.6	3Txslots	Front	29.19	30.00	1.25	1.205	0.345	0.416	
190	836.6	3Txslots	Rear	29.19	30.00	-0.21	1.205	**0.619**	**0.746**	Plot 1
190	836.6	3Txslots	Left	29.19	30.00	-1.31	1.205	0.454	0.547	
190	836.6	3Txslots	Right	29.19	30.00	0.07	1.205	0.213	0.257	
190	836.6	3Txslots	Top	29.19	30.00	0.86	1.205	0.230	0.277	
190	836.6	3Txslots	Bottom	29.19	30.00	-1.46	1.205	0.317	0.382	

SAR Values [GSM 1900]

Ch.	Freq. (MHz)	time slots	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power Drift (%)	Scaling Factor	SAR1-g results(W/kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers – Body (hotspot open, distance 0mm)										
661	1880.0	3Txslots	Front	26.34	27.00	-0.65	1.164	0.482	0.561	
512	1850.2	3Txslots	Rear	26.24	27.00	-2.14	1.191	0.712	0.848	
661	1880.0	3Txslots		26.34	27.00	-0.70	1.164	**0.777**	**0.904**	Plot 2
810	1909.8	3Txslots		26.38	27.00	1.26	1.153	0.756	0.872	
661	1880.0	3Txslots	Left	26.34	27.00	0.48	1.164	0.553	0.644	
661	1880.0	3Txslots	Right	26.34	27.00	-2.89	1.164	0.301	0.350	
661	1880.0	3Txslots	Top	26.34	27.00	2.01	1.164	0.321	0.374	
661	1880.0	3Txslots	Bottom	26.34	27.00	-0.85	1.164	0.396	0.461	

SAR Values [WCDMA Band V]

Ch.	Freq. (MHz)	Channel Type	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power Drift (%)	Scaling Factor	SAR1-g results(W/kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers - Body (hotspot open, distance 0mm)										
4183	836.6	RMC	Front	23.50	24.00	3.24	1.122	0.416	0.467	
4132	826.4	RMC	Rear	23.44	24.00	-1.67	1.138	0.689	0.784	
4183	836.6	RMC		23.50	24.00	0.00	1.122	**0.755**	**0.847**	Plot 3
4233	846.6	RMC		23.47	24.00	2.55	1.130	0.727	0.822	
4183	836.6	RMC	Left	23.50	24.00	0.66	1.122	0.447	0.502	
4183	836.6	RMC	Right	23.50	24.00	-3.85	1.122	0.283	0.318	
4183	836.6	RMC	Top	23.50	24.00	-1.08	1.122	0.353	0.396	
4183	836.6	RMC	Bottom	23.50	24.00	-2.00	1.122	0.382	0.429	

SAR Values [WCDMA Band II]

Ch.	Freq. (MHz)	Channel Type	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power Drift (%)	Scaling Factor	SAR1-g results(W/kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers - Body (hotspot open, distance 0mm)										
9400	1800.0	RMC	Front	23.41	24.00	1.57	1.146	0.364	0.417	
9400	1800.0	RMC	Rear	23.41	24.00	-0.17	1.146	**0.584**	**0.669**	Plot 4
9400	1800.0	RMC	Left	23.41	24.00	0.47	1.146	0.335	0.384	
9400	1800.0	RMC	Right	23.41	24.00	0.36	1.146	0.195	0.223	
9400	1800.0	RMC	Top	23.41	24.00	0.35	1.146	0.292	0.335	
9400	1800.0	RMC	Bottom	23.41	24.00	-1.26	1.146	0.273	0.313	

Note:
1. The value with black color is the maximum Reported SAR Value of each test band.
2. Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is optional for such test configuration(s).
6. Per KDB 648474 D04, when the reported SAR for a body-worn accessory measured without a headset

connected to the handset is ≤ 1.2 W/kg, SAR testing with a headset connected to the handset is not required.

4.5.2 Standalone SAR Test Exclusion Considerations and Estimated SAR

Per KDB447498 requires when the standalone SAR test exclusion of section 4.3.1 is applied to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to the following to determine simultaneous transmission SAR test exclusion;
● (max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] • [√ f(GHz)/x] W/kg for test separation distances ≤ 50 mm;
where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.
● 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is > 50 mm
Per FCC KD B447498 D01,simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the transmitting antenna in a specific a physical test configuration is ≤1.6 W/Kg.When the sum is greater than the SAR limit,SAR test exclusion is determined by the SAR to peak location separation ratio.

$$\text{Ratio}=\frac{(SAR_1+SAR_2)^{1.5}}{(\text{peak location separation,mm})}<0.04$$

Estimated stand alone SAR					
Communication system	Frequency (MHz)	Configuration	Maximum Power (including tune-up tolerance) (dBm)	Separation Distance (mm)	Estimated SAR_{1-g} (W/kg)
Bluetooth*	2450	body	1.0	5	0.026

Bluetooth*- Including Lower Energy Bluetooth

4.6. Simultaneous TX SAR Considerations

4.6.1 Introduction

The following procedures adopted from “FCC SAR Considerations for Cell Phones with Multiple Transmitters” are applicable to handsets with built-in unlicensed transmitters such Bluetooth devices which may simultaneously transmit with the licensed transmitter.
For the DUT,the BT modules sharing same antenna, GSM/WCDMA modules sharing same single antenna;
Application Simultaneous Transmission information:

Air-Interface	Band (MHz)	Type	Simultaneous Transmissions	Voice over Digital Transport(Data)
GSM	850	VO	Yes, BLE	N/A
	1900	VO		
	GPRS	DT	Yes, BLE	N/A
WCDMA	Band II/BandV	DT	Yes, BLE	N/A
BLE	2450	DT	Yes,GSM,GPRS, UMTS	N/A
Note:VO-Voice Service only;DT-Digital Transport				

