

## SAR TEST REPORT

For

ComNav Technology Ltd.

**Data Collector** 

Test Model:R60

Prepared for : ComNav Technology Ltd.

Address Building 2, No.618 Chengliu Middle Rd. Malu town, Shanghai,

China

Prepared by : Shenzhen LCS Compliance Testing Laboratory Ltd.

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Date of receipt of test sample : March 10, 2022

Number of tested samples : 2

Sample No. : 220223047A-1, 220223047A-2

Serial number : Prototype

Date of Test : March 10, 2022~April 13, 2022

Date of Report : April 20, 2022



Scan code to check authenticity



## SAR TEST REPORT

Report Reference No. ....: LCS220223047AEB

Date Of Issue ...... April 20, 2022

Testing Laboratory Name....:: **Shenzhen LCS Compliance Testing Laboratory Ltd.** 

101, 201 Bldg A & 301 Bldg C, Juji Industrial Park Yabianxueziwei, Address .....:

Shajing Street, Baoan District, Shenzhen, 518000, China

Full application of Harmonised standards Testing Location/ Procedure .....:

Partial application of Harmonised standards

Applicant's Name .....: ComNav Technology Ltd.

Building 2, No.618 Chengliu Middle Rd. Malu town, Shanghai, China Address .....:

**Test Specification:** 

Standard.....: IEEE Std C95.1. 2019/ IEEE Std 1528™-2013/FCC Part 2.1093

Test Report Form No. .....: LCSEMC-1.0

TRF Originator.....: Shenzhen LCS Compliance Testing Laboratory Ltd.

Master TRF ...... Dated 2011-03

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Test Item Description....:: **Data Collector** 

Trade Mark .....: **Sino GNSS** 

Model/Type Reference..... R60

GSM 850,1900;WCDMA II,V; Operation Frequency .....:

LTE2,4,5,17,41;WLAN2.4G,5.2G,5.8G

Ratings .....: For Adapter Input: 100-240V~, 50/60Hz, 0.6A

Output: 3.6-6.0V-3.0A/ 6.0-9.0V-2.0A/9.0-12.0V-1.5A

DC 3.8V by Rechargeable Li-ion Battery, 9000mAh

Result ....:: **Positive** 

> Compiled by: Supervised by: Approved by:

Jay Zhan/ File administrators

Jin Wang/ Technique principal

Gavin Liang/ Manager



## **SAR -- TEST REPORT**

Test Report No. : LCS220223047AEB April 20, 2022 Date of issue
--

Type / Model	: R60
EUT	: Data Collector
Applicant	: ComNav Technology Ltd.
Address	Building 2, No.618 Chengliu Middle Rd. Malu town, Shanghai, China
Telephone	: /
Fax	: /
Manufacturer	: ComNav Technology Ltd.
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Address	· China
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Telephone	China : / : / : ComNav Technology Ltd. Building 2, No.618 Chengliu Middle Rd. Malu town, Shanghai, China : /
FactoryAddress	China : / : / : ComNav Technology Ltd. Building 2, No.618 Chengliu Middle Rd. Malu town, Shanghai, China : /

Test Result Positive
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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
000	April 20, 2022	Initial Issue	Gavin Liang

## **TABLE OF CONTENTS**

1. TES'	T STANDARDS AND TEST DESCRIPTION	6
1.1.	TEST STANDARDS	6
1.2.	TEST DESCRIPTION.	
1.3.	GENERAL REMARKS	6
1.4.	PRODUCT DESCRIPTION	6
1.5.	STATEMENT OF COMPLIANCE	
2. TES	T ENVIRONMENT	10
2.1.	TEST FACILITY	10
	ENVIRONMENTAL CONDITIONS	
	SAR LIMITS	
2.4.	EQUIPMENTS USED DURING THE TEST	11
3. SAR	MEASUREMENTS SYSTEM CONFIGURATION	12
3.1.	SARMEASUREMENT SET-UP	12
3.2.	OPENSAR E-FIELD PROBE SYSTEM	
3.3.	PHANTOMS	
3.4.	DEVICE HOLDER	14
3.5.	SCANNING PROCEDURE	15
3.6.	DATA STORAGE AND EVALUATION	16
3.7.	TISSUE DIELECTRIC PARAMETERS FOR HEAD AND BODY PHANTOMS	18
3.8.	TISSUE EQUIVALENT LIQUID PROPERTIES	
3.9.	SYSTEM CHECK	-
	SAR MEASUREMENT PROCEDURE	
	. Power Reduction	
3.12.	Power Drift	26
4. TES	T CONDITIONS AND RESULTS	27
4.1.		
4.2.	TRANSMIT ANTENNAS AND SAR MEASUREMENT POSITION	
4.3.	SAR MEASUREMENT RESULTS	
4.4.	SIMULTANEOUS TX SAR CONSIDERATIONS	
4.5.	SAR MEASUREMENT VARIABILITY	
4.6.	GENERAL DESCRIPTION OF TEST PROCEDURES	
4.7.	MEASUREMENT UNCERTAINTY (450MHz-6GHz)	
4.8.	SYSTEM CHECK RESULTS	
4.9.	SAR TEST GRAPH RESULTS	
5. CAL	LIBRATION CERTIFICATES	70
5.1	PROBE-EPGO324 CALIBRATION CERTIFICATE	
5.2	SID750DIPOLE CALIBRATION CERITICATE	
5.3	SID835DIPOLE CALIBRATION CERITICATE	
5.4	SID1800 DIPOLE CALIBRATION CERTIFICATE	
5.5	SID1900 DIPOLE CALIBRATION CERTIFICATE	
5.6	SID2450 DIPOLE CALIBRATION CERITICATE	
5.7 5.8	SID2600 DIPOLE CALIBRATION CERITICATESID5G-6G DIPOLE CALIBRATION CERITICATE	
	OTOGRAPHS OF THE LIQUID	
	OTOGRAPHS OF THE TEST	163
O TITUD	PRIOTO CD A DIIG	1.4



## 1. TEST STANDARDS AND TEST DESCRIPTION

## 1.1. Test Standards

<u>IEEE Std C95.1-2019</u>: IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz 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.

<u>IEEE Std 1528™-2013:</u> 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

<u>KDB447498 D02 SAR Procedures for Dongle Xmtr v02r01</u>: SAR Measurement Procedures For USB Dongle Transmitters.

KDB865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04 : SAR Measurement Requirements for 100 MHz to 6 GHz

<u>KDB865664 D02 RF Exposure Reporting v01r02:</u> RF Exposure Compliance Reporting and Documentation Considerations

KDB 248227 D01 802.11 Wi-Fi SAR v02r02: SAR GUIDANCE FOR IEEE 802.11 (Wi-Fi) TRANSMITTERS

KDB941225 D01 3G SAR Procedures: 3G SAR MEAUREMENT PROCEDURES

KDB 941225 D05 SAR for LTE Devices: SAR Evaluation Considerations For LTE Devices

## 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	:	March 10, 2022
Testing commenced on	:	March 10, 2022
Testing concluded on	:	April 13, 2022

## 1.4. Product Description

The ComNav Technology Ltd.'s Model: R60 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		
EUT:	Data Collector	
Model/Type reference:	R60	
Additional Model No.		
Model Declaration:		
Hardware Version		
Firmware Version:		
	For Adapter Input: 100-240V~, 50/60Hz, 0.6A	
Power supply:	Output: 3.6-6.0V=3.0A/ 6.0-9.0V=2.0A/9.0-12.0V=1.5A DC 3.8V by Rechargeable Li-ion Battery, 9000mAh	
	DC 3.6V by Rechargeable Li-luit ballery, 9000IIIAII	

The EUT is Data Collector. the Data Collector is intended for WLAN transmission. It is equipped with WiFi2.4G,5.2G,5.8G; GSM 850,1900; WCDMA Band II,Band V; LTE 2,4,5,17, 41. For more information see the following datasheet



Shenzhen LCS Compliance Testing Laboratory Ltd. FCC ID: 2ACHBR60 Report No.: LCS220223047A		
Technical Characteristics		
LTE		
Operation Band:	⊠E-UTRA Band 2(U.SBand) ⊠E-UTRA Band 4(U.SBand)	
Modulation Type:	QPSK/16QAM	
Release Version:	R12	
Power Class:	Class 3	
Antenna Description:	FPC Antenna 1.1dBi (max.) For E-UTRA Band 2 -0.15dBi (max.) For E-UTRA Band 4 -1.57dBi (max.) For E-UTRA Band 5 -2.73dBi (max.) For E-UTRA Band 17 -2.17dBi (max.) For E-UTRA Band 41	
Bluetooth		
Frequency Range:	2402MHz ~ 2480MHz	
Chanel Number: Chanel Spacing:	79 channels for Bluetooth V5.0(DSS) 40 channels for Bluetooth V5.0 (DTS) 1MHz for Bluetooth V5.0 (DSS)	
	2MHz for Bluetooth V5.0 (DTS)	
Modulation Type; GFSK, π/4-DQPSK, 8-DPSK for Bluetooth V5.0(DSS) GFSK for Bluetooth V5.0 (DTS)		
Bluetooth Version:	V5.0	
Antenna Description:	FPC Antenna, 3.07dBi (max.)	
WIFI 2.4G		
Supported Standards:	IEEE 802.11b/802.11g/802.11n(HT20 and HT40)	
Frequency Range:	2412MHz-2462MHz	
Operation frequency:	2412-2462MHz for 11b/g/n(HT20) 2422-2452MHz for 11n(HT40)	
Type of Modulation:	IEEE 802.11b: DSSS (CCK, DQPSK, DBPSK) IEEE 802.11g: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n: OFDM (64QAM, 16QAM, QPSK, BPSK)	
Channel number:	11 channels for 20MHz bandwidth (2412~2462MHz) 7 channels for 40MHz bandwidth (2422~2452MHz)	
Channel separation:	5MHz	
Antenna Description:	FPC Antenna, 3.07dBi (max.)	
WIFI 5.2G		
Frequency Range:	5180MHz-5240MHz	
Type of Modulation:  Channel number:	IEEE 802.11a/n/ac: OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK) 4 channels for 20MHz bandwidth (5180-5240MHz) 2 channels for 40MHz bandwidth (5190~5230MHz) 1 channels for 80MHz bandwidth (5210MHz)	
Channel separation:	5MHz	
Antenna Description:	FPC Antenna, 4.79dBi (max.)	
WIFI 5.8G		
Frequency Range:	5745-5825MHz	
Type of Modulation:	IEEE 802.11a/n/ac: OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK)	
Channel number:	5 channels for 20MHz bandwidth(5745-5825MHz) 2 channels for 40MHz bandwidth(5755~5795MHz) 1 channels for 80MHz bandwidth(5775MHz)	
Channel separation:	1	
Antenna Description:	FPC Antenna, 4.1dBi (max.)	
UMTS		
Operation Band:	<ul><li></li></ul>	

V			
	⊠WCDMA Band I (EU-Band)		
	⊠WCDMA Band VIII (EU-Band)		
F D	WCDMA Band II: 1852.4~1907.6MHz		
FrequencyRange:	WCDMA Band V: 826.4~846.6MHz		
Modulation Type:	QPSK,16QAM		
WCDMA Release Version:	R99		
	FPC Antenna		
Antenna Description:	-0.2dBi (max.) For WCDMA Band II		
'	-1.57dBi (max.) For WCDMA Band V		
GSM			
Support Band:	☐ GSM 900 (EU-Band) ☐ DCS 1800 (EU-Band)		
Support Band:			
Release Version:	R99		
GPRS Class	Class 12		
EGPRS Class	Class 12		
Modulation Type:	GMSK for GSM/GPRS; 8PSK for EGPRS		
	FPC Antenna		
Antenna Description: -1.57dBi (max.) For GSM 850			
	-0.2dBi (max.) For PCS 1900		
GPS function	Support and only RX		
NFC			
Operating Frequency	13.56MHz		
Modulation Type	ASK		
Antenna Description	COIL Antenna, 0dBi (Max.)		



## 1.5. Statement of Compliance

The maximum of results of SAR found during testing for R60 are follows:

<Highest Reported standalone SAR Summary>

Classment	Frequency	Hotspot (Report SAR <sub>1-g</sub> (W/kg)	Body-worn (Report SAR <sub>1-g</sub> (W/kg)	
Class	Band	(Separation Distance 0mm)		
	GSM 850	0.704	0.704	
	GSM1900	0.467	0.467	
	WCDMA Band V	0.181	0.181	
	WCDMA Band II	0.774	0.774	
PCB	LTE band 2	0.485	0.485	
	LTE band 4	0.932	0.932	
	LTE band 5	0.296	0.296	
	LTE band 17	0.361	0.361	
	LTE band 41	0.238	0.238	
DTS	WIFI2.4G	0.243	0.243	
NII	WIFI5.2G	0.230	0.230	
INII	WIFI5.8G	0.071	0.071	

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 C95.1-2019, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.

<Highest Reported simultaneous SAR Summary>

Exposure Position	Classment Class	Highest Reported Simultaneous Transmission SAR <sub>1-g</sub> (W/kg)
Body-worn	PCB	4.475
(hotspot open)	DTS	1.175



## 2. TEST ENVIRONMENT

## 2.1. Test Facility

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

Site Description

EMC Lab. : NVLAP Accreditation Code is 600167-0.

FCC Designation Number is CN5024.

CAB identifier is CN0071.

CNAS Registration Number is L4595. Test Firm Registration Number: 254912.

## 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)

	SAR (W/k	(g)
EXPOSURE LIMITS	(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

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	PC	Lenovo	G5005	MY42081102	N/A	N/A
2	SAR Measurement system	SATIMO	4014_01	SAR_4014_01	N/A	N/A
3	Signal Generator	Agilent	E4438C	MY49072627	2021-06-11	2022-06-10
4	Multimeter	Keithley	MiltiMeter 2000	4059164	2021-11-13	2022-11-12
5	S-parameter Network Analyzer	Agilent	8753ES	US38432944	2021-11-13	2022-11-12
6	Wideband Radio Communication Tester	R&S	CMW500	103818-1	2021-11-20	2022-11-19
7	E-Field PROBE	MVG	SSE2	SN 31/17 EPGO324	2021-10-06	2022-10-05
8	DIPOLE 750	SATIMO	SID 750	SN 07/14 DIP 0G750-302	2021-09-29	2024-09-28
9	DIPOLE 835	SATIMO	SID 835	SN 07/14 DIP 0G835-303	2021-09-29	2024-09-28
10	DIPOLE 1800	SATIMO	SID 1800	SN 07/14 DIP 1G800-301	2021-09-29	2024-09-28
11	DIPOLE 1900	SATIMO	SID 1900	SN 38/18 DIP 1G900-466	2021-09-22	2024-09-21
12	DIPOLE 2450	SATIMO	SID 2450	SN 07/14 DIP 2G450-306	2021-09-29	2024-09-28
13	DIPOLE 2600	SATIMO	SID 2600	SN 38/18 DIP 2G600-468	2021-09-22	2024-09-21
14	DIPOLE 5000-6000	MVG	SWG5500	SN 49/16 WGA 43	2021-09-22	2024-09-21
15	COMOSAR OPENCoaxial Probe	SATIMO	OCPG 68	SN 40/14 OCPG68	2021-11-13	2022-11-12
16	SAR Locator	SATIMO	VPS51	SN 40/14 VPS51	2021-11-13	2022-11-12
17	Communication Antenna	SATIMO	ANTA57	SN 39/14 ANTA57	2021-11-13	2022-11-12
18	FEATURE PHONEPOSITIONING DEVICE	SATIMO	MSH98	SN 40/14 MSH98	N/A	N/A
19	DUMMY PROBE	SATIMO	DP60	SN 03/14 DP60	N/A	N/A
20	SAM PHANTOM	SATIMO	SAM117	SN 40/14 SAM117	N/A	N/A
21	Liquid measurement Kit	HP	85033D	3423A03482	2021-11-13	2022-11-12
22	Power meter	Agilent	E4419B	MY45104493	2021-06-11	2022-06-10
23	Power meter	Agilent	E4419B	MY45100308	2021-11-20	2022-11-19
24	Power sensor	Agilent	E9301H	MY41495616	2021-11-20	2022-11-19
25	Power sensor	Agilent	E9301H	MY41495234	2021-06-11	2022-06-10
26	Directional Coupler	MCLI/USA	4426-20	03746	2021-06-11	2022-06-10

## 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  $5\Omega$  from the provious measurement.
- 2) Network analyzer probe calibration against air, distilled water and a shorting block performed before measuring liquid parameters.



## 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

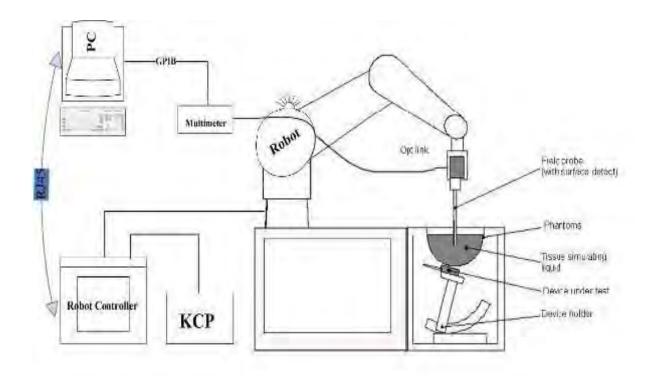
Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.

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 EPGO324 (manufactured by MVG), 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 450 MHz to 6 GHz;

Linearity: 0.25dB(450 MHz to 6 GHz)

0.25 dB in HSL (rotation around probe axis) Directivity

0.5 dB in tissue material (rotation normal to probe

0.01W/kg to > 100 W/kg; Dynamic Range

Linearity: 0.25 dB

Overall length: 330 mm (Tip: 16mm) **Dimensions** 

Tip diameter: 5 mm (Body: 8 mm)

Distance from probe tip to sensor centers: 2.5 mm

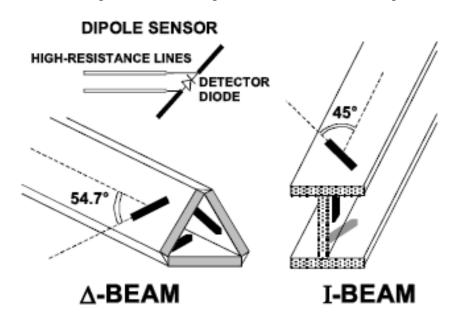
Application General dosimetry up to 6 GHz

> 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 integrated in a wooden table. The shape of the shell is in compliance with the specification set in IEEE 1528 and EN62209-1, EN62209-2. 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 all predefined phantom positions and measurement grids by manually teaching three points in the robo

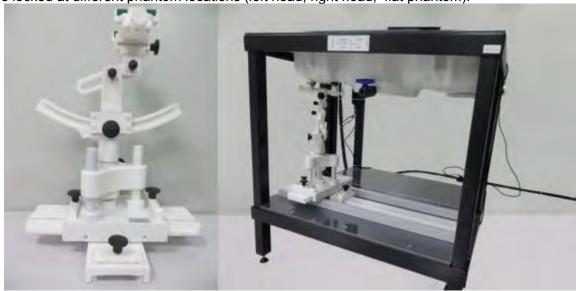
System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.



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 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	$5 \text{ mm} \pm 1 \text{ mm}$	$\frac{1}{2} \cdot \delta \cdot \ln(2) \text{ mm} \pm 0.5 \text{ mm}$
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
	$\leq$ 2 GHz: $\leq$ 15 mm 2 – 3 GHz: $\leq$ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
Maximum area scan spatial resolution: $\Delta x_{Area}$ , $\Delta y_{Area}$	When the x or y dimension measurement plane orientat above, the measurement rescorresponding x or y dimensat least one measurement po	ion, is smaller than the olution must be $\leq$ the sion of the test device with

#### 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 res	olution: $\Delta x_{Zoom}$ , $\Delta y_{Zoom}$	$\leq$ 2 GHz: $\leq$ 8 mm 2 - 3 GHz: $\leq$ 5 mm	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*	
	uniform	grid: Δz <sub>Zoom</sub> (n)	≤ 5 mm	$3 - 4 \text{ GHz}$ : $\leq 4 \text{ mm}$ $4 - 5 \text{ GHz}$ : $\leq 3 \text{ mm}$ $5 - 6 \text{ GHz}$ : $\leq 2 \text{ mm}$	
Maximum zoom scan spatial resolution, normal to phantom surface	graded	Δz <sub>Zoom</sub> (1): between 1 <sup>st</sup> two points closest to phantom surface	$\leq 4 \text{ mm}$	$3 - 4 \text{ GHz}$ : $\leq 3 \text{ mm}$ $4 - 5 \text{ GHz}$ : $\leq 2.5 \text{ mm}$ $5 - 6 \text{ GHz}$ : $\leq 2 \text{ mm}$	
	grid	Δz <sub>Zoom</sub> (n>1): between subsequent points	$\leq 1.5 \cdot \Delta z_{Zo}$	toom(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:  $\delta$  is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.

<sup>\*</sup> When zoom scan is required and the <u>reported</u> SAR from the <u>area scan based 1-g SAR estimation</u> 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:

E – fieldprobes : 
$$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

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

 $H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}$ (i = x, y, z) With = compensated signal of channel i Normi = sensor sensitivity of channel i

[mV/(V/m)2] for E-field Probes

ConvF = sensitivity enhancement in solution = sensor sensitivity factors for H-field probes

= carrier frequency [GHz] f

= electric field strength of channel i in V/m Εi Ηi = 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.

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

= local specific absorption rate in mW/g with SAR

= total field strength in V/m

of the simulation liquid.

= conductivity in [mho/m] or [Siemens/m] σ = equivalent tissue density in g/cm3 ρ

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



## 3.7. 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

Frequency (MHz)	Bactericide	DGBE	HEC	NaCl	Sucrose	1,2- Propan ediol	X100	Water	Conductivity	Permittivity
	%	%	%	%	%	%	%	%	σ	εr
750	/	1	/	0.79	/	64.81	/	34.40	0.97	41.8
835	/	1	/	0.79	1	64.81	/	34.40	0.97	41.8
900	/	1	/	0.79	/	64.81	/	34.40	0.97	41.8
1800	/	13.84	/	0.35	1	/	30.45	55.36	1.38	41.0
1900	/	13.84	/	0.35	1	/	30.45	55.36	1.38	41.0
2000	/	7.99	1	0.16	/	1	19.97	71.88	1.55	41.1
2450	/	7.99	/	0.16	1	/	19.97	71.88	1.88	40.3
2600	/	7.99	/	0.16	/	/	19.97	71.88	1.88	40.3

Target Frequency	He	ad	В	ody
(MHz)	٤r	σ(S/m)	٤ <sub>r</sub>	σ(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

## 3.8. Tissue equivalent liquid properties

Dielectric Performance of Head and Body Tissue Simulating Liquid

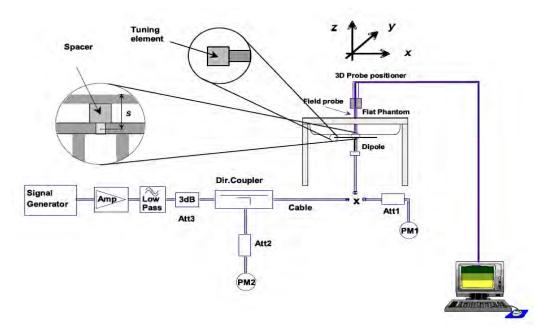
Test Eng	gineer: Jay Zha	an							
Tissue	Measured	Targe	t Tissue		Measure	d Tissue		Liquid	Test Data
Type	Frequency (MHz)	σ	$\epsilon_{\rm r}$	σ	Dev.	$\epsilon_{ m r}$	Dev.	Temp.	
750H	750	0.89	41.90	0.88	-1.12%	41.58	-0.76%	21.3	03/10/2022
835H	835	0.90	41.50	0.86	-4.44%	40.14	-3.28%	20.2	03/14/2022
1800H	1800	1.40	40.00	1.42	1.43%	41.59	3.98%	22.1	03/18/2022
1900H	1900	1.40	40.00	1.37	-2.14%	39.23	-1.93%	21.3	03/25/2022
2450H	2450	1.80	39.20	1.76	-2.22%	40.12	2.35%	22.4	03/29/2022
2600H	2600	4.66	36.00	4.59	-1.50%	35.81	-0.53%	22.3	04/04/2022
5200H	5200	5.30	49.00	5.25	-0.94%	48.80	-0.41%	23.2	04/08/2022
5800H	5800	6.00	48.20	6.05	0.83%	48.46	0.54%	22.3	04/13/2022



## 3.9. 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.

Mixture	Frequency	Power	SAR <sub>1g</sub>	SAR <sub>10g</sub>	Drift	1W Ta			rence ntage	Liquid	Date
Туре	(MHz)	Fowei	(W/Kg)	(W/Kg)	(%)	SAR <sub>1g</sub> (W/Kg)	SAR <sub>10g</sub> (W/Kg)	1g	10g	Temp	Date
		100 mW	0.824	0.562							
Head	750	Normalize to 1 Watt	8.24	5.62	1.42	8.38	5.53	-1.67%	1.63%	21.3	03/10/2022
		100 mW	0.975	0.632							
Head	835	Normalize to 1 Watt	9.75	6.32	-0.21	9.60	6.20	1.56%	1.94%	20.2	03/14/2022
		100 mW	3.819	20.13							
Head	1800	Normalize to 1 Watt	38.19	20.13	3.56	38.13	20.20	0.16%	-0.35%	22.1	03/18/2022
		100 mW	3.921	2.068							
Head	1900	Normalize to 1 Watt	39.21	20.68	-1.17	40.03	20.55	-2.05%	0.63%	21.3	03/25/2022
		100 mW	5.224	2.343							
Head	2450	Normalize to 1 Watt	52.24	23.43	0.24	53.89	24.15	-3.06%	-2.98%	22.4	03/29/2022
		100 mW	5.511	2.458							
Head	2600	Normalize to 1 Watt	55.11	24.58	3.25	56.91	24.69	-3.16%	-0.45%	22.3	04/04/2022
		100 mW	15.467	5.512							
Head	5200	Normalize to 1 Watt	154.67	55.12	-3.02	165.77	57.20	-6.70%	-3.64%	23.2	04/08/2022
		100 mW	18.293	6.177							
Head	5800	Normalize to 1 Watt	182.93	61.77	-1.01	186.77	62.84	-2.06%	-1.70%	22.3	04/13/2022



## 3.10. SAR measurement procedure

The measurement procedures are as follows:

## 3.10.1 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 WLAN/BT power measurement, use engineering software to configure EUT WLAN/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 WLAN/BT output power.

## 3.10.2 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. the EGPRS 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.

## 3.10.3 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  $\leq \frac{1}{4}$  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  $\leq 1.2$  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.

#### **Output power Verification**

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.

## **Head SAR**

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.



#### Body-Worn Accessory SAR

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.

## 2) 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 shouldbe configured with a CQI feedback cycle of 4 ms with a CQI repetition factor of 2 to maintain aconstant rate of active CQI slots. DPCCH and DPDCH gain factors( $\beta$ c,  $\beta$ d), and HS-DPCCHpower offset parameters ( $\Delta$ ACK,  $\Delta$ NACK,  $\Delta$ CQI) 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

	<u> </u>			<del></del>			
Sub-set	β <sub>c</sub>	$\beta_{d}$	β <sub>d</sub> (SF)	$\beta_c/\beta_d$	β <sub>hs</sub> (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:  $\triangle_{ACK}$ ,  $\triangle_{NACK}$  and  $\triangle_{CQI}$ = 8  $\Leftrightarrow$   $A_{hs}$  =  $\beta_{hs}/\beta_c$ =30/15  $\Leftrightarrow$   $\beta_{hs}$ =30/15\* $\beta_c$ 

Note2: CM=1 for $\beta_c/\beta_d$  =12/15,  $\beta_{hs}/\beta_c$ =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  $\beta_c$ =11/15 and  $\beta_d$ =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	$eta_{c}$	$\beta_{d}$	β <sub>d</sub> (SF)	$\beta_c/\beta_d$	$\beta_{hs}^{(1)}$	$eta_{ ext{ec}}$	$eta_{ ext{ed}}$	β <sub>ed</sub> (SF)	$\beta_{\text{ed}} \\ (\text{codes})$	CM (2) (dB)	MPR (dB)	AG <sup>(4)</sup> Index	E- TFCI
1	11/15 <sup>(3)</sup>	15/15 <sup>(3)</sup>	64	11/15 <sup>(3)</sup>	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	$\beta_{ed1} 47/15$ $\beta_{ed2} 47/15$	4	2	2.0	1.0	15	92



Shenzhen LCS Compliance Testing Laboratory Ltd. FCC ID: 2ACHBR60 Report No.: LCS220223047AEB

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 <sup>(4)</sup>	15/15 <sup>(4)</sup>	64	15/15 <sup>(4)</sup>	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1:  $\Delta_{ACK}$ ,  $\Delta NACK$  and  $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \underline{\beta}_{hs}/\underline{\beta}_{c} = 30/15 \Leftrightarrow \underline{\beta}_{hs} = 30/15 *\beta_{c}$ .

Note 2: CM = 1 for  $\beta c/\beta d$  =12/15,  $\underline{\beta}_{hs}/\underline{\beta}_{c}$  =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  $\beta c/\beta d$  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  $\beta c = 10/15$  and  $\beta d = 15/15$ .

Note 4: For subtest 5 the  $\beta$ c/ $\beta$ d 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  $\beta$ c = 14/15 and  $\beta$ d = 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.

## 3.10.4 WIFI Test Configuration

The SAR measurement and test reduction procedures are structured according to either the DSSS or OFDM transmission mode configurations used in each standalone frequency band and aggregated band. For devices that operate in exposure configurations that require multiple test positions, additional SAR test reduction may be applied. The maximum output power specified for production units, including tune-up tolerance, are used to determine initial SAR test requirements for the 802.11 transmission modes in a frequency band. SAR is measured using the highest measured maximum output power channel for the initial test configuration. SAR measurement and test reduction for the remaining 802.11 modes and test channels are determined according to measured or specified maximum output power and reported SAR of the initial measurements. The general test reduction and SAR measurement approaches are summarized in the following:

- 1. The maximum output power specified for production units are determined for all applicable 802.11 transmission modes in each standalone and aggregated frequency band. Maximum output power is measured for the highest maximum output power configuration(s) in each frequency band according to the default power measurement procedures.
- 2. For OFDM transmission configurations in the 2.4 GHz and 5 GHz bands, an "initial test configuration" is first determined for each standalone and aggregated frequency band according to the maximum output power and tune-up tolerance specified for production units.
- a. When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band.
- b. SAR is measured for OFDM configurations using the initial test configuration procedures. Additional frequency band specific SAR test reduction may be considered for individual frequency bands
- c. Depending on the reported SAR of the highest maximum output power channel tested in the initial test configuration, SAR test reduction may apply to subsequent highest output channels in the initial test configuration to reduce the number of SAR measurements.
- 3. The Initial test configuration does not apply to DSSS. The 2.4 GHz band SAR test requirements and 802.11b DSSS procedures are used to establish the transmission configurations required for SAR measurement.
- 4. An "initial test position" is applied to further reduce the number of SAR tests for devices operating in next to the ear, UMPC mini-tablet or hotspot mode exposure configurations that require multiple test positions.
- a. SAR is measured for 802.11b according to the 2.4 GHz DSSS procedure using the exposure condition established by the initial test position.
- b. SAR is measured for 2.4 GHz and 5 GHz OFDM configurations using the initial test configuration. 802.11b/g/n operating modes are tested independently according to the service requirements in each frequency band. 802.11b/g/n modes are tested on the maximum average output channel.
- 5. The Initial test position does not apply to devices that require a fixed exposure test position. SAR is measured in a fixed exposure test position for these devices in 802.11b according to the 2.4 GHz DSSS procedure or in 2.4 GHz and 5 GHz OFDM configurations using the initial test configuration procedures.
- 6. The "subsequent test configuration" procedures are applied to determine if additional SAR measurements are required for the remaining OFDM transmission modes that have not been tested in the initial test configuration. SAR test exclusion is determined according to reported SAR in the initial test configuration and maximum output power specified or measured for these other OFDM configurations.

## 2.4 GHz and 5GHz SAR Procedures



Separate SAR procedures are applied to DSSS and OFDM configurations in the 2.4 GHz band to simplify DSSS test requirements. For 802.11b DSSS SAR measurements, DSSS SAR procedure applies to fixed exposure test position and initial test position procedure applies to multiple exposure test positions. When SAR measurement is required for an OFDM configuration, the initial test configuration, subsequent test configuration and initial test position procedures are applied. The SAR test exclusion requirements for 802.11g/n OFDM configurations are described in section 5.2.2.

1. 802.11b DSSS SAR Test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either a fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:

- a. When the reported SAR of the highest measured maximum output power channel (section 3.1) for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
- b. When the reported SAR is > 0.8 W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.
- 1. 2.4 GHz 802.11g/n OFDM SAR Test Exclusion Requirements

When SAR measurement is required for 2.4 GHz 802.11g/n OFDM configurations, the measurement and test reduction procedures for OFDM are applied (section 5.3). SAR is not required for the following 2.4 GHz OFDM conditions.

- a. When KDB Publication 447498 SAR test exclusion applies to the OFDM configuration
- b. When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.
- 2. SAR Test Requirements for OFDM Configurations

When SAR measurement is required for 802.11 a/g/n/ac OFDM configurations, each standalone and frequency aggregated band is considered separately for SAR test reduction. When the same transmitter and antenna(s) are used for U-NII-1 and U-NII-2A bands, additional SAR test reduction applies. When band gap channels between U-NII-2C band and 5.8 GHz U-NII-3 or §15.247 band are supported, the highest maximum output power transmission mode configuration and maximum output power channel across the bands must be used to determine SAR test reduction, according to the initial test configuration and subsequent test configuration requirements.20 In applying the initial test configuration and subsequent test configuration procedures, the 802.11 transmission configuration with the highest specified maximum output power and the channel within a test configuration with the highest measured maximum output power should be clearly distinguished to apply the procedures.

- 3. OFDM Transmission Mode SAR Test Configuration and Channel Selection Requirements The initial test configuration for 2.4 GHz and 5 GHz OFDM transmission modes is determined by the 802.11 configuration with the highest maximum output power specified for production units, including tune-up tolerance, in each standalone and aggregated frequency band. SAR for the initial test configuration is measured using the highest maximum output power channel determined by the default power measurement procedures (section 4). When multiple configurations in a frequency band have the same specified maximum output power, the initial test configuration is determined according to the following steps applied sequentially.
- a. The largest channel bandwidth configuration is selected among the multiple configurations with the same specified maximum output power.
- b. If multiple configurations have the same specified maximum output power and largest channel bandwidth, the lowest order modulation among the largest channel bandwidth configurations is selected.
- c. If multiple configurations have the same specified maximum output power, largest channel bandwidth and lowest order modulation, the lowest data rate configuration among these configurations is selected.
- d. When multiple transmission modes (802.11a/g/n/ac) have the same specified maximum output power, largest channel bandwidth, lowest order modulation and lowest data rate, the lowest order 802.11 mode is selected; i.e., 802.11a is chosen over 802.11n then 802.11ac or 802.11g is chosen over 802.11n.