Note: BLE-Bluetooth low energy

4.6.2 Evaluation of Simultaneous SAR

Body Exposure Conditions

Simultaneous transmission SAR for BT and GSM

Test Position	GSM850 Reported SAR_{1-g}(W/Kg)	GSM1900 Reported SAR_{1-g}(W/Kg)	BT Estimated SAR_{1-g} (W/Kg)	MAX. ΣSAR_{1-g} (W/Kg)	SAR_{1-g} Limit (W/Kg)	Peak location separation ratio	Simut Meas. Required
Front	0.416	0.561	0.052	0.613	1.6	no	no
Rear	**0.746**	**0.904**	0.052	**0.956**	1.6	no	no
Left	0.547	0.644	0.052	0.696	1.6	no	no
Right	0.257	0.350	0.052	0.402	1.6	no	no
Top	0.277	0.374	0.052	0.426	1.6	no	no
Bottom	0.382	0.461	0.052	0.513	1.6	no	no

Simultaneous transmission SAR for BT and UMTS

Test Position	UMTS Band V Reported SAR1-g(W/Kg)	UMTS Band II Reported SAR_{1-g}(W/Kg)	BT Estimated SAR_{1-g}(W/Kg)	MAX. ΣSAR_{1-g}(W/Kg)	SAR1-g Limit (W/Kg)	Peak location separationratio	Simut Meas. Required
Front	0.467	0.417	0.052	0.519	1.6	no	no
Rear	**0.847**	**0.669**	0.052	**0.899**	1.6	no	no
Left	0.502	0.384	0.052	0.554	1.6	no	no
Right	0.318	0.223	0.052	0.370	1.6	no	no
Top	0.396	0.335	0.052	0.448	1.6	no	no
Bottom	0.429	0.313	0.052	0.481	1.6	no	no

Note:
1. The value with black color is the maximum values of standalone
2. The value with blue color is the maximum values of $\sum SAR_{1-g}$

4.7. SAR Measurement Variability

According to KDB865664, Repeated measurements are required only when the measured 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 reaffirm that the results are not expected to have substantial variations, which may introduce significant compliance concerns. A second repeated measurement is required only if the measured result for the initial repeated measurement is within 10% of the SAR limit and vary by more than 20%, which are often related to device and measurement setup difficulties. The following procedures are applied to determine if repeated measurements are required. 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 thresholds.19 The repeated measurement results must be clearly identified in the SAR report. All measured SAR, including the repeated results, must be considered to determine compliance and for reporting according to KDB 690783.Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.

4) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
5) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
6) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.
7) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20

Frequency Band (MHz)	Air Interface	RF Exposure Configuration	Test Position	Repeated SAR (yes/no)	Highest Measured SAR_{1-g} (W/Kg)	First Repeated	
						Measured SAR_{1-g} (W/Kg)	Largest to Smallest SAR Ratio
850	GSM850	Standalone	Body-Rear	no	0.619	n/a	n/a
	WCDMA Band V	Standalone	Body-Rear	no	0.755	n/a	n/a
1900	GSM1900	Standalone	Body-Rear	no	0.777	n/a	n/a
	WCDMA Band II	Standalone	Body-Rear	no	0.584	n/a	n/a

4.8. General description of test procedures

1. The DUT is tested using CMU 200 communications testers as controller unit to set test channels and maximum output power to the DUT, as well as for measuring the conducted peak power.
2. Test positions as described in the tables above are in accordance with the specified test standard.
3. Tests in body position were performed in that configuration, which generates the highest time based averaged output power (see conducted power results).
4. UMTS was tested in RMC mode with 12.2 kbit/s and TPC bits set to 'all 1'.
5. According to KDB 447498 D01 testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:
   - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
   - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz

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

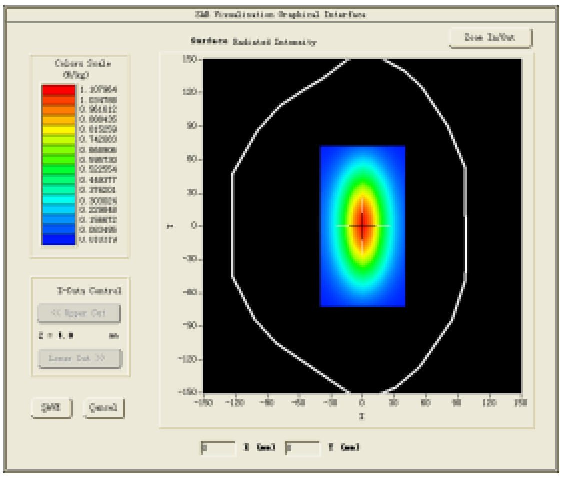
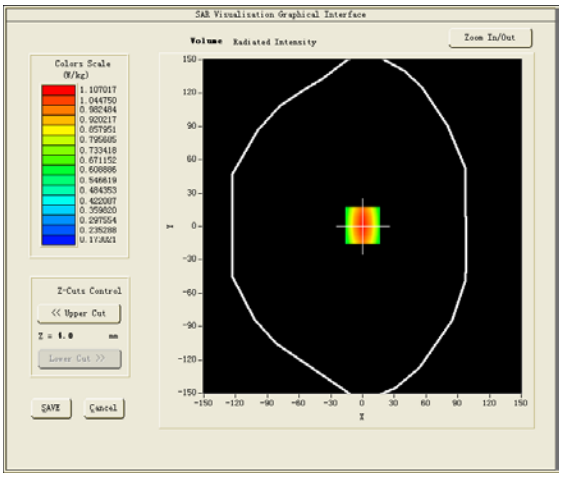
6. Per KDB648474 D04 require when the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is < 1.2 W/kg.

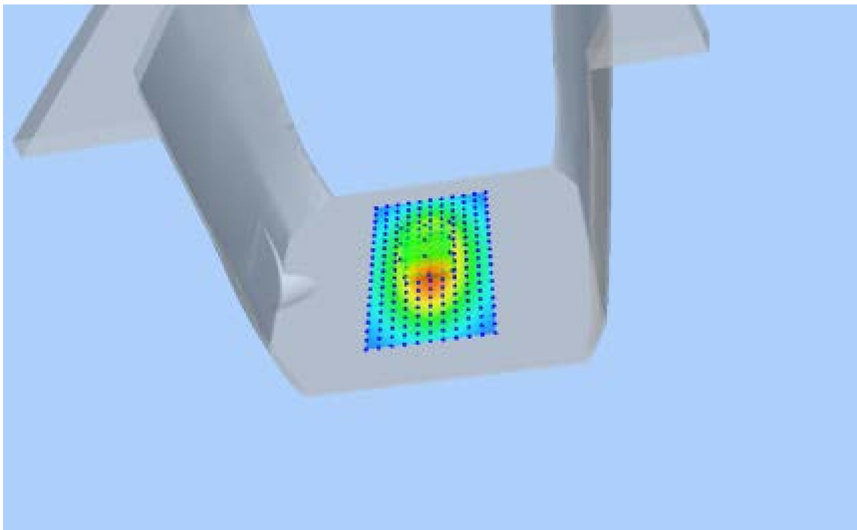
4.9. Measurement Uncertainty (300MHz-3GHz)

Not required as SAR measurement uncertainty analysis is required in SAR reports only when the highest measured SAR in a frequency band is ≥ 1.5 W/kg for 1-g SAR accoridng to KDB865664D01.

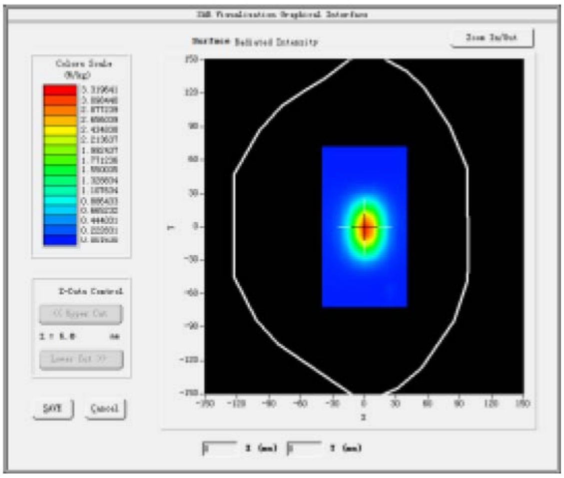
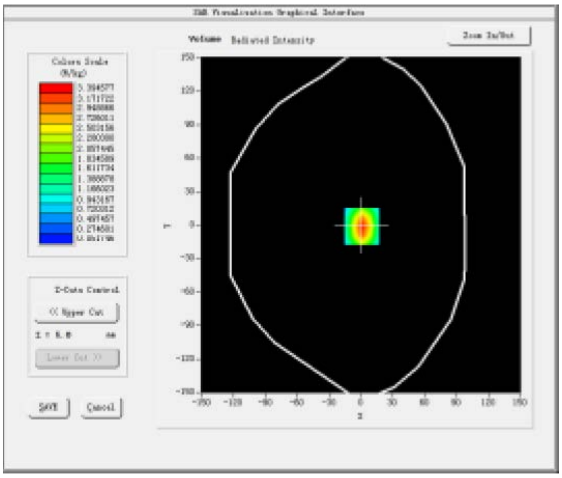
4.10. System Check Results

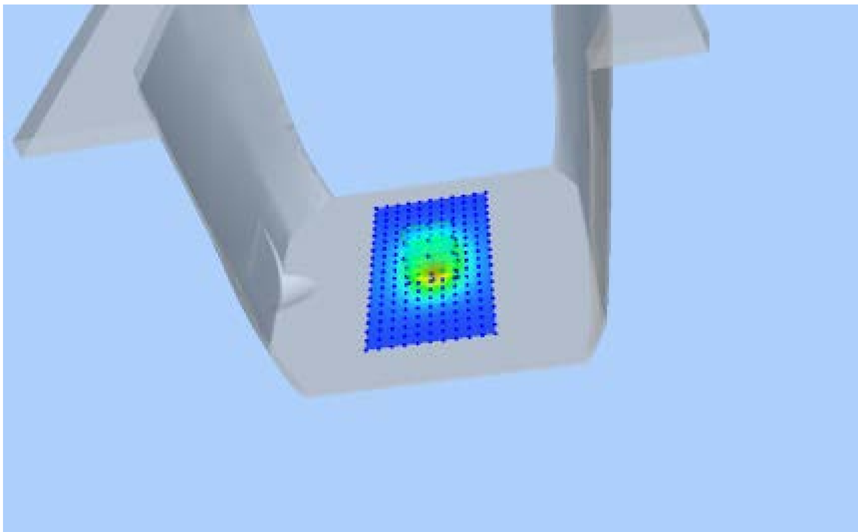
Test mode:835MHz(Body)
Product Description:Validation
Model:Dipole SID835
E-Field Probe: SSE2(SN34/15 EPGO265)
Test Date: April 05, 2017

Medium(liquid type)	MSL_850
Frequency (MHz)	835.0000
Relative permittivity (real part)	53.19
Conductivity (S/m)	0.93
Input power	100mW
Crest Factor	1.0
Conversion Factor	2.12
Variation (%)	-2.3400000
SAR 10g (W/Kg)	0.6537469
SAR 1g (W/Kg)	0.9810254
SURFACE SAR	**VOLUME SAR**
	



Test mode:1900MHz(Body)
Product Description:Validation
Model :Dipole SID1900
E-Field Probe: SSE2(SN34/15 EPGO265)
Test Date: April 06, 2017