After an initial test configuration is determined, if multiple test channels have the same measured maximum output power, the channel chosen for SAR measurement is determined according to the following. These channel selection procedures apply to both the initial test configuration and subsequent test configuration(s), with respect to the default power measurement procedures or additional power measurements required for further SAR test reduction. The same procedures also apply to subsequent highest output power channel(s) selection.

- a. Channels with measured maximum output power within ¼ dB of each other are considered to have the same maximum output.
- b. When there are multiple test channels with the same measured maximum output power, the channel closest to mid-band frequency is selected for SAR measurement.



When there are multiple test channels with the same measured maximum output power and equal separation from mid-band frequency; for example, high and low channels or two mid-band channels, the higher frequency (number) channel is selected for SAR measurement.

Initial Test Configuration Procedures

An initial test configuration is determined for OFDM transmission modes according to the channel bandwidth, modulation and data rate combination(s) with the highest maximum output power specified for production units in each standalone and aggregated frequency band. SAR is measured using the highest measured maximum output power channel. For configurations with the same specified or measured maximum output power, additional transmission mode and test channel selection procedures are required (see section 5.3.2). SAR test reduction of subsequent highest output test channels is based on the reported SAR of the initial test configuration.

For next to the ear, hotspot mode and UMC mini-tablet exposure configurations where multiple test positions are required, the initial test position procedure is applied to minimize the number of test positions required for SAR measurement using the initial test configuration transmission mode.23 For fixed exposure conditions that do not have multiple SAR test positions, SAR is measured in the transmission mode determined by the initial test configuration. When the reported SAR of the initial test configuration is > 0.8 W/kg, SAR measurement is required for the subsequent next highest measured output power channel(s) in the initial test configuration until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

4. Subsequent Test Configuration Procedures

SAR measurement requirements for the remaining 802.11 transmission mode configurations that have not been tested in the initial test configuration are determined separately for each standalone and aggregated frequency band, in each exposure condition, according to the maximum output power specified for production units. The initial test position procedure is applied to next to the ear, UMPC mini-tablet and hotspot mode configurations. When the same maximum output power is specified for multiple transmission modes, the procedures in section 5.3.2 are applied to determine the test configuration. Additional power measurements may be required to determine if SAR measurements are required for subsequent highest output power channels in a subsequent test configuration. The subsequent test configuration and SAR measurement procedures are described in the following.

- a. When SAR test exclusion provisions of KDB Publication 447498 are applicable and SAR measurement is not required for the initial test configuration, SAR is also not required for the next highest maximum output power transmission mode subsequent test configuration(s) in that frequency band or aggregated band and exposure configuration.
- b. When the highest reported SAR for the initial test configuration (when applicable, include subsequent highest output channels), according to the initial test position or fixed exposure position requirements, is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for that subsequent test configuration.
- c. The number of channels in the initial test configuration and subsequent test configuration can be different due to differences in channel bandwidth. When SAR measurement is required for a subsequent test configuration and the channel bandwidth is smaller than that in the initial test configuration, all channels in the subsequent test configuration that overlap with the larger bandwidth channel tested in the initial test configuration should be used to determine the highest maximum output power channel. This step requires additional power measurement to identify the highest maximum output power channel in the subsequent test configuration to determine SAR test reduction.
- 1). SAR should first be measured for the channel with highest measured output power in the subsequent test configuration.
- 2). SAR for subsequent highest measured maximum output power channels in the subsequent test configuration is required only when the reported SAR of the preceding higher maximum output power channel(s) in the subsequent test configuration is > 1.2 W/kg or until all required channels are tested. a) For channels with the same measured maximum output power, SAR should be measured using the channel closest to the center frequency of the larger channel bandwidth channel in the initial test configuration.
- d. SAR measurements for the remaining highest specified maximum output power OFDM transmission mode configurations that have not been tested in the initial test configuration (highest maximum output) or subsequent test configuration(s) (subsequent next highest maximum output power) is determined by applying the subsequent test configuration procedures in this section to the remaining configurations according to the following:
- 1) replace "subsequent test configuration" with "next subsequent test configuration" (i.e., subsequent next highest specified maximum output power configuration)
- 2) replace "initial test configuration" with "all tested higher output power configurations.



## 3.11. Power Reduction

The product without any power reduction.

## 3.12. 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

According KDB 447498D01 General RF Exposure Guidance v06 Section 4.1 2) states that "Unless it is specified differently in the published RF exposure KDB procedures, these requirements also apply to test reduction and test exclusion considerations. Time-averaged maximum conducted output power applies to SAR and, as required by § 2.1091(c), time-averaged ERP applies to MPE. When an antenna port is not available on the device to support conducted power measurement, such as FRS and certain Part 15 transmitters with built-in integral antennas, the maximum output power allowed for production units should be used to determine RF exposure test exclusion and compliance."

#### <GSM Conducted Power>

General Note:

- 1. Per KDB 447498 D01v06, the maximum output power channel is used for SAR testing and for further SAR test reduction.
- 2. According to October 2013TCB Workshop, for GSM / GPRS / EGPRS, the number of time slots to test for SAR should correspond to the highest frame-average maximum output power configuration, considering the possibility of e.g. 3rd party VoIP operation for head and body-worn SAR testing, the EUT was set in GPRS (4Tx slot) for GSM850/GSM1900 band due to their highest frame-average power.
- 3. For hotspot mode SAR testing, GPRS should be evaluated, therefore the EUT was set in GPRS (4 Tx slots) for GSM850/GSM1900 band due to its highest frame-average power.

Conducted power measurement results for GSM850/PCS1900

						courts for C				
		Tune	Burst C	Conducted (dBm)	power		Tune-	Averag	e power (d	Bm)
GSN	И 850	-up	Channe	/Frequen	cy(MHz)	Division	up	Channel/	Frequency	(MHz)
301		Max	128/ 824.2	190/ 836.6	251/ 848.8	Factors	Max	128/ 824.2	190/ 836.6	251/8 48.8
G	SM	32.50	32.38	32.43	32.42	-9.03dB	23.47	23.35	23.40	23.39
	1TX slot	32.50	32.28	32.32	32.30	-9.03dB	23.47	23.25	23.29	23.27
GPRS	2TX slot	31.50	30.99	31.01	31.02	-6.02dB	25.48	24.97	24.99	25.00
(GMSK)	3TX slot	30.00	29.52	29.51	29.51	-4.26dB	25.74	25.26	25.25	25.25
	4TX slot	28.50	27.99	28.00	28.02	-3.01dB	25.49	24.98	24.99	25.01
	1TX slot	26.50	26.02	25.99	25.98	-9.03dB	17.47	16.99	16.96	16.95
EGPRS	2TX slot	25.00	24.50	24.52	24.52	-6.02dB	18.98	18.48	18.50	18.50
(8PSK)	3TX slot	23.50	23.03	23.03	22.97	-4.26dB	19.24	18.77	18.77	18.71
	4TX slot	21.50	21.50	21.49	21.50	-3.01dB	18.49	18.49	18.48	18.49
		Tune	Burst C	Conducted (dBm)	power		Tune-	Averag	e power (d	Bm)
GSM	1 1900	-up	Channel/Frequency(MHz)			Division	up	Channel/Frequency(MHz)		(MHz)
		Max	512/ 1850.2	661/ 1880	810/ 1909.8	Factors	Max.	512/ 1850.2	661/ 1880	810/ 1909. 8
G	SM	29.50	29.45	29.44	29.44	-9.03dB	20.47	20.42	20.41	20.41
	1TX slot	29.50	29.42	29.38	29.40	-9.03dB	20.47	20.39	20.35	20.37
GPRS	2TX slot	28.50	27.97	28.01	28.02	-6.02dB	22.48	21.95	21.99	22.00
(GMSK)	3TX slot	27.00	26.51	26.52	26.47	-4.26dB	22.74	22.25	22.26	22.21
	4TX slot	25.50	24.98	25.02	25.02	-3.01dB	22.49	21.97	22.01	22.01
	1TX slot	25.50	25.49	25.50	25.50	-9.03dB	16.47	16.46	16.47	16.47
EGPRS	2TX slot	24.50	24.03	24.02	23.99	-6.02dB	18.48	18.01	18.00	17.97
(8PSK)	3TX slot	22.50	22.47	22.49	22.50	-4.26dB	18.24	18.21	18.23	18.24
Natas	4TX slot	21.50	21.02	21.00	20.99	-3.01dB	18.49	18.01	17.99	17.98

## 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.

## **<UMTS** Conducted Power>

The following tests were conducted according to the test requirements outlines in 3GPP TS 34.121 specification. A summary of these settings are illustrated below:

## **HSDPA Setup Configuration:**

- a. The EUT was connected to Base Station E5515C referred to the Setup Configuration.
- b. The RF path losses were compensated into the measurements.
- c. A call was established between EUT and Base Station with following setting:
  - i. Set Gain Factors ( $\beta_c$  and  $\beta_d$ ) and parameters were set according to each
  - ii. Specific sub-test in the following table, C10.1.4, quoted from the TS 34.121
  - iii. Set RMC 12.2Kbps + HSDPA mode.
  - iv. Set Cell Power = -86 dBm
  - v. Set HS-DSCH Configuration Type to FRC (H-set 1, QPSK)
  - vi. Select HSDPA Uplink Parameters
  - vii. Set Delta ACK, Delta NACK and Delta CQI = 8
  - viii. Set Ack-Nack Repetition Factor to 3
  - ix. Set CQI Feedback Cycle (k) to 4 ms
  - x. Set CQI Repetition Factor to 2
  - xi. Power Ctrl Mode = All Up bits
- d. The transmitted maximum output power was recorded.

Table C.10.1.4: β values for transmitter characteristics tests with HS-DPCCH

Sub-test	βο	βd	βd (SF)	βe/βd	βнs (Note1, Note 2)	CM (dB) (Note 3)	MPR (dB) (Note 3)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15	15/15	64	12/15	24/15	1.0	0.0
	(Note 4)	(Note 4)		(Note 4)			
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

- Note 1:  $\triangle_{ACK}$ ,  $\triangle_{NACK}$  and  $\triangle_{CQI} = 30/15$  with  $\beta_{hs} = 30/15 * \beta_c$ .
- Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA,  $\Delta_{ACK}$  and  $\Delta_{NACK}$  = 30/15 with  $\beta_{hs}$  = 30/15 \*  $\beta_c$ , and  $\Delta_{CQI}$  = 24/15 with  $\beta_{hs}$  = 24/15 \*  $\beta_c$ .
- Note 3: CM = 1 for  $\beta_c/\beta_d$  =12/15,  $\beta_{hs}/\beta_c$ =24/15. For all other combinations of DPDCH, DPCCH and HSDPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.
- Note 4: 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 signalled gain factors for the reference TFC (TF1, TF1) to  $\beta_c$  = 11/15 and  $\beta_d$  = 15/15.

#### **Setup Configuration**

#### **HSUPA Setup Configuration:**

- The EUT was connected to Base StationR&S CMU200 referred to the Setup Configuration.
- b. The RF path losses were compensated into the measurements.
- c. A call was established between EUT and Base Station with following setting \*:
  - i. Call Configs = 5.2B, 5.9B, 5.10B, and 5.13.2B with QPSK
  - ii. Set the Gain Factors ( $\beta_c$  and  $\beta_d$ ) and parameters (AG Index) were set according to each specific sub-test in the following table, C11.1.3, quoted from the TS 34.121
  - iii. Set Cell Power = -86 dBm
  - iv. Set Channel Type = 12.2k + HSPA
  - v. Set UE Target Power
  - vi. Power Ctrl Mode= Alternating bits
  - vii. Set and observe the E-TFCI
  - viii. Confirm that E-TFCI is equal to the target E-TFCI of 75 for sub-test 1, and other subtest's E-TFCI
- d. The transmitted maximum output power was recorded.



#### Table C.11.1.3: β values for transmitter characteristics tests with HS-DPCCH and E-DCH

Sub- test	βε	βa	β <sub>d</sub> (SF)	βc/βd	βнs (Note1)	βес	β <sub>ed</sub> (Note 5) (Note 6)	β <sub>ed</sub> (SF)	β <sub>ed</sub> (Codes)	CM (dB) (Note 2)	MPR (dB) (Note 2)	AG Index (Note 6)	E- TFCI
1	11/15 (Note 3)	15/15 (Note 3)	64	11/15 (Note 3)	22/15	209/2 25	1309/225	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 <sub>ed</sub> 1: 47/15 β <sub>ed</sub> 2: 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 (Note 4)	15/15 (Note 4)	64	15/15 (Note 4)	30/15	24/15	134/15	4	1	1.0	0.0	21	81

- Note 1:  $\Delta_{ACK}$ ,  $\Delta_{NACK}$  and  $\Delta_{CQI}$  = 30/15 with  $\beta_{hs}$  = 30/15 \*  $\beta_c$ .
- Note 2: CM = 1 for  $\beta_c/\beta_d$  =12/15,  $\beta_{hs}/\beta_c$ =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  $\beta_c/\beta_d$  ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to  $\beta_c$  = 10/15 and  $\beta_d$  = 15/15.
- Note 4: For subtest 5 the  $\beta_c/\beta_d$  ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to  $\beta_c$  = 14/15 and  $\beta_d$  = 15/15.
- Note 5: In case of testing by UE using E-DPDCH Physical Layer category 1, Sub-test 3 is omitted according to TS25.306 Table 5.1q.
- Note 6: βed can not be set directly, it is set by Absolute Grant Value.

#### **General Note**

- 1. Per KDB 941225 D01, RMC 12.2kbps setting is used to evaluate SAR. If AMR 12.2kbps power is < 0.25dB higher than RMC 12.2kbps, SAR tests with AMR 12.2kbps can be excluded.
- 2. By design, AMR and HSDPA/HSUPA RF power will not be larger than RMC 12.2kbps, detailed information is included in Tune-up Procure exhibit.
- 3. It is expected by the manufacturer that MPR for some HSDPA/HSUPA subtests may differ from the specification of 3GPP, according to the chipset implementation in this model. The implementation and expected deviation are detailed in tune-up procedure exhibit.

#### Conducted Power Measurement Results(WCDMA Band II/V)

		FDD Band V result (dBm)			EDD David II as suit (dDav)			
		FDD I	Band V res	suit (dBm)	FDD Band II result (dBm)			
Item	Band		Test Char	nel	Test Channel			
		4132/	4183/	4233/	9262/	9400/	9538/	
		826.4	836.6	846.6	1852.4	1880	1907.6	
RMC	12.2kbps	23.09	23.28	23.35	23.29	23.41	23.10	
	Subtest 1	22.72	22.86	22.61	22.54	22.58	22.47	
HSDPA	Subtest 2	22.46	22.74	22.61	22.53	22.48	22.70	
HODEA	Subtest 3	22.55	22.72	22.72	22.45	22.43	22.48	
	Subtest 4	22.67	22.76	22.54	22.49	22.65	22.41	
	Subtest 1	22.63	22.68	22.66	22.59	22.66	22.45	
	Subtest 2	22.52	22.67	22.40	22.41	22.44	22.41	
HSUPA	Subtest 3	22.35	22.73	22.62	22.56	22.69	22.46	
	Subtest 4	22.34	22.66	22.57	22.36	22.37	22.31	
	Subtest 5	21.46	21.68	21.39	21.43	21.69	21.50	

Note:1.When the maximum output power and tune-up tolerance specified for production units in a secondary mode is  $\leq 1/2$ dB 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  $\leq 1.2$  W/kg, SAR measurement is not required for the secondary mode.



#### LTE Band2

BW	Frequency		nfiguration	Average Po	
(MHz)	(MHz)	Size	Offset	QPSK	16QAM
,	,	1	0	22.05	21.02
		<u>.</u> 1	2	22.11	21.11
		1	5	22.08	21.05
	4050.7				
	1850.7	3	0	22.13	20.98
		3	1	22.19	21.02
		3	3	22.18	20.67
		6	0	21.35	19.97
		1	0	22.10	21.21
		1	2	22.14	21.30
		1	5	21.98	21.09
1.4	1880.0	3	0	21.97	20.85
1.4	1000.0	3	1	21.93	20.81
		3	3	21.80	20.70
		6	0	21.07	20.14
		11	0	22.23	21.25
		1	2	22.18	21.07
		1	5	22.08	21.21
	1909.3	3	0	22.29	21.05
	<u> </u>	3	1	22.24	21.08
		3	3	22.15	21.26
		6	0	21.26	20.22
		4			
		1	0	21.93	21.16
		1	8	22.10	21.04
		1	14	22.06	21.18
	1851.5	8	0	21.05	20.12
		8	4	21.04	20.21
		8	7	20.94	20.19
		15	0	21.02	20.04
		1	0	21.80	21.02
		1	8	21.95	21.01
		<u>'</u> 1	14		21.32
•	1880.0			21.90	
3		8	0	21.08	20.00
		8	4	20.88	19.81
		8	7	20.91	19.91
		15	0	20.88	19.93
		1	0	22.09	20.83
		1	8	22.11	21.55
		<u>.</u> 1	14	22.22	21.28
	1908.5	8	0	21.27	20.22
	1900.0				
		8	4	21.22	20.21
		8	7	21.28	20.24
		15	0	21.18	20.47
		1	0	21.98	21.02
		1	12	22.08	20.94
		1	24	22.03	20.99
	1852.5	12	0	21.03	20.16
		12	6	21.09	20.13
		12	13	21.13	20.15
		25	0	21.05	20.27
5		1	0	22.06	20.87
J		1	12	21.94	20.83
		1	24	22.03	20.84
	1880.0	12	0	20.96	20.14
		12	6	20.93	20.11
		12	13	20.89	19.89
		25	0	20.99	19.09
	1907.5	1	0	22.15	21.09
		1	12	22.16	21.03

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		1	24	22.08	21.16
		12	0	21.20	20.21
		12	6	21.18	20.10
		12	13	21.25	20.19
		25	0	21.12	20.28
		1	0	22.12	21.00
		1	24	22.16	21.44
		1	49	21.68	20.73
	1855.0	25	0	21.15	20.20
		25	12	21.15	20.20
		25	25	21.53	20.28
		50	0	21.18	20.23
		1	0	21.92	20.90
		1	24	22.18	21.37
		1	49	21.89	20.79
10	1880.0	25	0	21.13	20.03
		25	12	21.10	20.06
		25	25	20.86	19.92
		50	0	20.95	19.94
		1	0	20.40	19.55
		1	24	22.91	22.03
	4005.0	1	49	21.35	20.50
	1905.0	25	0	21.87	20.85
		25	12	21.80	20.85
		25	25	21.25	20.31
		50	0	22.22	20.38
		1 1	0	21.98	21.18
		1	38 74	22.34	21.24 20.73
	1857.5	37	0	21.84 21.57	21.02
	1657.5	37	18	21.37	21.72
		37	37	20.83	20.83
		75	0	21.24	20.26
		1	0	21.81	20.99
	1880.0	1	38	21.78	20.77
		1	74	21.52	20.58
15		37	0	20.99	20.99
1.0		37	18	20.90	20.91
		37	37	20.84	20.72
		75	0	20.91	19.98
		1	0	21.09	20.29
		1	38	22.04	21.33
		1	74	22.07	21.20
	1902.5	37	0	20.08	20.21
		37	18	21.26	21.34
		37	37	21.25	21.21
		75	0	21.00	20.14
		1	0	22.09	20.81
		1	49	22.39	21.09
		1	99	21.76	20.69
	1860.0	50	0	21.20	20.33
		50	25	21.27	20.44
		50	50	21.17	20.29
20		100	0	21.14	20.23
		1	0	21.83	21.22
		1	49	22.28	21.96
	4000.0	1 50	99	21.71	21.26
	1880.0	50	0	20.93	20.06
		50	25	20.95	20.09
		50	50	20.84	19.96
		100	0	20.92	20.04

	Snenznen LCS Compilance Testil	<u>Report No.: LCS220223047AEB</u>			
V					
		1	0	21.79	20.52
		1	49	21.31	21.10
		1	99	22.18	21.39
	1900.0	50	0	20.76	19.95
		50	25	20.91	20.09
		50	50	21.16	20.29
		100	0	21.11	20.08

LTE Band4					
BW	Frequency	RB Coi	nfiguration	Average Po	wer [dBm]
(MHz)	(MHz)	Size	Offset	QPSK	16QAM
		1	0	22.27	21.38
		1	2	22.34	21.43
		1	5	22.19	21.23
	1710.7	3	0	22.33	21.24
		3	1	22.31	21.22
		3	3	22.13	21.09
		6	0	21.54	20.49
		1	0	22.48	21.71
		<u>.</u> 1	2	22.36	21.71
		<u>.</u> 1	5	22.44	21.57
1.4	1732.5	3	0	22.56	21.29
17	1702.0	3	1	22.44	21.20
	_	3	3	22.36	20.98
		6	0	21.40	20.46
		1	0	21.98	20.93
			2	21.97	
	_	1			21.14
	4754.0	1	5	21.97	20.95
	1754.3	3	0	21.76	20.67
		3	1	21.93	20.65
	_	3	3	21.90	20.72
		6	0	20.90	19.99
		1	0	22.28	21.61
	_	1	8	22.45	21.15
		1	14	22.20	21.34
	1711.5	8	0	21.40	20.46
		8	4	21.42	20.56
		8	7	21.48	20.34
		15	0	21.21	20.10
		1	0	22.54	21.58
		1	8	22.38	21.19
		1	14	22.33	21.50
3	1732.5	8	0	21.56	20.60
		8	4	21.55	20.41
		8	7	21.61	20.68
		15	0	21.59	20.58
		1	0	22.04	20.79
		1	8	21.82	21.36
		1	14	22.08	20.91
	1753.5	8	0	20.83	19.82
		8	4	20.87	19.99
		8	7	20.97	20.07
		15	0	20.89	20.04
		1	0	22.75	21.39
		<u>·</u> 1	12	22.45	21.29
		<u>.</u> 1	24	22.21	21.17
	1712.0	12	0	21.51	20.56
5	17.12.0	12	6	21.48	20.41
		12	13	21.36	20.31
		25	0	21.20	20.18
	1732.5				
	1732.5	1	0	22.40	21.26

<u>Sherizhen L</u>	oc compilarios rocal	ng Laboratory Ltu.	FCC ID. ZACI IBK	00 Report No., LC.	<u> </u>
		1	12	22.36	20.95
		1	24	22.36	21.22
		12	0	21.41	20.54
		12	6	21.60	20.56
		12	13	21.45	20.50
		25	0	21.41	20.49
		1	0	22.19	21.07
		1	12	22.13	20.94
		1		22.13	20.94
	4750.5	12	24		
	1752.5		0	20.96	19.96
		12	6	21.03	19.94
		12	13	20.85	19.98
		25	0	20.99	20.10
		1	0	22.35	21.37
		1	24	22.18	21.26
		1	49	21.05	20.07
	1715.0	25	0	22.12	20.55
		25	12	22.07	20.49
		25	25	21.34	20.40
		50	0	21.63	20.70
		1	0	22.10	21.31
		1	24	22.36	21.55
		1	49	22.14	21.15
10	1732.5	25	0	21.32	20.47
		25	12	21.41	20.40
		25	25	21.35	20.42
		50	0	21.33	20.36
		1	0	22.27	21.44
		1	24	22.60	21.47
		1	49	22.17	21.14
	1750.0	25	0	21.25	20.35
		25	12	21.32	20.28
		25	25	21.03	20.01
		50	0	21.08	20.25
		1	0	21.83	21.40
		1	38	22.06	21.19
		1	74	22.04	21.33
	1717.5	37	0	21.26	21.01
	17.17.0	37	18	20.80	21.11
		37	37	21.25	20.94
		75	0	21.32	20.36
		1	0	22.55	21.48
		1	38	22.62	22.06
		1	74	22.11	21.55
15	1732.5	37	0	21.78	21.78
13	1732.3	37	18	22.08	21.40
		37	37	21.28	21.33
		75	0	21.60	20.56
		1	0	22.40	21.52
			38	22.40	
		1	74	22.14	21.43 21.32
	1747.5	37	0	21.84	21.84
	1/4/.5				
		37	18	21.98	21.97
		37	37	21.28	21.29
	1	75	0	21.58	20.59
		1	0	21.97	20.76
		1	49	21.95	21.02
20	1720.0	1	99	22.20	21.00
	1.23.0	50	0	21.22	20.30
		50	25	21.16	20.39
		50	50	21.22	20.29

Shenzhen LCS Compliance Testing Laboratory Ltd. 100 0 21.35 20.47 21.80 1 0 20.68 1 49 22.68 21.92 1 99 22.27 20.98 1732.5 50 0 21.34 20.51 50 25 21.38 20.34 50 50 21.14 20.32 21.32 100 0 20.48 22.35 1 0 21.06 1 49 22.67 21.30 1 99 21.88 20.91 50 21.27 1745.0 0 20.35 50 25 21.36 20.45 50 50 21.14 20.10 100 21.22 20.37 0

LTE Band5					
BW	Frequency		figuration		ower [dBm]
(MHz)	(MHz)	Size	Offset	QPSK	16QAM
		1	0	23.05	22.16
		1	2	23.02	22.13
		1	5	23.16	22.37
	824.7	3	0	23.11	21.81
		3	1	23.22	22.03
		3	3	23.06	21.98
		6	0	22.23	21.34
		1	0	23.38	22.48
		1	2	23.49	22.55
		1	5	23.32	22.45
1.4	836.5	3	0	23.29	22.10
		3	1	23.33	22.30
		3	3	23.37	22.29
		6	0	22.42	21.36
		1	0	23.13	22.15
		1	2	23.49	22.67
		1	5	23.33	22.27
	848.3	3	0	23.37	21.89
		3	1	23.31	22.08
		3	3	23.32	21.83
		6	0	22.35	21.52
		1	0	23.08	22.27
		1	8	23.35	22.36
		1	14	23.48	22.74
	825.5	8	0	22.27	21.25
		8	4	22.23	21.27
		8	7	22.30	21.33
		15	0	22.30	21.23
		1	0	23.24	22.80
		1	8	23.29	22.73
		1	14	23.32	22.37
3	836.5	8	0	22.44	21.45
		8	4	22.54	21.47
		8	7	22.50	21.44
		15	0	22.47	21.25
		1	0	23.06	22.30
		1	8	23.09	22.63
		1	14	23.43	22.50
	847.5	8	0	22.37	21.51
		8	4	22.36	21.22
		8	7	22.37	21.37
		15	0	22.35	21.27

Shenzhen LCS Compliance Testing Laboratory Lt

V					
		1	0	23.40	22.06
		1	12	23.34	22.23
		1	24	23.02	22.18
	826.5	12	0	22.26	21.15
		12	6	22.27	21.37
		12	13	22.27	21.28
		25	0	22.30	21.21
		1	0	23.20	22.32
		1	12	23.48	22.35
		1	24	23.26	22.20
5	836.5	12	0	22.47	21.38
		12	6	22.45	21.36
		12	13	22.38	21.28
		25	0	22.36	21.52
		1	0	23.10	22.14
		1	12	23.29	22.23
		1	24	23.39	22.26
	846.5	12	0	22.38	21.35
		12	6	22.32	21.33
		12	13	22.41	21.31
		25	0	22.38	21.52
		1	0	22.87	22.17
		1	24	23.13	22.52
		1	49	23.01	22.22
	829.0	25	0	22.42	21.36
		25	12	22.33	21.38
		25	25	22.41	21.36
		50	0	22.41	21.41
		1	0	23.31	22.30
		1	24	23.66	22.84
		1	49	23.18	22.14
10	836.5	25	0	22.60	21.53
		25	12	22.57	21.60
		25	25	22.48	21.60
		50	0	22.57	21.42
		1	0	23.12	22.48
		1	24	23.41	22.50
		1	49	23.10	22.25
	844.0	25	0	22.49	21.48
		25	12	22.54	21.54
		25	25	22.46	21.44
		50	0	22.36	21.30

## LTE Band17

LTE Ballu 17								
BW	Frequency	RB Conf	iguration	Average Po	ower [dBm]			
(MHz)	(MHz)	Size	Offset	QPSK	16QAM			
		1	0	22.42	21.18			
		1	12	22.53	21.05			
		1	24	22.60	21.08			
	706.5	12	0	21.70	20.84			
		12	6	21.60	20.71			
		12	13	21.56	20.81			
		25	0	21.64	20.86			
5		1	0	22.75	21.17			
		1	12	22.80	21.11			
		1	24	22.70	21.18			
	710	12	0	21.65	20.85			
		12	6	21.67	20.86			
		12	13	21.78	20.81			
		25	0	21.79	20.93			
	713.5	1	0	22.62	21.70			

711

Shenzhen L	CS Compliance Testi	ng Laboratory Ltd.	FCC ID: 2ACHBR60	Report No.: LC	S220223047AEB
		1	12	22.74	21.63
		1	24	22.64	21.66
		12	0	21.72	20.98
		12	6	21.79	20.97
		12	13	21.76	21.01
		25	0	21.77	20.87
		1	0	22.73	21.80
		1	24	22.75	21.80
		1	49	22.80	21.86
	709	25	0	21.84	20.99
		25	12	21.84	20.99
		25	25	21.87	21.03
		50	0	21.73	21.02
		1	0	22.57	22.09
		1	24	22.57	22.02
		1	49	22.55	22.03
10	710	25	0	21.85	21.03
		25	12	21.79	21.03
		25	25	21.93	20.97
		50	0	21.77	21.08
		1	0	22.67	21.41
		1	24	22.87	21.41

25

25

25

50

49

0

12

25

0

22.82

21.93

21.93

21.94

21.88

21.43

21.26

21.27

21.33

21.19

## LTE Band41

BW	Frequency	RB Configuration		Average Power [dBm]	
(MHz)	(MHz)	Size	Offset	QPSK	16QAM
5	2498.5	1	0	22.10	21.59
		1	12	22.29	22.31
		1	24	22.32	21.70
		12	0	21.33	20.59
		12	6	21.33	20.36
		12	13	21.17	20.43
		25	0	21.15	20.61
	2593.0	1	0	22.11	21.64
		1	12	22.02	22.38
		1	24	21.94	21.66
		12	0	21.20	20.47
		12	6	21.21	20.41
		12	13	20.85	20.30
		25	0	21.00	20.38
	2687.5	1	0	21.39	20.90
		1	12	21.40	21.40
		1	24	21.46	20.88
		12	0	20.58	19.71
		12	6	20.42	19.71
		12	13	20.56	19.78
		25	0	20.42	19.84
10	2501.0	1	0	22.01	20.28
		1	24	21.99	21.18
		1	49	21.93	21.44
		25	0	21.17	21.34
		25	12	21.18	20.65
		25	25	21.14	20.65
		50	0	21.05	20.54
	2593.0	1	0	21.96	20.58
		1	24	21.87	21.31

		1	49	21.82	21.27
		25	0	21.00	21.14
		25	12	21.01	20.28
		25	25	20.90	20.29
		50	0	20.93	20.20
		1	0	21.30	20.36
		1	24	21.22	20.54
		1	49	21.35	20.52
	2685.0	25	0	20.32	20.52
		25	12	20.33	19.63
		25	25	20.39	19.63
		50	0	22.01	19.61
		1	0	21.78	21.42
		1	38	21.79	21.64
		1	74	21.79	21.42
	2503.5	37	0	21.53	21.59
	2303.3	37	18	21.61	21.53
		37	37	21.46	21.43
				20.62	
		75	0		19.77
		1	0	21.90	20.99
		1	38	21.23	19.98
4.5	0500.0	1	74	21.42	20.92
15	2593.0	37	0	21.02	20.95
		37	18	21.12	20.95
		37	37	20.90	20.93
		75	0	20.00	19.32
		1	0	21.20	21.15
		1	38	21.72	21.31
		1	74	21.54	21.31
	2682.5	37	0	21.16	21.15
		37	18	21.34	20.60
		37	37	20.75	21.35
		75	0	20.72	19.89
		1	0	22.46	21.05
		1	49	21.34	20.97
		1	99	21.14	20.62
	2506.0	50	0	20.47	19.86
		50	25	20.45	19.83
		50	50	20.12	19.60
		100	0	20.19	19.81
		1	0	20.61	21.04
		1	49	21.24	21.34
		1	99	20.83	20.97
20	2593.0	50	0	19.95	19.37
		50	25	19.95	19.55
		50	50	19.89	19.46
		100	0	20.01	19.35
		1	0	21.23	20.96
	i		49	21.46	21.27
		1	<b>→</b> ⊃	∠ 1. <del>1</del> U	<i>ا ک</i> . ا ک
		1			21 56
	2620.0	1	99	21.67	21.56
	2680.0	1 50	99 0	21.67 20.42	19.88
	2680.0	1	99	21.67	

## <WLAN 2.4GHz Conducted Power>

Mode	Channel	Frequency (MHz)	Data rate (Mbps)	Average Output Power (dBm)
			1	13.90
IEEE 802.11b	1	2412	2	13.82
			5.5	13.75

		1	44	40.70
			11	13.70 13.25
			2	13.25
	6	2437	5.5	13.14
			11	13.06
			1	13.64
			2	13.54
	11	2462	5.5	13.48
			11	13.36
			6	12.61
			9	12.56
			12	12.51
	1	2412	18	12.48
	ı	2412	24	12.41
			36	12.34
			48	12.28
			54	12.20
			6	12.19
			9	12.10
			12	12.06
IEEE 802.11g	6	2437	18	11.94
			24	11.85
			36	11.80
			48	11.74
			54	11.65
			6 9	11.85 11.76
	11	2462	12	11.65
			18	11.57
			24	11.46
			36	11.32
			48	11.20
			54	11.16
			MCS0	13.90
			MCS1	13.82
			MCS2	13.76
	_	0.440	MCS3	13.71
	1	2412	MCS4	13.64
			MCS5	13.59
			MCS6	13.50
			MCS7	13.44
			MCS0	13.24
			MCS1	13.18
			MCS2	13.11
IEEE 802.11n HT20	6	2437	MCS3	13.06
		2-101	MCS4	13.00
			MCS5	12.92
			MCS6	12.84
			MCS7	12.77
			MCS0	14.54
			MCS1	14.48
			MCS2	14.41
	11	2462	MCS3	14.36
			MCS4	14.31
			MCS5	14.25
			MCS6	14.21
			MCS7	14.16
			MCS0	12.44
IEEE 802.11n HT40	3	2422	MCS1 MCS2	12.32
				12.26
		j	MCS3	12.20



			MCS4	12.16
			MCS5	12.08
			MCS6	12.04
			MCS7	12.00
			MCS0	12.11
			MCS1	12.05
			MCS2	12.00
		0407	MCS3	11.96
	6	2437	MCS4	11.88
			MCS5	11.82
			MCS6	11.77
			MCS7	11.73
			MCS0	13.18
			MCS1	13.11
			MCS2	13.06
		2452	MCS3	13.01
	9	2432	MCS4	12.96
			MCS5	12.91
			MCS6	12.85
			MCS7	12.81

**Note:** SAR is not required for the following 2.4 GHz OFDM conditions as the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is  $\leq 1.2$  W/kg.