Medium(liquid type)	MSL_1900
Frequency (MHz)	1900.0000
Relative permittivity (real part)	54.31
Conductivity (S/m)	1.51
Input power	100mW
Crest Factor	1.0
Conversion Factor	2.42
Variation (%)	0.8500000
SAR 10g (W/Kg)	2.2090072
SAR 1g (W/Kg)	4.4156166
SURFACE SAR	**VOLUME SAR**
	

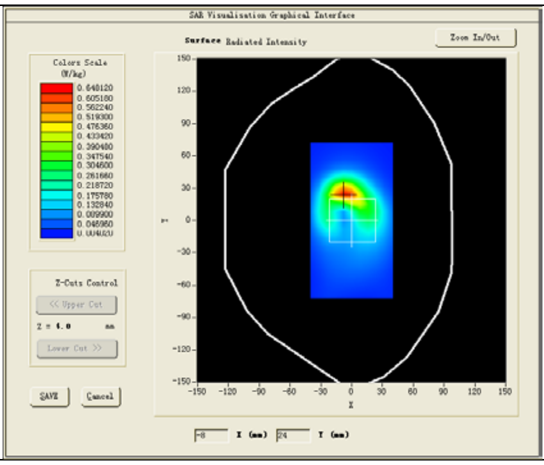
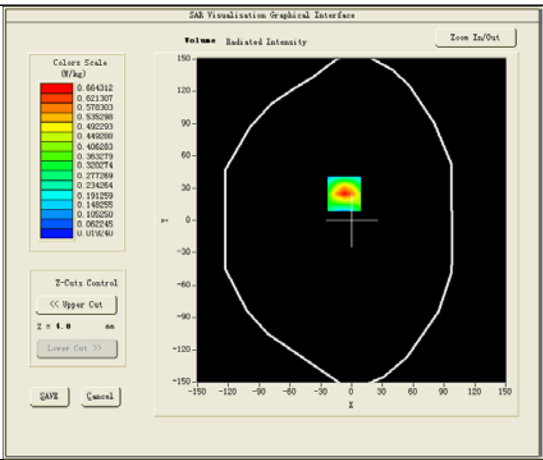
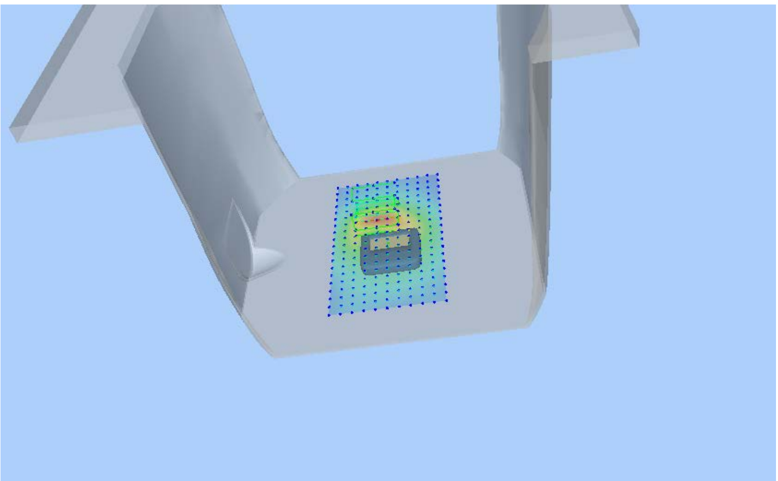
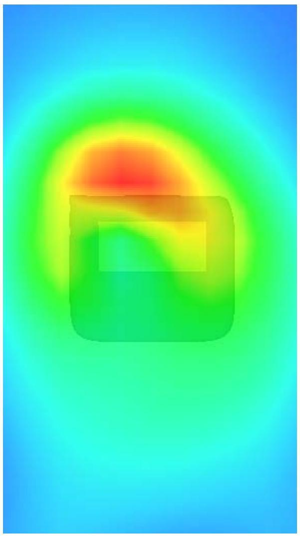


4.11. SAR Test Graph Results

SAR plots for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination according to FCC KDB 865664 D02

#1

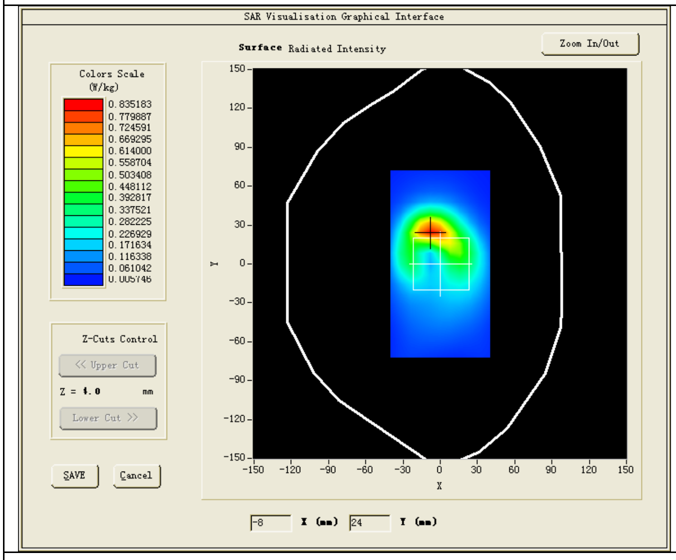
Test Mode: GPRS850MHz,Mid channel(Body Back Side)
Product Description: GPS Tracker
Model: TRKM010
Test Date: April 05, 2017

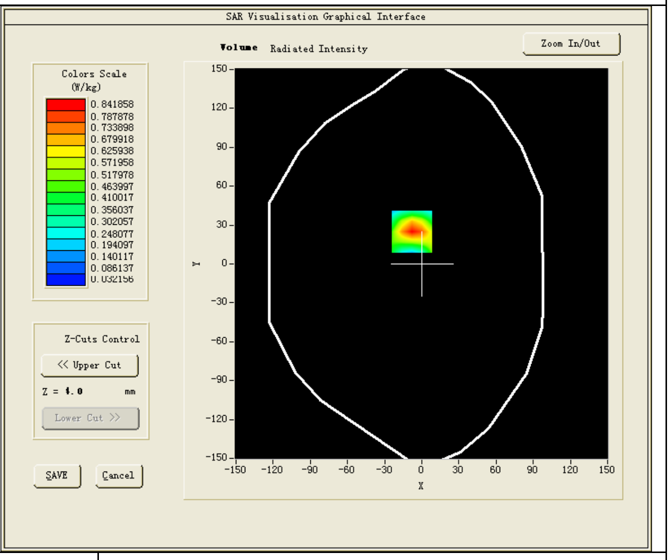
Medium(liquid type)	MSL_850
Frequency (MHz)	836.600000
Relative permittivity (real part)	53.19
Conductivity (S/m)	0.93
E-Field Probe	SN34/15 EPGO265
Crest Factor	2.67
Conversion Factor	2.12
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-0.210000
SAR 10g (W/Kg)	0.302685
SAR 1g (W/Kg)	0.619038
SURFACE SAR	VOLUME SAR
	
	

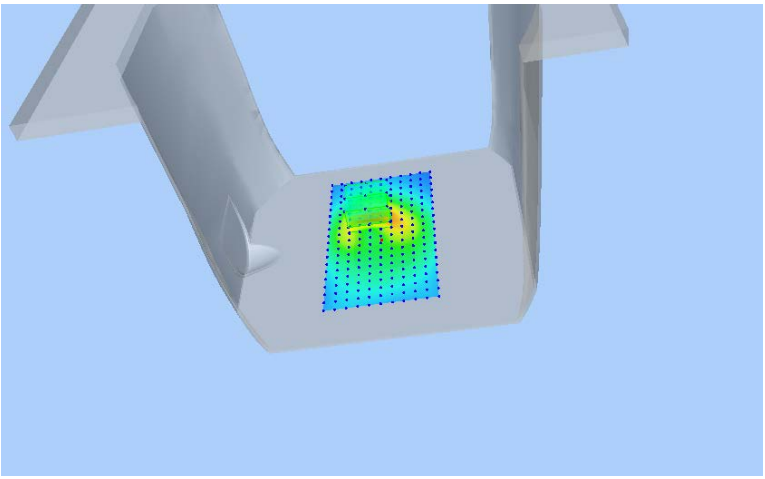
#2

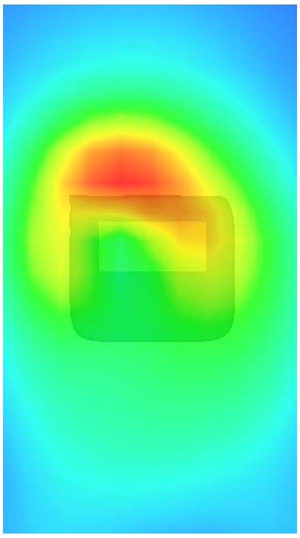
Test Mode: GPRS1900MHz,Mid channel(Body Back Side)
Product Description: GPS Tracker
Model: TRKM010
Test Date: April 06, 2017

Medium(liquid type)	MSL_1900
Frequency (MHz)	1880.000000
Relative permittivity (real part)	54.11
Conductivity (S/m)	1.51
E-Field Probe	SN34/15 EPGO265
Crest Factor	2.67
Conversion Factor	2.42
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-0.700000
SAR 10g (W/Kg)	0.411816
SAR 1g (W/Kg)	0.776559
SURFACE SAR	**VOLUME SAR**



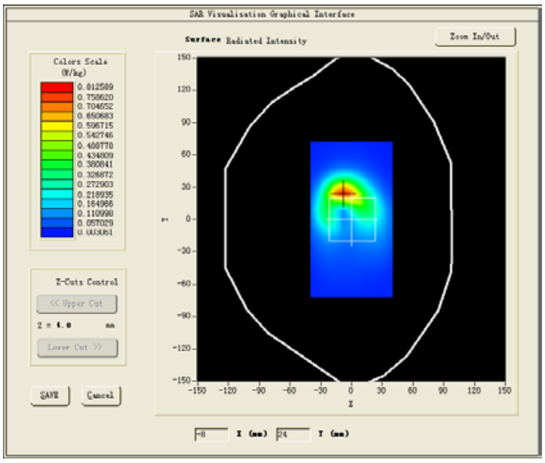
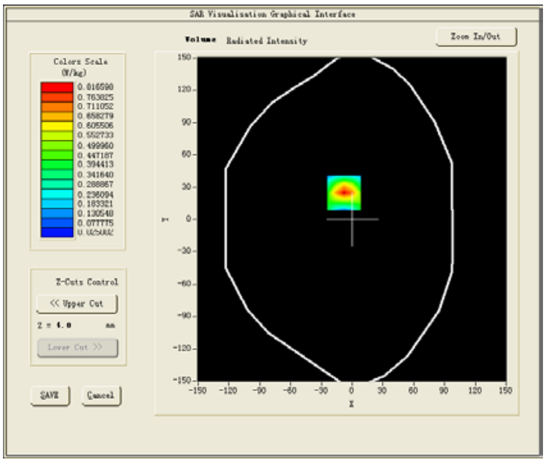
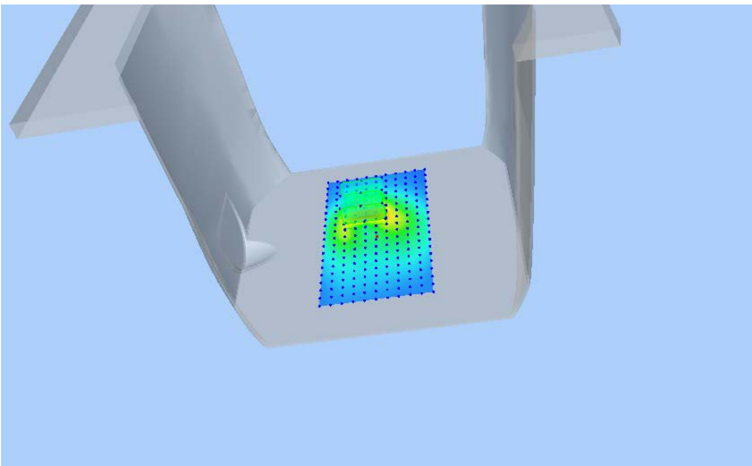
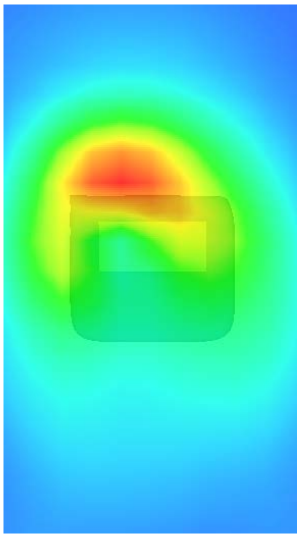