### <WLAN 5GHz U-NI-1 Conducted Power

WEAR SOILE O-MI-1 Colladated I Owel							
Mode	Channel	Frequency (MHz)	Average Conducted Output Power(dBm)	Worst Case Test Rate Data			
	36	5180	13.46	MCS0			
IEEE 802.11a	40	5200	12.89	MCS0			
	48	5240	13.63	MCS0			
IEEE 802.11n HT20	36	5180	13.65	MCS0			
	40	5200	12.84	MCS0			
	48	5240	13.76	MCS0			
IEEE 902 445 HT40	38	5190	13.60	MCS0			
IEEE 802.11n HT40	46	5230	13.84	MCS0			
	36	5180	13.32	MCS0			
IEEE 802.11AC20	40	5200	13.51	MCS0			
	48	5240	13.36	MCS0			
IEEE 902 11AC40	38	5190	13.25	MCS0			
IEEE 802.11AC40	46	5230	13.80	MCS0			
IEEE 802.11AC80	42	5210	12.58	MCS0			

### <WLAN 5GHz U-NI-3 Conducted Power>

Mode	Channel	Frequency (MHz)	Average Conducted Output Power(dBm)	Worst Case Test Rate Data
	149	5745	12.05	MCS0
IEEE 802.11a	157	5785	12.39	MCS0
	165	5825	13.63	MCS0
	149	5745	13.45	MCS0
IEEE 802.11n HT20	157	5785	12.86	MCS0
	165	5825	13.12	MCS0
IEEE 802.11n HT40	151	5755	13.59	MCS0
IEEE 802.11n H140	159	5795	12.94	MCS0
IEEE 802.11AC20	149	5745	13.45	MCS0



	157	5785	12.87	MCS0
	165	5825	13.12	MCS0
IEEE 000 44 A C 40	151	5755	13.53	MCS0
IEEE 802.11AC40	159	5795	12.57	MCS0
IEEE 802.11AC80	155	5775	13.32	MCS0

### <BT Conducted Power>

Mode	channel	Frequency (MHz)	Conducted AVG output power (dBm)
	0	2402	1.99
BLE	20	2442	3.10
	39	2480	1.36
	0	2402	1.99
GFSK	39	2441	3.22
	78	2480	1.45
	0	2402	1.15
π/4-DQPSK	39	2441	2.36
	78	2480	0.67
	0	2402	1.31
8DPSK	39	2441	2.45
	78	2480	0.81

Per KDB 447498 D01v06, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separationdistances ≤ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)]  $[\sqrt{f(GHz)}] \le 3.0$  for 1-g SAR and  $\le 7.5$  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

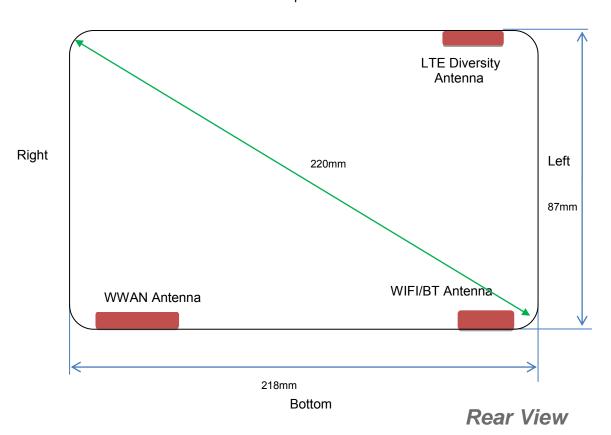
Bluetooth Turn up	Separation Distance (mm)	Frequency	Exclusion
Power (dBm)		(GHz)	Thresholds
3.5	5	2.45	0.7

Per KDB 447498 D01v06, when the minimum test separation distance is < 5 mm, a distance of 5 mm is applied todetermine SAR test exclusion. The test exclusion threshold is 0.7< 3.0, SAR testing is not required.



### **Transmit Antennas and SAR Measurement Position**

Top



### Antenna information:

,	
WLAN/BT Antenna	WLAN/BT TX/RX
WWAN Antenna	GSM/UMTS/LTE TX/RX

### Note:

- 1). Per KDB648474 D04, because the overall diagonal distance of this devices is 282mm>160mm, it is considered as "Data Collector PC" device.
- 2). Per KDB648474 D04, 10-g extremity SAR is not required when Body-Worn mode 1-g reported SAR < 1.2 W/Kg.
- 3). According to the KDB941225 D06 Hot Spot SAR v02, the edges with less than 25 mm distance to the antennas need to be tested for SAR.
- 4). Per KDB 616217 D04, The antennas in tablets are typically located near the back (bottom) surface and/or along the edges of the devices; therefore, SAR evaluation is required for these configurations. Exposures from antennas through the front (top) surface of the displaysection of a full-size tablet, away from the edges, are generally limited to the user's hands.

Distance of The Antenna to the EUT surface and edge (mm)							
Antennas	Antennas Front Back Top Side Bottom Side Left Side Right Side						
BT/WLAN	<5	<5	81	<5	<5	186	
WWAN	<5	<5	80	<b>&lt;</b> 5	174	<5	

Positions for SAR tests; Hotspot mode								
Antennas Front Back Top Side Bottom Side Left Side Right Side								
BT/WLAN	Yes	Yes	No	Yes	Yes	No		
WWAN	Yes	Yes	No	Yes	No	Yes		

General Note: Referring to KDB 941225 D06 v02, When the overall device length and width are ≥9cm\*5cm, the test distance is 0mm, SAR must be measured for all sides and surfaces with a transmitting antenna located with 25mm from that surface or edge.



### 4.3. SAR Measurement Results

The calculated SAR is obtained by the following formula:

Reported SAR=Measured SAR\*10<sup>(Ptarget-Pmeasured))/10</sup>

Scaling factor=10<sup>(Ptarget-Pmeasured))/10</sup>

Reported SAR= Measured SAR\* Scaling factor

Where

P<sub>target</sub> is the power of manufacturing upper limit;

P<sub>measured</sub> 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
GSM	3:8
UMTS	1:1
LTE	1:1
WLAN2450	1:1
WLAN5200	1:1
WLAN5800	1:1

#### 4.3.1 SAR Results

SAR Values [GSM 850]

					and to the t					
	Ch. Freq. Time slots			Conducted	Maximum	Power		SAR <sub>1-g</sub> res	ults(W/kg)	
Ch.			Test Position	Power (dBm)	Allowed Power (dBm)	Drift (%)	Scaling Factor	Measured	Reported	Graph Results
measured / reported SAR numbers - Body (hotspot open, distance 0mm)										
128	824.2	3Txslots	Front	29.52	30.00	0.07	1.117	0.362	0.404	
128	824.2	3Txslots	Rear	29.52	30.00	-3.42	1.117	0.630	0.704	Plot 1
128	824.2	3Txslots	Right	29.52	30.00	1.47	1.117	0.345	0.385	
128	824.2	3Txslots	Bottom	29.52	30.00	-2.65	1.117	0.322	0.360	

## Remark:

- 1. The value with black color is the maximum SAR Value of each test band.
- 2. The frame average of GPRS (4Tx slots) higher than GSM and sample can support VoIP function, tested at GPRS (4Tx slots) mode for head.
- 3. 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  $\leq 0.8$  W/kg then testing at the other channels is optional for such test configuration(s).

### SAR Values [GSM 1900]

				Conducted	Maximum	Power		SAR <sub>1-g</sub> res	ults(W/kg)	
Ch.	Freq. (MHz)	time slots	Test Position	Power (dBm)	Allowed Power (dBm)	Drift (%)	Scaling Factor	Measured	Reported	Graph Results
		r	neasured / repo	orted SAR numb	ers – Body (ho	tspot ope	n, distance	0mm)		
661	1880.0	3Txslots	Front	26.52	27.00	1.86	1.117	0.213	0.238	
661	1880.0	3Txslots	Rear	26.52	27.00	-2.60	1.117	0.418	0.467	Plot 2
661	1880.0	3Txslots	Right	26.52	27.00	3.65	1.117	0.206	0.230	
661	1880.0	3Txslots	Bottom	26.52	27.00	-1.88	1.117	0.200	0.223	

#### Remark:

- 1. The value with black color is the maximum SAR Value of each test band.
- 2. The frame average of GPRS (4Tx slots) higher than GSM and sample can support VoIP function, tested at GPRS (4Tx slots) mode for head.
- 3. 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  $\leq 0.8$  W/kg then testing at the other channels is optional for such test configuration(s).

**SAR Values [WCDMA Band V]** 

					O [III O D III / D					
	Frea.	Channel	Test	Conducted	Maximum Allowed	Power	Cooling	SAR <sub>1-g</sub> res	ults(W/kg)	Cranh
Ch.	(MHz)	Type	Position	Power (dBm)	Power	Drift	Scaling Factor	Measured	Reported	Graph Results
				(ubili)	(dBm)	(%)			·	
		m	easured / repo	orted SAR numb	ers - Body (ho	tspot opei	n, distance	0mm)		
4183	836.6	RMC*	Front	22.86	23.00	-2.69	1.033	0.162	0.167	
4183	836.6	RMC*	Rear	22.86	23.00	-0.67	1.033	0.175	0.181	Plot 3
4183	836.6	RMC*	Right	22.86	23.00	3.44	1.033	0.154	0.159	
4183	836.6	RMC*	Bottom	22.86	23.00	-0.21	1.033	0.146	0.151	

### Remark:

- 1. The value with block color is the maximum 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  $\leq 0.8$  W/kg then testing at the other channels is optional for such test configuration(s).
- 3. RMC\* RMC 12.2kbps mode;

SAR Values [WCDMA Band II]

				<u> </u>	25 [WODINA					
Ch.	Freq. (MHz)	Chan nel Type	Test Position	Condu cted Power (dBm)	Maximum Allowed Power (dBm)	Power Drift (%)	Scaling Factor	SAR <sub>1-g</sub> res Measured	ults(W/kg) Reported	Graph Results
			measured / reporte	ed SAR num	bers - Body (h	otspot opei	n, distance	0mm)		
9538	1907.6	RMC	Front	22.70	23.00	-1.26	1.072	0.722	0.774	Plot 4
9538	1907.6	RMC	Rear	22.70	23.00	0.25	1.072	0.684	0.733	
9538	1907.6	RMC	Right	22.70	23.00	-3.03	1.072	0.665	0.713	
9538	1907.6	RMC	Bottom	22.70	23.00	-1.54	1.072	0.643	0.689	

### Remark:

- 1. The value with block color is the maximum 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  $\leq 0.8$  W/kg then testing at the other channels is optional for such test configuration(s).
- 3. RMC\* RMC 12.2kbps mode;

SAR Values [LTE Band 2]

				OAIL Val	ues [L I E Bai	14 Z]				
Ch.	Freq. (MHz)	Channel Type (20M)	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power Drift (%)	Scaling Factor	SAR <sub>1-g</sub> res	ults(W/kg) Reported	Graph Results
		me	easured / repo	orted SAR numb	ers - Body (ho	tspot oper	n, distance	0mm)		
18700	1860.0	1RB	Front	22.39	22.50	-0.71	1.026	0.440	0.451	
18700	1860.0	1RB	Rear	22.39	22.50	-1.30	1.026	0.473	0.485	Plot 5
18700	1860.0	1RB	Right	22.39	22.50	-1.54	1.026	0.421	0.432	
18700	1860.0	1RB	Bottom	22.39	22.50	0.54	1.026	0.415	0.426	
18700	1860.0	50%RB	Front	21.27	21.50	-1.54	1.054	0.265	0.279	
18700	1860.0	50%RB	Rear	21.27	21.50	3.65	1.054	0.284	0.299	
18700	1860.0	50%RB	Right	21.27	21.50	-0.20	1.054	0.249	0.263	
18700	1860.0	50%RB	Bottom	21.27	21.50	3.05	1.054	0.236	0.249	

SAR Values [LTE Band 4]

				SAR Vali	ues [LIE Bar	ıu 4]				
Ch.	Freq. (MHz)	Channel Type (20M)	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power Drift (%)	Scaling Factor	SAR <sub>1-g</sub> res	ults(W/kg) Reported	Graph Results
		me	easured / repo	orted SAR numb	ers - Body (ho	tspot oper	n, distance	0mm)		
20175	1732.5	1RB	Front	22.68	23.00	-0.37	1.076	0.774	0.833	
20175	1732.5	1RB	Rear	22.68	23.00	-0.44	1.076	0.866	0.932	Plot 6
20175	1732.5	1RB	Right	22.68	23.00	1.47	1.076	0.768	0.827	
20175	1732.5	1RB	Bottom	22.68	23.00	0.205	1.076	0.754	0.812	
20175	1732.5	50%RB	Front	21.38	21.50	3.98	1.028	0.387	0.398	
20175	1732.5	50%RB	Rear	21.38	21.50	-1.45	1.028	0.402	0.413	
20175	1732.5	50%RB	Right	21.38	21.50	-2.87	1.028	0.374	0.384	
20175	1732.5	50%RB	Bottom	21.38	21.50	0.62	1.028	0.361	0.371	



SAR Values [LTE Band 5]

Ch.	Freq. (MHz)	Channel Type (20M)	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power Drift (%)	Scaling Factor	SAR <sub>1-g</sub> res	cults(W/kg) Reported	Graph Results
		me	easured / repo	orted SAR numb	pers - Body (ho	tspot opei	n, distance	0mm)		
20525	836.5	1RB	Front	23.66	24.00	0.35	1.081	0.132	0.143	
20525	836.5	1RB	Rear	23.66	24.00	-1.08	1.081	0.274	0.296	Plot 7
20525	836.5	1RB	Right	23.66	24.00	3.65	1.081	0.122	0.132	
20525	836.5	1RB	Bottom	23.66	24.00	-1.47	1.081	0.116	0.125	
20525	836.5	50%RB	Front	22.60	23.00	0.21	1.096	0.075	0.082	
20525	836.5	50%RB	Rear	22.60	23.00	1.58	1.096	0.115	0.126	
20525	836.5	50%RB	Right	22.60	23.00	0.78	1.096	0.062	0.068	
20525	836.5	50%RB	Bottom	22.60	23.00	3.68	1.096	0.051	0.056	

**SAR Values [LTE Band 17]** 

	OAK Values [ETE Balla 17]												
		Channe		Condu	Maximum	Power		SAR <sub>1-g</sub> rest	ults(W/kg)				
Ch.	Freq.	1	Test	cted	Allowed	Drift	Scaling		Reporte	Graph			
On.	(MHz)	Туре	Position	Power	Power	(%)	Factor	Measured	d	Results			
		(20M)		(dBm)	(dBm)	(/•/			<u>.</u>				
		me	easured / reported	I SAR numb	ers - Body (ho	tspot oper	n, distance	0mm)					
23800	711.0	1RB	Front	22.87	23.00	-0.34	1.030	0.291	0.300				
23800	711.0	1RB	Rear	22.87	23.00	-1.02	1.030	0.350	0.361	Plot 8			
23800	711.0	1RB	Right	22.87	23.00	3.45	1.030	0.284	0.293				
23800	711.0	1RB	Bottom	22.87	23.00	0.15	1.030	0.276	0.284				
23800	711.0	50%RB	Front	21.94	22.00	-2.88	1.014	0.158	0.160				
23800	711.0	50%RB	Rear	21.94	22.00	-3.60	1.014	0.199	0.202				
23800	711.0	50%RB	Right	21.94	22.00	1.89	1.014	0.147	0.149				
23800	711.0	50%RB	Bottom	21.94	22.00	2.06	1.014	0.138	0.140				

**SAR Values [LTE Band 41]** 

						<b></b>	400 [E   E Dui					
			Channel		Con	ducted	Maximum	Power		SAR1-g res	sults(W/kg)	
Ch.	Freq. (MHz)		Type (10M)	Test Position	Po	ower Bm)	Allowed Power (dBm)	Drift (%)	Scaling Factor	Measured	Reported	Graph Results
			easured / r	eportea	SAR num	bers - Body (ho	otspot ope	n, distance	· 0mm)			
3975	0 250	06.0	1RB	Fro	nt	22.46	22.50	-0.68	1.009	0.172	0.174	
3975	0 250	06.0	1RB	Re	ar	22.46	22.50	-0.73	1.009	0.236	0.238	Plot 9
3975	0 250	06.0	1RB	Rig	ht	22.46	22.50	3.54	1.009	0.165	0.167	
3975	0 250	06.0	1RB	Bott	om	22.46	22.50	-0.12	1.009	0.144	0.145	
4149	0 268	30.0	50%RB	Fro	nt	20.55	21.00	3.66	1.109	0.122	0.135	
4149	0 268	30.0	50%RB	Re	ar	20.55	21.00	-2.54	1.109	0.163	0.181	
4149	0 268	30.0	50%RB	Rig	ht	20.55	21.00	0.09	1.109	0.116	0.129	
4149	0 268	30.0	50%RB	Bott	om	20.55	21.00	3.91	1.109	0.110	0.122	

SAR Values [WIFI2.4G]

					OAIL V	aiues [vvii iz	<u>0</u> ]				
Ī					Condu	Maximum	Power		SAR1-g res	ults(W/kg)	
ı	Ch.	Freq.	Service	Test	cted	Allowed	Drift	Scaling			Graph
ı	011.	(MHz)	00/1/00	Position	Power	Power	(%)	Factor	Measured	Reported	Results
L					(dBm)	(dBm)	(70)				
			me	easured / reported	I SAR nun	nbers - Body (I	hotspot ope	en, distance	e 0mm)		
	11	2462	802.11n20	Front	15.54	16.00	-2.30	1.112	0.145	0.161	
	11	2462	802.11n20	Rear	15.54	16.00	-1.12	1.112	0.219	0.243	Plot 10
ſ	11	2462	802.11n20	Left	15.54	16.00	1.54	1.112	0.136	0.151	
Ī	11	2462	802.11n20	Bottom	15.54	16.00	0.01	1.112	0.128	0.142	



SAR Values [WIFI5.2G]

					<u> </u>					
	h. Freq. Service Test Position			Conducted	Maximum	Power		SAR <sub>1-g</sub> res	ults(W/kg)	
Ch.		Service		Power (dBm)	Allowed Power (dBm)	Drift (%)	Scaling Factor	Measured	Reported	Graph Results
		r	neasured / rep	orted SAR num	bers - Body (ho	tspot opei	n, distance	0mm)		
46	5230	802.11n40	Front	13.84	14.00	-1.01	1.038	0.081	0.084	
46	5230	802.11n40	Rear	13.84	14.00	-0.27	1.038	0.222	0.230	Plot 11
46	5230	802.11n40	Left	13.84	14.00	3.54	1.038	0.075	0.078	
46	5230	802.11n40	Bottom	13.84	14.00	-0.14	1.038	0.062	0.064	

SAR Values [WIFI5.8G]

				Conducted	Maximum	Power		SAR <sub>1-g</sub> res	ults(W/kg)	
Ch.	Freq. (MHz)	Service	Test Position	Power (dBm)	Allowed Power (dBm)	Drift (%)	Scaling Factor	Measured	Reported	Graph Results
	measured / reported SAR numbers - Body (hotspot open, distance 0mm)									
165	5825	802.11a	Front	13.63	14.00	0.78	1.089	0.019	0.021	
165	5825	802.11a	Rear	13.63	14.00	-1.72	1.089	0.065	0.071	Plot 12
165	5825	802.11a	Left	13.63	14.00	3.65	1.089	0.012	0.013	
165	5825	802.11a	Bottom	13.63	14.00	0.14	1.089	0.008	0.009	

#### Remark:

- 1. The value with blue color is the maximum 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  $\leq 0.8$  W/kg then testing at the other channels is optional for such test configuration(s).
- 3. When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements.19 If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition); otherwise, each band is tested independently for SAR.
- 4. When different maximum output power is specified for the bands, begin SAR measurement in the band with higher specified maximum output power. The highest reported SAR for the tested configuration is adjusted by the ratio of lower to higher specified maximum output power for the two bands. When the adjusted SAR is  $\leq 1.2$  W/kg, SAR is not required for the band with lower maximum output power in that test configuration; otherwise, each band is tested independently for SAR.