#3

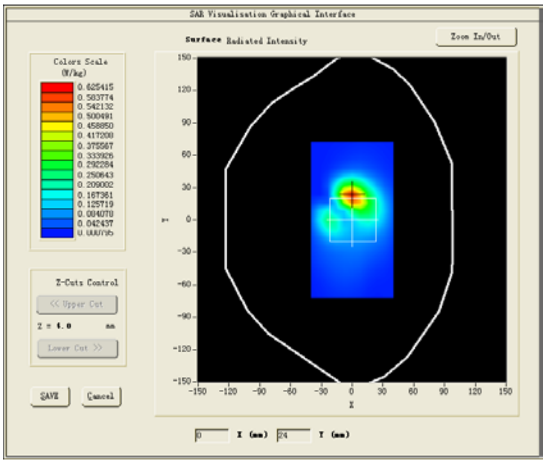
Test Mode: WCDMA Band V,Mid channel(Body Back Side)
Product Description: GPS Tracker
Model: TRKM010
Test Date: April 05, 2017

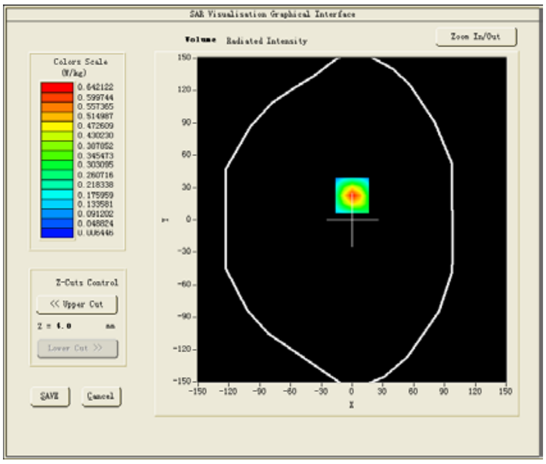
Medium(liquid type)	MSL_850
Frequency (MHz)	836.600000
Relative permittivity (real part)	53.19
Conductivity (S/m)	0.93
E-Field Probe	SN34/15 EPGO265
Crest Factor	1.0
Conversion Factor	2.12
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	0.000000
SAR 10g (W/Kg)	0.380781
SAR 1g (W/Kg)	0.755028
SURFACE SAR	**VOLUME SAR**
	
	

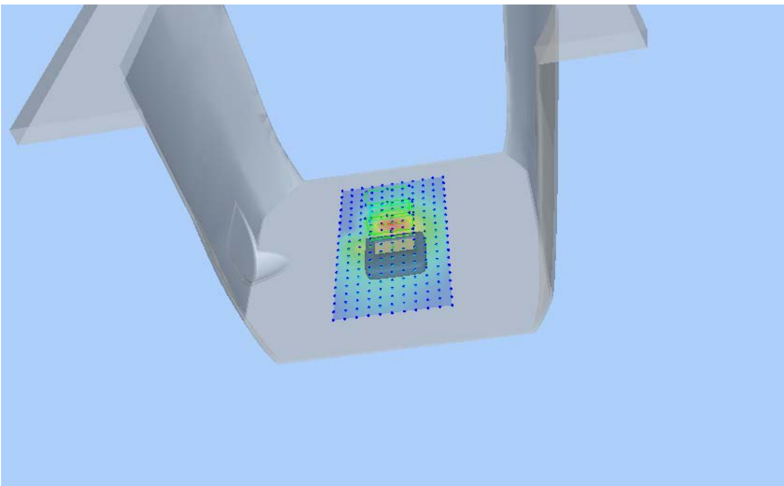
#4

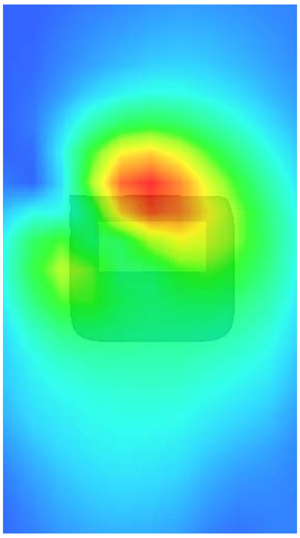
Test Mode: WCDMA Band II,Mid channel(Body Back Side)
Product Description: GPS Tracker
Model: TRKM010
Test Date: April 05, 2016