## 4.3.2 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)] [  $\sqrt{f(GHz)/x}$ ] W/kg for test separation distances  $\leq$  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.

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

Estimated stand alone SAR							
Communication system	Frequency (MHz)	Configuration	Maximum Power (dBm)	Separation Distance (mm)	Estimated SAR <sub>1-q</sub> (W/kg)		
Bluetooth*	2450	Hotspot	3.5	5	0.094		
Bluetooth*	2450	Body-worn	3.5	5	0.094		

#### Remark:

- 1. Bluetooth\*- Including Lower power Bluetooth
- 2. Maximum average power including tune-up tolerance;
- When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion
- 4. Body as body use distance is 10mm from manufacturer declaration of user manual

### 4.4. Simultaneous TX SAR Considerations

### 4.4.1 Introduction

Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneous transmiting antenna. The device has 4 antennas, WWAN main antenna, WWAN diversity antenna(RX only), and WiFi antenna supports 2.4Wi-Fi.The 2 TX antennas can always transmit simultaneously. The work mode combination is showed as below table.;

Application Simultaneous Transmission information:

Combination No.	Mode
1	WWAN+WIFI
2	WWAN+BT

### 4.4.2 Evaluation of Simultaneous SAR

### **Body Hotspot Exposure Conditions**

#### Simultaneous transmission SAR for WiFi and GSM

Test Position	GSM850 Reported SAR1-g (W/kg)	GSM1900 Reported SAR1-g (W/kg)	WiFi2.4G Reported SAR1-g (W/kg)	WiFi5.2G Reported SAR1-g (W/kg)	WiFi5.8G Reported SAR1-g (W/kg)	MAX. ΣSAR1- g (W/kg)	SAR1- g Limit (W/kg)	Peak location separation ratio	Simut Meas. Required
Front	0.404	0.238	0.161	0.084	0.021	0.565	1.6	no	no
Rear	0.704	0.467	0.243	0.230	0.071	0.947	1.6	no	no
Left	/	/	0.151	0.078	0.013	0.151	1.6	no	no
Right	0.385	0.230	1	/	/	0.385	1.6	no	no
Bottom	0.360	0.223	0.142	0.064	0.009	0.502	1.6	no	no
Top	1	/	1	1	1	/	1.6	no	no



## Simultaneous transmission SAR for WiFi and UMTS

Test Position	UMTS Band V Reported SAR1-g (W/kg)	UMTS Band II Reported SAR1-g (W/kg)	WiFi2.4G Reported SAR1-g (W/kg)	WiFi5.2G Reported SAR1-g (W/kg)	WiFi5.8G Reported SAR1-g (W/kg)	MAX. ΣSAR1- g (W/kg)	SAR1- g Limit (W/kg)	Peak location separation ratio	Simut Meas. Required
Front	0.167	0.774	0.161	0.084	0.021	0.935	1.6	no	no
Rear	0.181	0.733	0.243	0.230	0.071	0.976	1.6	no	no
Left	/	/	0.151	0.078	0.013	0.151	1.6	no	no
Right	0.159	0.713	/	/	/	0.713	1.6	no	no
Bottom	0.151	0.689	0.142	0.064	0.009	0.831	1.6	no	no
Top	1	1	1	1	1	/	1.6	no	no

## **SAR for WiFi and LTE**

Departed CAD4 g/M/kg)	Test Position							
Reported SAR1-g(W/kg)	Front	Rear	Left	Right	Bottom	Тор		
LTE Band2	0.451	0.485	1	0.432	0.426	/		
LTE Band4	0.833	0.932	1	0.827	0.812	/		
LTE Band5	0.143	0.296	1	0.132	0.125	/		
LTE Band17	0.300	0.361	1	0.293	0.284	/		
LTE Band41	0.174	0.238	/	0.167	0.145	/		
WiFi2.4G	0.161	0.243	0.151	1	0.142	1		
WiFi5.2G	0.084	0.230	0.078	/	0.064	/		
WiFi5.8G	0.021	0.071	0.013	/	0.009	/		
MAX. ΣSAR1-g (W/kg)	0.994	1.175	0.151	0.827	0.954	/		
SAR1-g Limit (W/kg)	1.6	1.6	1.6	1.6	1.6	1.6		
Peak location separation ratio	no	no	no	no	no	no		
Simut Meas. Required	no	no	no	no	no	no		

## Simultaneous transmission SAR for BT and GSM

Test Position	GSM850 Reported SAR1-g (W/kg)	GSM1900 Reported SAR1-g (W/kg)	BT Estimated SAR1-g (W/kg)	MAX. ΣSAR1-g (W/kg)	SAR1-g Limit (W/kg)	Peak location separation ratio	Simut Meas. Required
Front	0.404	0.238	0.094	0.498	1.6	no	no
Rear	0.704	0.467	0.094	0.798	1.6	no	no
Left	1	1	0.094	0.094	1.6	no	no
Right	0.385	0.230	1	0.385	1.6	no	no
Bottom	0.360	0.223	0.094	0.454	1.6	no	no
Top	1	1	1	1	1.6	no	no

## Simultaneous transmission SAR for BT and UMTS

	3	iiiiuitaiieous	li ali silli ssibi	I SAIT IOI DI	and Own 3		
Test Position	UMTS Band V Reported SAR1-g (W/kg)	UMTS Band II Reported SAR1-g (W/kg)	BT Estimated SAR1-g (W/kg)	MAX. ΣSAR1-g (W/kg)	SAR1-g Limit (W/kg)	Peak location separation ratio	Simut Meas. Required
Front	0.167	0.774	0.094	0.969	1.6	no	no
Rear	0.181	0.733	0.094	0.827	1.6	no	no
Left	1	1	0.094	0.094	1.6	no	no
Right	0.159	0.713	1	0.713	1.6	no	no
Bottom	0.151	0.689	0.094	0.783	1.6	no	no
Top	1	1	1	1	1.6	no	no

## Simultaneous transmission SAR for BT and LTE

Deported CAD1 a/M/kg)	Test Position							
Reported SAR1-g(W/kg)	Front	Rear	Left	Right	Bottom	Top		
LTE Band2	0.451	0.485	1	0.432	0.426	/		
LTE Band4	0.833	0.932	/	0.827	0.812	1		
LTE Band5	0.143	0.296	/	0.132	0.125	/		
LTE Band17	0.300	0.361	/	0.293	0.284	/		
LTE Band41	0.174	0.238	/	0.167	0.145	/		
BT Estimated SAR1-g (W/kg)	0.066	0.066	0.066	1	0.066	1		
MAX. ΣSAR1-g (W/kg)	0.899	0.998	0.066	0.827	0.878	1		
SAR1-g Limit (W/kg)	1.6	1.6	1.6	1.6	1.6	1.6		
Peak location separation ratio	no	no	no	no	no	no		
Simut Meas. Required	no	no	no	no	no	no		

#### Note:

- 1. The WiFi and BT share same antenna, so cannot transmit at same time.
- 2. The value with **block** color is the maximum values of standalone
- 3. The value with blue color is the maximum values of  $\sum SAR_{1-\alpha}$

## 4.5. SAR Measurement Variability

According to KDB865664, Repeated measurements are required only when the measured SAR is  $\geq$  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 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.

- 3) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
- 4) 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).
- 5) 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.
- 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

Fraguenay		RF		Repeated	Highest	First Re	epeated
Frequency Band (MHz)	Air Interface	Exposure Configuration	Test Position	SAR (yes/no)	Measured SAR <sub>1-g</sub> (W/Kg)	Measued SAR <sub>1-g</sub> (W/Kg)	Largest to Smallest SAR Ratio
750	LTE Band 17	Standalone	Body-Rear	no	0.350	n/a	n/a
	GSM 850	Standalone	Body-Rear	no	0.630	n/a	n/a
850	WCDMA Band V	Standalone	Body- Rear	no	0.175	n/a	n/a
	LTE Band 5	Standalone	Body-Rear	no	0.274	n/a	n/a
1800	LTE Band 4	Standalone	Body- Rear	no	0.866	n/a	n/a
	GSM 1900	Standalone	Body-Rear	no	0.418	n/a	n/a
1900	WCDMA Band II	Standalone	Body-Front	no	0.722	n/a	n/a
	LTE Band 2	Standalone	Body-Rear	no	0.473	n/a	n/a
2450	2.4GWLAN	Standalone	Body-Rear	no	0.219	n/a	n/a
2600	LTE Band 41	Standalone	Body-Rear	no	0.236	n/a	n/a
5200	5.2GWLAN	Standalone	Body-Rear	no	0.222	n/a	n/a
5800	5.8GWLAN	Standalone	Body-Rear	no	0.065	n/a	n/a

### Remark:

1. Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the original and first repeated measurement is not > 1.20 or 3 (1-g or 10-g respectively)



## 4.6. General description of test procedures

- 1. Test positions as described in the tables above are in accordance with the specified test standard.
- 2. Tests in body position were performed in that configuration, which generates the highest time based averaged output power (see conducted power results).
- 3. According to IEEE 1528 the SAR test shall be performed at middle channel. Testing of top and bottom channel is optional.
- 4. 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
  - $\bullet \le 0.6$  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
- 5. IEEE 1528-2003 require the middle channel to be tested first. This generally applies to wireless devices that are designed to operate in technologies with tight tolerances for maximum output power variations across channels in the band. When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel must be used.
- 6. When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements.19 If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition); otherwise, each band is tested independently for SAR.
- 7. When different maximum output power is specified for the bands, begin SAR measurement in the band with higher specified maximum output power. The highest reported SAR for the tested configuration is adjusted by the ratio of lower to higher specified maximum output power for the two bands. When the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for the band with lower maximum output power in that test configuration; otherwise, each band is tested independently for SAR.

## 4.7. Measurement Uncertainty (450MHz-6GHz)

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 according to KDB865664D01.



# 4.8. System Check Results

Test mode:750MHz(Head) Product Description: Validation

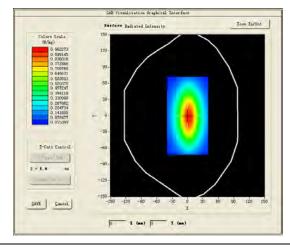
Model:Dipole SID750

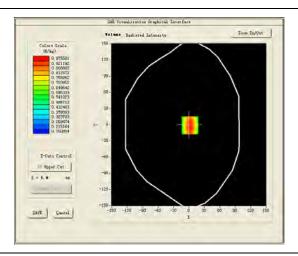
E-Field Probe: SSE2(SN 31/17 EPGO324)

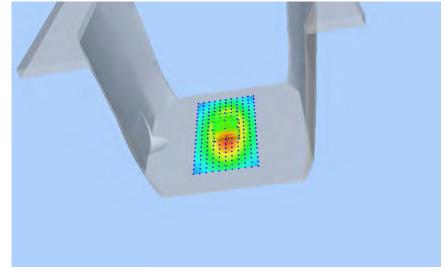
Test Date: March 10, 2022

Medium(liquid type)	HSL_750
Frequency (MHz)	750.0000
Relative permittivity (real part)	41.58
Conductivity (S/m)	0.88
Input power	100mW
Crest Factor	1.0
Conversion Factor	1.45
Variation (%)	1.420000
SAR 10g (W/Kg)	0.562452
SAR 1g (W/Kg)	0.824413

# **SURFACE SAR**









Test mode:835MHz(Head) **Product Description:Validation** 

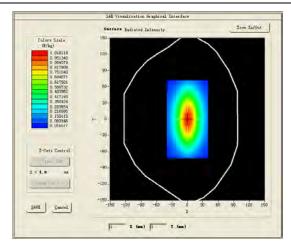
Model:Dipole SID835

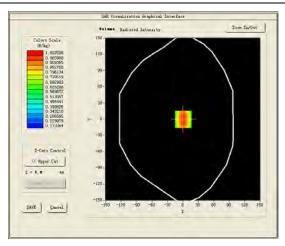
E-Field Probe:SSE2(SN 31/17 EPGO324)

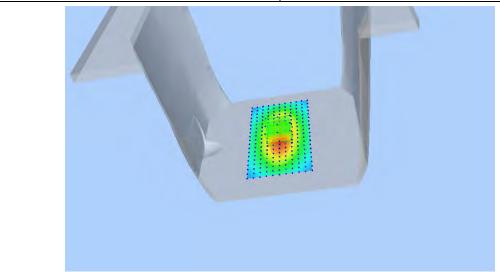
Test Date: March 14, 2022

Medium(liquid type)	HSL_850		
Frequency (MHz)	835.0000		
Relative permittivity (real part)	40.14		
Conductivity (S/m)	0.86		
Input power	100mW		
Crest Factor	1.0		
Conversion Factor	1.55		
Variation (%)	-0.210000		
SAR 10g (W/Kg)	0.632132		
SAR 1g (W/Kg)	0.975488		

## **SURFACE SAR**









Test mode:1800MHz(Head) **Product Description:Validation** 

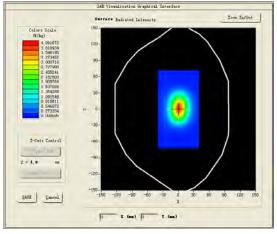
Model:Dipole SID1800

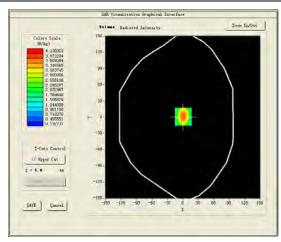
E-Field Probe:SSE2(SN 31/17 EPGO324)

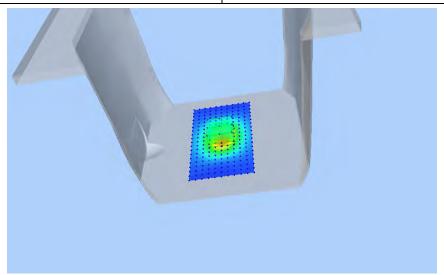
Test Date: March 18, 2022

Medium(liquid type)	HSL_1800
Frequency (MHz)	1800.0000
Relative permittivity (real part)	41.59
Conductivity (S/m)	1.42
Input power	100mW
Crest Factor	1.0
Conversion Factor	1.65
Variation (%)	3.560000
SAR 10g (W/Kg)	2.013283
SAR 1g (W/Kg)	3.819085

## **SURFACE SAR**









Test mode:1900MHz(Head) Product Description: Validation

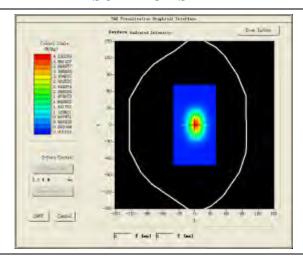
Model:Dipole SID1900

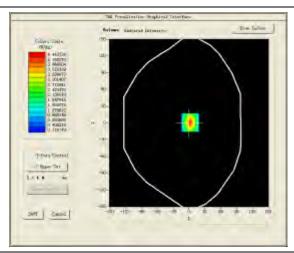
E-Field Probe:SSE2(SN 31/17 EPGO324)