Medium(liquid type)	MSL_1900
Frequency (MHz)	1880.000000
Relative permittivity (real part)	54.11
Conductivity (S/m)	1.51
E-Field Probe	SN34/15 EPGO265
Crest Factor	1.0
Conversion Factor	2.42
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-0.170000
SAR 10g (W/Kg)	0.298837
SAR 1g (W/Kg)	0.583689
SURFACE SAR	**VOLUME SAR**









5. CALIBRATION CERTIFICATES

5.1 Probe-EPGO265 Calibration Certificate

COMOSAR E-Field Probe Calibration Report

Ref : ACR.294.1.16.SATU.A

SHENZHEN BALUN TECHNOLOGY CO.,LTD.
BLOCK B, FL 1, BAISHA SCIENCE AND TECHNOLOGY PARK, SHAHE XI ROAD,
NANSHAN DISTRICT, SHENZHEN, GUANGDONG PROVINCE, P.R. CHINA 518055
MVG COMOSAR DOSIMETRIC E-FIELD PROBE
SERIAL NO.: SN 34/15 EPGO265

Calibrated at MVG US
2105 Barrett Park Dr. - Kennesaw, GA 30144

Calibration Date: 09/15/2016

Summary:

This document presents the method and results from an accredited COMOSAR Dosimetric E-Field Probe calibration performed in MVG USA using the CALISAR / CALIBAIR test bench, for use with a COMOSAR system only. All calibration results are traceable to national metrology institutions.

COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.294.1.16.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	9/24/2016	
Checked by :	Jérôme LUC	Product Manager	9/24/2016	
Approved by :	Kim RUTKOWSKI	Quality Manager	9/24/2016	

	Customer Name
Distribution :	SHENZHEN BALUN TECHNOLOGY Co.,Ltd.

Issue	Date	Modifications
A	9/24/2016	Initial release

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1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE2
Serial Number	SN 34/15 EPGO265
Product Condition (new / used)	New
Frequency Range of Probe	0.45 GHz-6GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.192 MΩ Dipole 2: R2=0.230 MΩ Dipole 3: R3=0.205 MΩ

A yearly calibration interval is recommended.

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

MVG's COMOSAR E field Probes are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards.

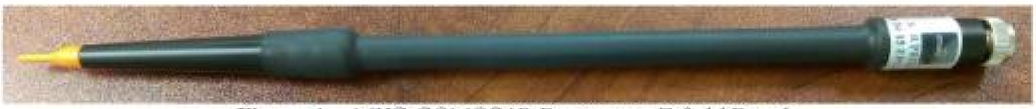


Figure 1 – *MVG COMOSAR Dosimetric E field Dipole*

Probe Length	330 mm
Length of Individual Dipoles	2 mm
Maximum external diameter	8 mm
Probe Tip External Diameter	2.5 mm
Distance between dipoles / probe extremity	1 mm

3 MEASUREMENT METHOD

The IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards provide recommended practices for the probe calibrations, including the performance characteristics of interest and methods by which to assess their affect. All calibrations / measurements performed meet the fore mentioned standards.

3.1 LINEARITY

The evaluation of the linearity was done in free space using the waveguide, performing a power sweep to cover the SAR range 0.01W/kg to 100W/kg.

3.2 SENSITIVITY

The sensitivity factors of the three dipoles were determined using a two step calibration method (air and tissue simulating liquid) using waveguides as outlined in the standards.

3.3 LOWER DETECTION LIMIT

The lower detection limit was assessed using the same measurement set up as used for the linearity measurement. The required lower detection limit is 10 mW/kg.

3.4 ISOTROPY

The axial isotropy was evaluated by exposing the probe to a reference wave from a standard dipole with the dipole mounted under the flat phantom in the test configuration suggested for system validations and checks. The probe was rotated along its main axis from 0 - 360 degrees in 15 degree steps. The hemispherical isotropy is determined by inserting the probe in a thin plastic box filled with tissue-equivalent liquid, with the plastic box illuminated with the fields from a half wave dipole. The dipole is rotated about its axis (0°–180°) in 15° increments. At each step the probe is rotated about its axis (0°–360°).

3.5 BOUNDARY EFFECT

The boundary effect is defined as the deviation between the SAR measured data and the expected exponential decay in the liquid when the probe is oriented normal to the interface. To evaluate this effect, the liquid filled flat phantom is exposed to fields from either a reference dipole or waveguide. With the probe normal to the phantom surface, the peak spatial average SAR is measured and compared to the analytical value at the surface.

4 MEASUREMENT UNCERTAINTY

The guidelines outlined in the IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty associated with an E-field probe calibration using the waveguide technique. All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

Uncertainty analysis of the probe calibration in waveguide					
ERROR SOURCES	**Uncertainty value (%)**	**Probability Distribution**	**Divisor**	**ci**	**Standard Uncertainty (%)**
Incident or forward power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Reflected power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Liquid conductivity	5.00%	Rectangular	$\sqrt{3}$	1	2.887%
Liquid permittivity	4.00%	Rectangular	$\sqrt{3}$	1	2.309%
Field homogeneity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Field probe positioning	5.00%	Rectangular	$\sqrt{3}$	1	2.887%

Field probe linearity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Combined standard uncertainty					5.831%
Expanded uncertainty 95 % confidence level k = 2					12.0%

5 CALIBRATION MEASUREMENT RESULTS

Calibration Parameters	
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

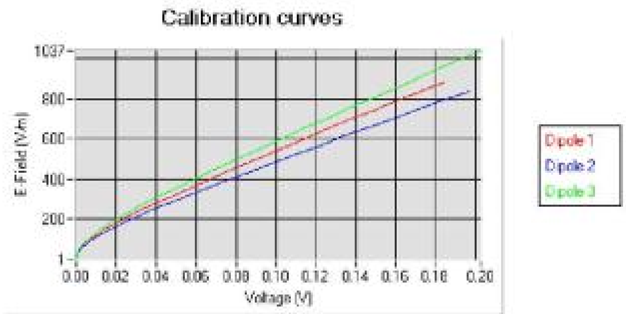
5.1 SENSITIVITY IN AIR

Normx dipole 1 ($\mu V/(V/m)^2$)	Normy dipole 2 ($\mu V/(V/m)^2$)	Normz dipole 3 ($\mu V/(V/m)^2$)
0.72	0.81	0.85