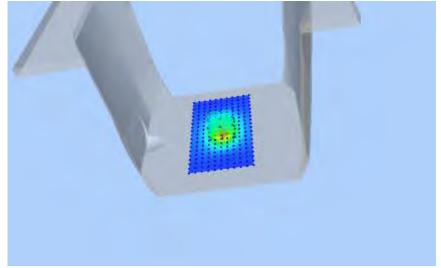
Test Date: March 25, 2022

Medium(liquid type)	HSL_1900
Frequency (MHz)	1900.0000
Relative permittivity (real part)	39.23
Conductivity (S/m)	1.37
Input power	100mW
Crest Factor	1.0
Conversion Factor	1.86
Variation (%)	-1.170000
SAR 10g (W/Kg)	2.068260
SAR 1g (W/Kg)	3.921162

# **SURFACE SAR**









Test mode:2450MHz(Head) **Product Description:Validation** 

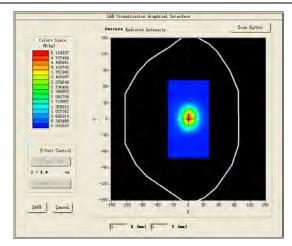
Model:Dipole SID2450

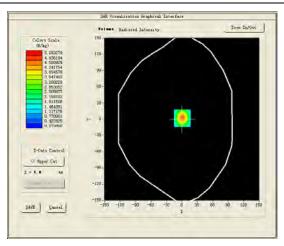
E-Field Probe:SSE2(SN 31/17 EPGO324)

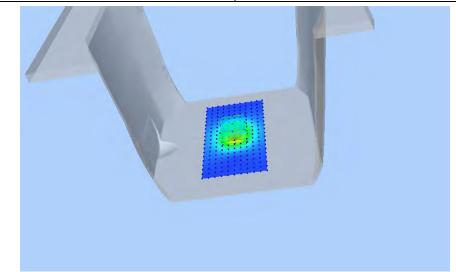
Test Date: March 29, 2022

Medium(liquid type)	HSL_2450
Frequency (MHz)	2450.0000
Relative permittivity (real part)	40.12
Conductivity (S/m)	1.76
Input power	100mW
Crest Factor	1.0
Conversion Factor	1.91
Variation (%)	0.240000
SAR 10g (W/Kg)	2.343463
SAR 1g (W/Kg)	5.224016

## **SURFACE SAR**









Test mode:2600MHz

**Product Description:Validation** 

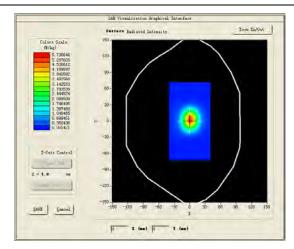
Model:Dipole SID2600

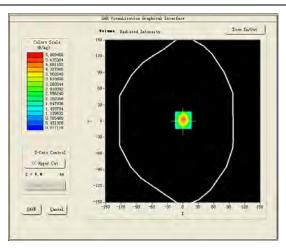
E-Field Probe: SSE2(SN 31/17 EPGO324)

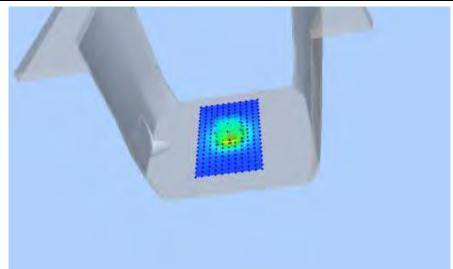
Test Date: April 04, 2022

HSL_2600
2600.0000
35.81
4.59
100mW
1.0
1.89
3.250000
2.458235
5.511023

## **SURFACE SAR**









Test mode:5200MHz(Head) **Product Description:Validation** 

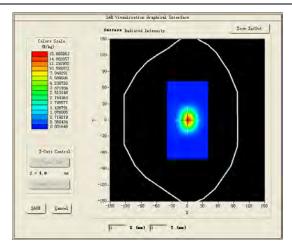
Model:Dipole SID5000

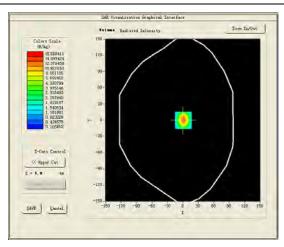
E-Field Probe: SSE2(SN 31/17 EPGO324)

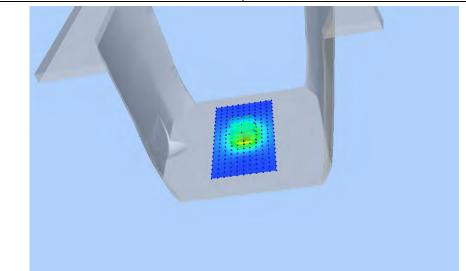
Test Date: April 08, 2022

Medium(liquid type)	HSL_5000
Frequency (MHz)	5200.0000
Relative permittivity (real part)	48.80
Conductivity (S/m)	5.25
Input power	100mW
Crest Factor	1.0
Conversion Factor	1.50
Variation (%)	-3.020000
SAR 10g (W/Kg)	5.512210
SAR 1g (W/Kg)	15.467034

## **SURFACE SAR**









Test mode:5800MHz(Head) **Product Description:Validation** 

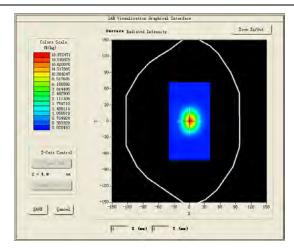
Model:Dipole SID5000

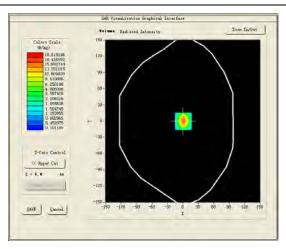
E-Field Probe: SSE2(SN 31/17 EPGO324)

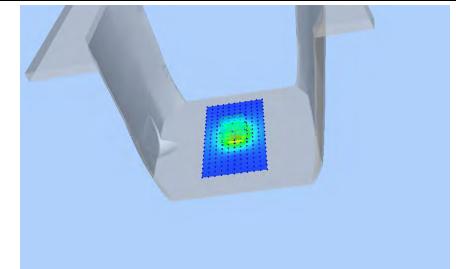
Test Date: April 13, 2022

Medium(liquid type)	HSL_5000
Frequency (MHz)	5800.0000
Relative permittivity (real part)	48.46
Conductivity (S/m)	6.05
Input power	100mW
Crest Factor	1.0
Conversion Factor	1.50
Variation (%)	-1.010000
SAR 10g (W/Kg)	6.177085
SAR 1g (W/Kg)	18.293250

## **SURFACE SAR**









# 4.9. SAR Test Graph Results

SAR plots for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination

#1

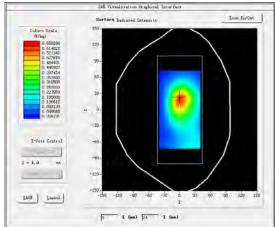
Test Mode: GSM850MHz, Low channel(Body Rear Side)

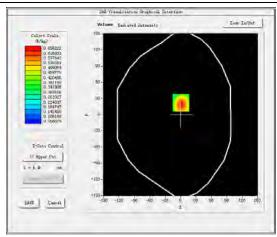
Product Description: Data Collector

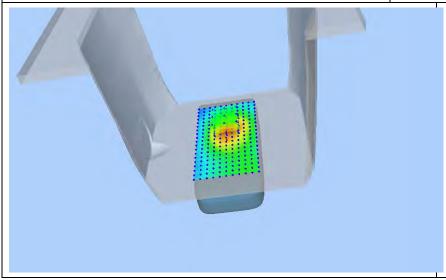
Model:R60

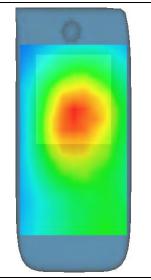
Test Date: March 14, 2022

Medium(liquid type)	HSL_850
Frequency (MHz)	824.2000
Relative permittivity (real part)	41.23
Conductivity (S/m)	0.91
E-Field Probe	SN 31/17 EPGO324
Crest Factor	2.0
Conversion Factor	1.55
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-3.420000
SAR 10g (W/Kg)	0.391933
SAR 1g (W/Kg)	0.630110
SURFACE SAR	VOLUME SAR









#2

Test Mode: GPRS1900MHz, Middle channel (Body Rear Side)

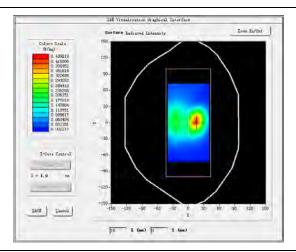
Product Description:Data Collector

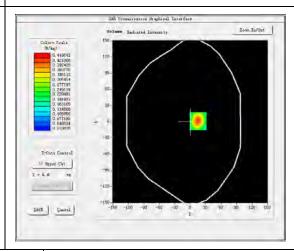
Model:R60

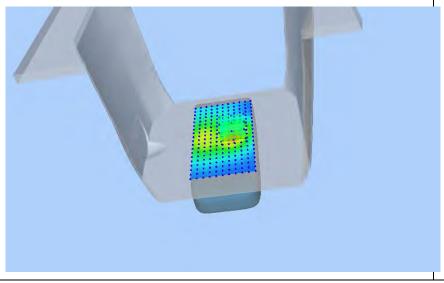
Test Date: March 25, 2022

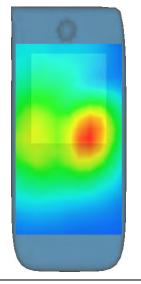
Medium(liquid type)	HSL_1900
Frequency (MHz)	1880.0000
Relative permittivity (real part)	40.75
Conductivity (S/m)	1.42
E-Field Probe	SN 31/17 EPGO324
Crest Factor	2.0
Conversion Factor	1.86
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-2.600000
SAR 10g (W/Kg)	0.221100
SAR 1g (W/Kg)	0.417612

## **SURFACE SAR**









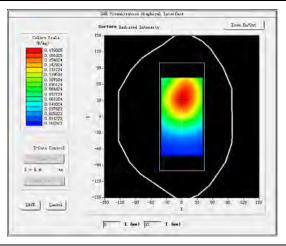
Test Mode: Hotspot WCDMA Band V, Middle channel(Body Rear Side)

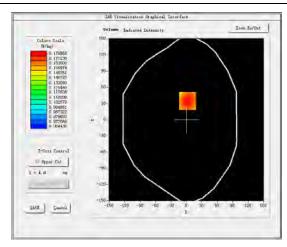
Product Description: Data Collector

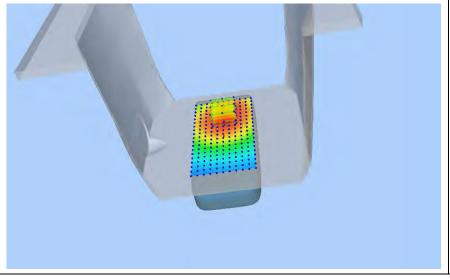
Model:R60

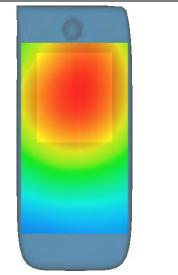
Test Date: March 14, 2022

Medium(liquid type)	HSL_850
Frequency (MHz)	836.6000
Relative permittivity (real part)	40.23
Conductivity (S/m)	0.89
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.55
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-0.670000
SAR 10g (W/Kg)	0.138210
SAR 1g (W/Kg)	0.174794
SURFACE SAR	VOLUME SAR











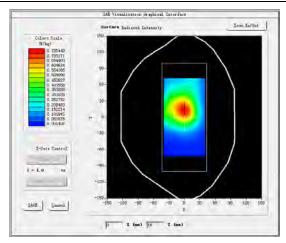
Test Mode: WCDMA Band II, High channel(Body Front Side)

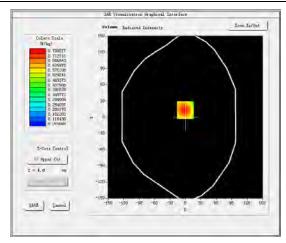
Product Description: Data Collector

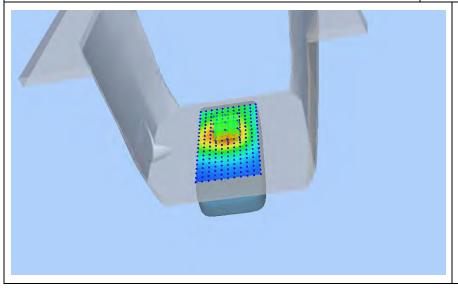
Model:R60

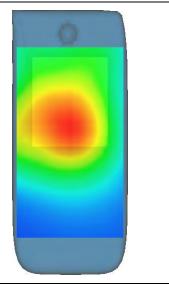
Test Date: March 25, 2022

Medium(liquid type)	HSL_1900
Frequency (MHz)	1907.6000
Relative permittivity (real part)	39.25
Conductivity (S/m)	1.43
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.86
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-1.260000
SAR 10g (W/Kg)	0.447115
SAR 1g (W/Kg)	0.722133
SURFACE SAR	VOLUME SAR











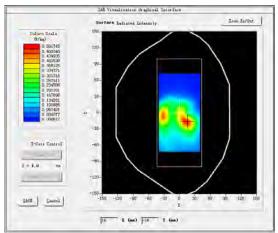
Test Mode: LTE Band 2, 1RB, Middle channel (Body Rear Side)

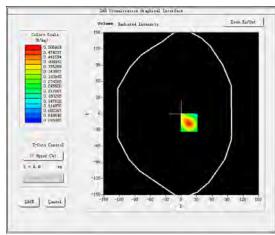
Product Description:Data Collector

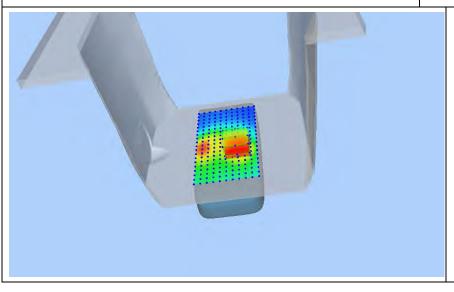
Model:R60

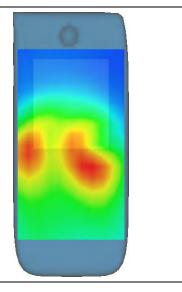
Test Date: March 25, 2022

Medium(liquid type)	HSL_1900
Frequency (MHz)	1860.0000
Relative permittivity (real part)	40.22
Conductivity (S/m)	1.78
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.86
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-1.300000
SAR 10g (W/Kg)	0.267440
SAR 1g (W/Kg)	0.472627
SURFACE SAR	VOLUME SAR











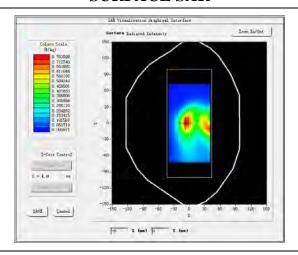
Test Mode: LTE Band 4, 1RB, Middle channel (Body Rear Side)

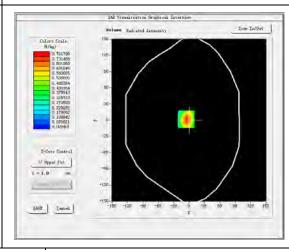
Product Description:Data Collector

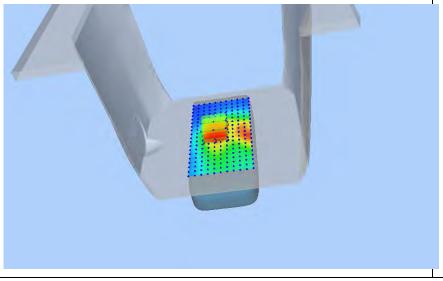
Model:R60

Test Date: March 18, 2022

Medium(liquid type)	HSL_1800
Frequency (MHz)	1732.5000
Relative permittivity (real part)	40.74
Conductivity (S/m)	1.38
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.65
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-0.440000
SAR 10g (W/Kg)	0.433443
SAR 1g (W/Kg)	0.865645
SURFACE SAR	VOLUME SAR









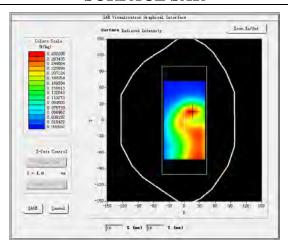
Test Mode: LTE Band 5, 1RB, Middle channel (Body Rear Side)

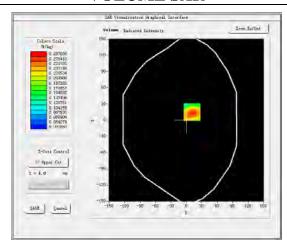
Product Description:Data Collector

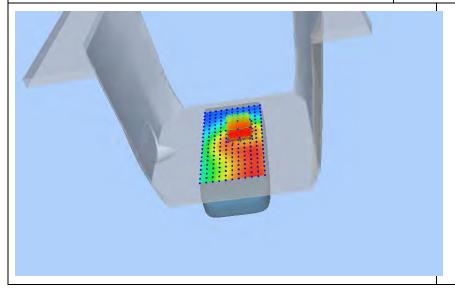
Model:R60

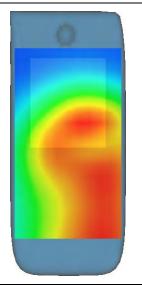
Test Date: March 14, 2022

Medium(liquid type)	HSL_835		
Frequency (MHz)	836.5000		
Relative permittivity (real part)	41.68		
Conductivity (S/m)	0.90		
E-Field Probe	SN 31/17 EPGO324		
Crest Factor	1.0		
Conversion Factor	1.55		
Sensor	4mm		
Area Scan	dx=8mm dy=8mm		
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm		
Variation (%)	-1.080000		
SAR 10g (W/Kg)	0.173005		
SAR 1g (W/Kg)	0.273991		
SURFACE SAR	VOLUME SAR		