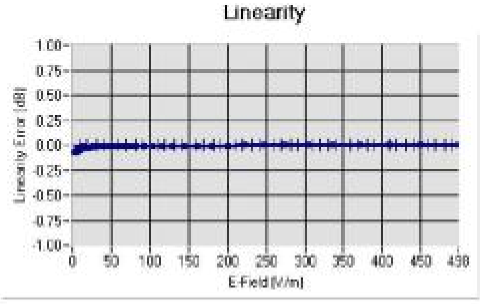
DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
92	90	95

Calibration curves ei=f(V) (i=1,2,3) allow to obtain E-field value using the formula:

$$E = \sqrt{E_1^2 + E_2^2 + E_3^2}$$



5.2 LINEARITY



Linearity:I+/-1.61% (+/-0.07dB)

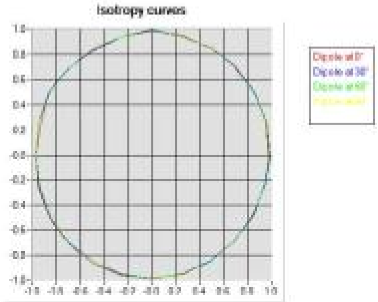
5.3 SENSITIVITY IN LIQUID

Liquid	Frequency (MHz +/- 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL450	450	44.12	0.88	1.85
BL450	450	58.92	1.00	1.90
HL750	750	42.24	0.90	1.81
BL750	750	56.85	0.99	1.88
HL850	835	43.02	0.90	2.04
BL850	835	53.72	0.98	2.12
HL900	900	42.47	0.99	1.86
BL900	900	56.97	1.09	1.92
HL1800	1800	42.24	1.40	2.04
BL1800	1800	53.53	1.53	2.08
HL1900	1900	40.79	1.42	2.35
BL1900	1900	54.47	1.57	2.42
HL2000	2000	40.52	1.44	2.23
BL2000	2000	54.18	1.56	2.32
HL2450	2450	38.73	1.81	2.47
BL2450	2450	53.23	1.96	2.55
HL2600	2600	38.54	1.95	2.36
BL2600	2600	52.07	2.23	2.43
HL5200	5200	36.80	4.84	1.81
BL5200	5200	51.21	5.16	1.85
HL5400	5400	36.35	4.96	2.04
BL5400	5400	50.51	5.70	2.11
HL5600	5600	35.57	5.23	2.08
BL5600	5600	49.83	5.91	2.15
HL5800	5800	35.30	5.47	1.88
BL5800	5800	49.03	6.28	1.93

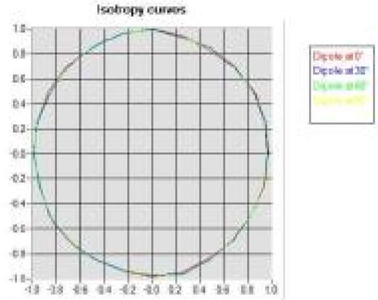
LOWER DETECTION LIMIT: 7mW/kg

5.4 ISOTROPY

HL900 MHz
- Axial isotropy: 0.04 dB
- Hemispherical isotropy: 0.06 dB

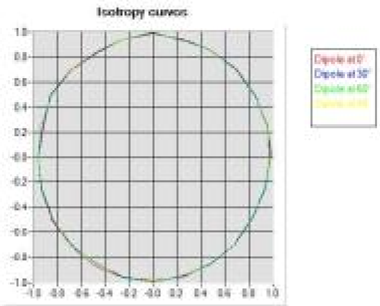


HL1800 MHz
- Axial isotropy: 0.04 dB
- Hemispherical isotropy: 0.06 dB



HL5600 MHz

- Axial isotropy: 0.06 dB
- Hemispherical isotropy: 0.09 dB



6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
Flat Phantom	MVG	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	10/2013	10/2016
Reference Probe	MVG	EP 94 SN 37/08	12/2015	12/2016
Multimeter	Keithley 2000	1188656	12/2013	12/2016
Signal Generator	Agilent E4438C	MY49070581	12/2013	12/2016
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Waveguide	Mega Industries	069Y7-158-13-712	Validated. No cal required.	Validated. No cal required.
Waveguide Transition	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Waveguide Termination	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.

5.2 SID835Dipole Calibration Ceriticate

SAR Reference Dipole Calibration Report

Ref : ACR.287.4.14.SATU.A

SHENZHEN LCS COMPLIANCE TESTING LABORATORY LTD.
1F., XINGYUAN INDUSTRIAL PARK, TONGDA ROAD, BAO'AN BLVD
BAO'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA
SATIMO COMOSAR REFERENCE DIPOLE
FREQUENCY: 835 MHZ
SERIAL NO.: SN 07/14 DIP 0G835-303

Calibrated at SATIMO US
2105 Barrett Park Dr. - Kennesaw, GA 30144

ACCREDITED Calibration CERT #2246-02

10/01/2015

Summary:

This document presents the method and results from an accredited SAR reference dipole calibration performed in SATIMO USA using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	10/14/2015	
Checked by :	Jérôme LUC	Product Manager	10/14/2015	
Approved by :	Kim RUTKOWSKI	Quality Manager	10/14/2015	

	Customer Name
Distribution :	Shenzhen LCS Compliance Testing Laboratory Ltd.

Issue	Date	Modifications
A	10/14/2015	Initial release

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