#8

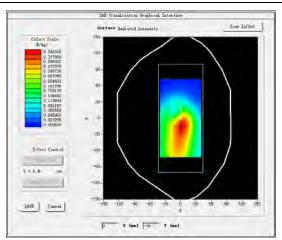
Test Mode: LTE Band 17, 1RB, High channel (Body Rear Side)

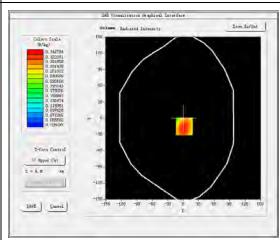
Product Description: Data Collector

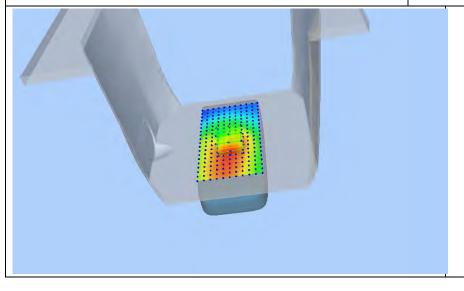
Model:R60

Test Date: March 10, 2022

Medium(liquid type)	HSL_750
Frequency (MHz)	711.0000
Relative permittivity (real part)	41.88
Conductivity (S/m)	0.85
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.45
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-1.020000
SAR 10g (W/Kg)	0.255988
SAR 1g (W/Kg)	0.350202
SURFACE SAR	VOLUME SAR









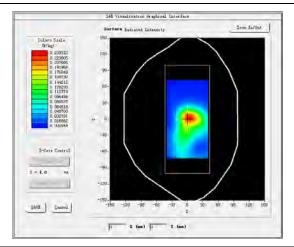
Test Mode: LTE Band 41, 1RB, Low channel(Body Rear Side)

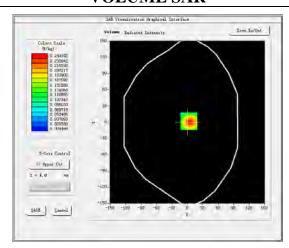
Product Description: Data Collector

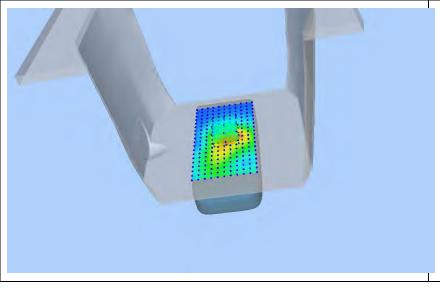
Model:R60

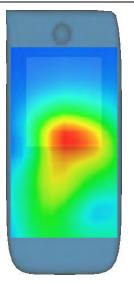
Test Date: April 04, 2022

M. diam. (1:: d. ()	1101 2000		
Medium(liquid type)	HSL_2600		
Frequency (MHz)	2506.0000		
Relative permittivity (real part)	36.15		
Conductivity (S/m)	4.69		
E-Field Probe	SN 31/17 EPGO324		
Crest Factor	1.58		
Conversion Factor	1.89		
Sensor	4mm		
Area Scan	dx=8mm dy=8mm		
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm		
Variation (%)	-0.730000		
SAR 10g (W/Kg)	0.119310		
SAR 1g (W/Kg)	0.235992		
SURFACE SAR	VOLUME SAR		











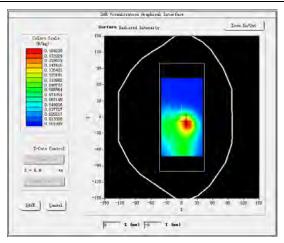
Test Mode: 802.11b(WiFi2.4G), High channel (Body Rear Side)

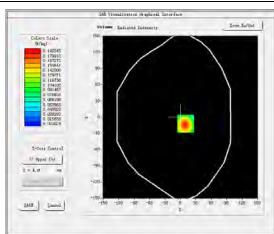
Product Description: Data Collector

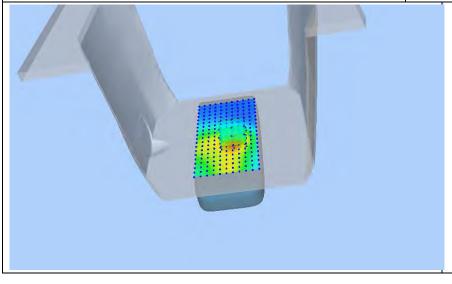
Model:R60

Test Date: March 29, 2022

Medium(liquid type)	HSL_2450
Frequency (MHz)	2462.0000
Relative permittivity (real part)	40.03
Conductivity (S/m)	1.79
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.91
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-1.120000
SAR 10g (W/Kg)	0.101361
SAR 1g (W/Kg)	0.219318
SURFACE SAR	VOLUME SAR









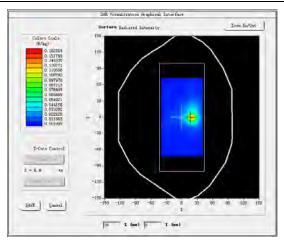
Test Mode: 802.11a(WiFi5.2G), High channel (Body Rear Side)

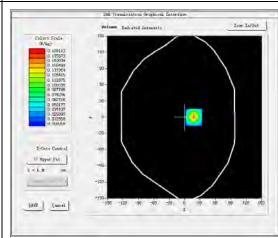
Product Description: Data Collector

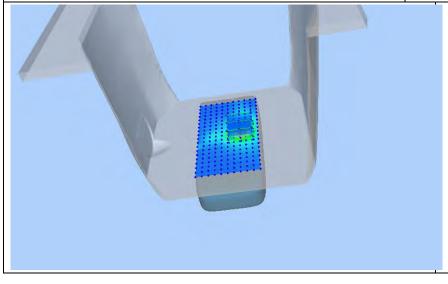
Model:R60

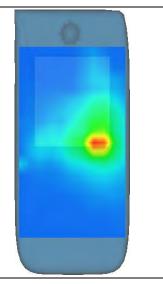
Test Date: April 08, 2022

Medium(liquid type)	HSL_5200
Frequency (MHz)	5230.0000
Relative permittivity (real part)	49.05
Conductivity (S/m)	5.36
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.50
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-0.270000
SAR 10g (W/Kg)	0.068015
SAR 1g (W/Kg)	0.221943
SURFACE SAR	VOLUME SAR











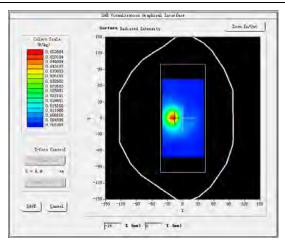
Test Mode: 802.11n20(WiFi5.8G), High channel (Body Rear Side)

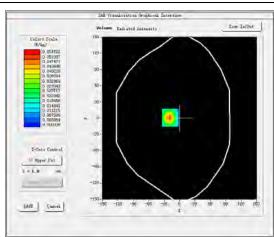
Product Description: Data Collector

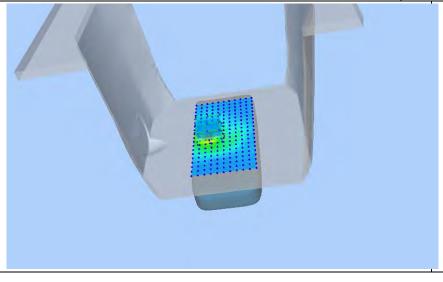
Model:R60

Test Date:April 13, 2022

Medium(liquid type)	HSL_5800
Frequency (MHz)	5825.0000
Relative permittivity (real part)	48.26
Conductivity (S/m)	5.97
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.50
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-1.720000
SAR 10g (W/Kg)	0.022669
SAR 1g (W/Kg)	0.065399
SURFACE SAR	VOLUME SAR









## 5. CALIBRATION CERTIFICATES

### 5.1 Probe-EPGO324 Calibration Certificate



# **COMOSAR E-Field Probe Calibration Report**

Ref: ACR.281.2.18.SATU.A

# SHENZHEN LCS COMPLIANCE TESTING LABORATORY LTD.

1F., XINGYUAN INDUSTRIAL PARK, TONGDA ROAD, **BAO'AN BLVD** 

BAO'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA MVG COMOSAR DOSIMETRIC E-FIELD PROBE

SERIAL NO.: SN 31/17 EPGO324

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





Calibration Date: 10/06/2021

### Summary:

This document presents the method and results from an accredited COMOSAR Dosimetric E-Field Probe ealibration 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.281.2.18.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	10/6/2021	25
Checked by :	Jérôme LUC	Product Manager	10/6/2021	23
Approved by :	Kim RUTKOWSKI	Quality Manager	10/6/2021	$= - E_{\mathcal{O}} \circ \rho \circ \mathcal{D}$

	Customer Name
Distribution;	Shenzhen LCS Compliance Testing Laboratory Ltd.

Issue	Date	Modifications
A	10/6/2021	Initial release

Page: 2/10

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### COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.281.2.18.SATU.A

## TABLE OF CONTENTS

ļ	Dev	vice Under Test4	
2	Pro	duet Description4	
	2.1	General Information	4
3	Mc	asurement Method	
	3.1	Lincarity	4
	3.2	Sensitivity	5
	3.3	Lower Detection Limit	5
	3.4	Isotropy	5
	3.5	Boundary Effect	5
4	Me	asurement Uncertainty5	
5	Cal	ibration Measurement Results	
	5.1	Sensitivity in air	6
	5.2	Lincarity	7
	5.3	Sensitivity in liquid	7
	5.4	Isotropy	8
6	Lis	t of Equipment10	

Page: 3/10

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Ref. ACR 281.2.18.SATU.A

#### 1 DEVICE UNDER TEST

Device	Under Test
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE2
Serial Number	SN 31/17 EPGO324
Product Condition (new / used)	New
Frequency Range of Probe	0.15 GHz-6GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.189 MΩ
	Dipole 2: R2=0.203 MΩ
	Dipole 3: R3=0.218 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.

Page: 4/10





Ruli ACR 281.2.18.SATU.A

#### 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  $(0^{\circ}-180^{\circ})$  in  $15^{\circ}$  increments. At each step the probe is rotated about its axis  $(0^{\circ}-360^{\circ})$ .

#### 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	rtainty analysis of the probe calibration in waveguide				
ERROR SOURCES	Uncertainty value (%)	Probability Distribution	Divisor	ci	Standard Uncertainty (%)
Incident or forward power	3.00%	Rectangular	<b>√</b> 3	1	1.732%
Reflected power	3.00%	Rectangular	<b>√</b> 3	ý	1.732%
Liquid conductivity	5.00%	Rectangular	<b>√</b> 3	1	2.887%
Liquid permittivity	4.00%	Rectangular	<b>√</b> 3	ý.	2.309%
Field homogeneity	3.00%	Rectangular	<b>√</b> 3	3 A -	1.732%
Field probe positioning	5.00%	Rectangular	<b>√</b> 3	1	2.887%

Page: 5/10





Ref: ACR.281.2.18.SATU.A

Field probe linearity	3.00%	Rectangular	<b>√</b> 3	1	1.732%
Combined standard uncertainty			TET		5.831%
Expanded uncertainty 95 % confidence level k = 2					12.0%

# CALIBRATION MEASUREMENT RESULTS

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

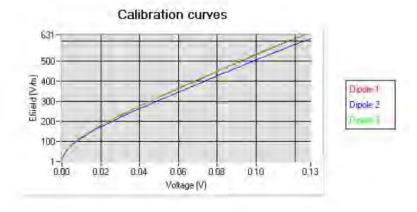
## SENSITIVITY IN AIR

	Normy dipole	
$I(\mu V/(V/m)^2)$	$2 (\mu V/(V/m)^2)$	$3 (\mu V/(V/m)^2)$
0.80	0.83	0.68

DCP dipole 1	DCP dipole 2	DCP dipole 3
(mV)	(mV)	(mV)
95	90	93

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

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



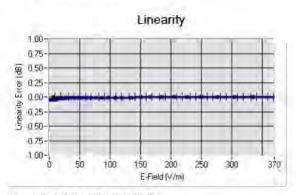
Page: 6/10





Ref: ACR.281.2.18.SATU.A

# 5.2 LINEARITY



Linearity:0+/-1.13% (+/-0.05dB)

# 5.3 SENSITIVITY IN LIQUID

<u>Liquid</u>	Frequency (MHz +/- 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL450	450	42.17	0.86	1.56
BL450	450	57.65	0.95	1.60
HL750	750	40.03	0.93	1.45
BL750	750	56.83	1.00	1.50
HL850	835	42.19	0.90	1.55
BL850	835	54.67	1.01	1.59
HL900	900	42.08	1.01	1.54
BL900	900	55.25	1.08	1.60
HL1800	1800	41.68	1.46	1.65
BL1800	1800	53.86	1.46	1.68
HL1900	1900	38.45	1.45	1.86
BL1900	1900	53.32	1.56	1.93
HL2000	2000	38.26	1.38	1.83
BL2000	2000	52.70	1.51	1.89
HL2300	2300	39.44	1.62	1.95
BL2300	2300	54.52	1.77	2.01
HL2450	2450	37.50	1.80	1.91
BL2450	2450	53.22	1.89	1.95
HL2600	2600	39.80	1.99	1.89
BL2600	2600	52.52	2.23	1.94
HL5200	5200	35.64	4.67	1.50
BL5200	5200	48.64	5.51	1.56
HL5400	5400	36.44	4.87	1.44
BL5400	5400	46.52	5.77	1.47
HL5600	5600	36.66	5.17	1.48
BL5600	5600	46.79	5.77	1.53
HL5800	5800	35.31	5.31	1.50
BL5800	5800	47.04	6.10	1.55

# LOWER DETECTION LIMIT: 9mW/kg

Page: 7/10



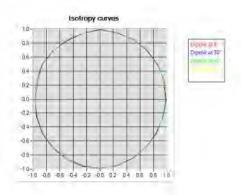


Ref: ACR.281.2.18.SATU.A

# 5.4 ISOTROPY

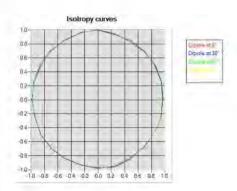
# HL900 MHz

- Axial isotropy: 0.05 dB- Hemispherical isotropy: 0.07 dB



# **HL1800 MHz**

- Axial isotropy: 0.06 dB - Hemispherical isotropy: 0.07 dB



Page: 8/10

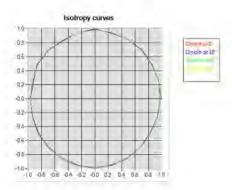




Ref: ACR.281.2.18.SATU.A

# **HL5600 MHz**

- Axial isotropy: 0.06 dB - Hemispherical isotropy: 0.10 dB



Page: 9/10





Ref: ACR.281.2.18.SATU.A

# 6 LIST OF EQUIPMENT

	Equi	pment Summary S	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 ca required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No ca required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2019	02/2022
Reference Probe	MVG	EP 94 SN 37/08	10/2019	10/2021
Multimeter	Keithley 2000	1188656	01/2020	01/2023
Signal Generator	Agilent E4438C	MY49070581	01/2020	01/2023
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	01/2020	01/2023
Power Sensor	HP ECP-E26A	US37181460	01/2020	01/2023
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.
Temperature / Humidity Sensor	Control Company	150798832	11/2020	11/2023

Page: 10/10



# 5.2 SID750 Dipole Calibration Ceriticate



# **SAR Reference Dipole Calibration Report**

Ref: ACR.287.3.14.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: 750 MHZ

SERIAL NO.: SN 07/14 DIP 0G750-302

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



09/29/2021

# 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.





Ruf. ACR 287.3.14.SATU. A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	10/12/2021	25
Checked by :	Jérôme LUC	Product Manager	10/12/2021	JE
Approved by :	Kim RUTKOWSKI	Quality Manager	10/12/2021	su weeksmeh

	Customer Name
Distribution;	Shenzhen LCS Compliance Testing Laboratory Ltd.

Issue	Date	Mod.fications
A	10/12/2021	Initial release
_ `_ ` _		

Page: 2/11





Ref: ACR.287.3.14.SATU.A

# TABLE OF CONTENTS

1 Int	roduction4	
2 De	vice Under Test4	
3 Pro	oduct Description4	
3.1	General Information	4
4 Mc	easurement Method5	
4.1	Return Loss Requirements	5
4.2	Mechanical Requirements	5
5 Mc	easurement Uncertainty5	
5.1	Return Loss	5
5.2	Dimension Measurement	5
5.3	Validation Measurement_	5
6 Ca	libration Measurement Results	
6.1	Return Loss and Impedance	6
6.2	Mechanical Dimensions	6
7 Va	lidation measurement	
7.1	Head Liquid Measurement	7
7.2	SAR Measurement Result With Head Liquid	7
7.3	Body Liquid Measurement	9
7.4	SAR Measurement Result With Body Liquid	9
8 Lis	st of Equipment11	

Page: 3/11





Ref: ACR 287.3.14.SATU.A

## 1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

## 2 DEVICE UNDER TEST

Device Under Test				
Device Type COMOSAR 750 MHz REFERENCE DIPOLE				
Manufacturer	Satimo			
Model	SID750			
Scrial Number	SN 07/14 DIP 0G750-302			
Product Condition (new / used)	New			

A yearly calibration interval is recommended.

## 3 PRODUCT DESCRIPTION

# 3.1 GENERAL INFORMATION

Satimo's COMOSAR Validation Dipoles are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.



Figure 1 – Satimo COMOSAR Validation Dipole

Page: 4/11





REE ACR 287.3.14.SATU.A

#### 4 MEASUREMENT METHOD

The IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

## 4.1 RETURN LOSS REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a return loss of -20 dB or better. The return loss measurement shall be performed against a liquid filled flat phantom, with the phantom constucted as outlined in the fore mentioned standards.

## 4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CEI/IEC 62209 standards specify the mechanical components and dimensions of the validation dipoles, with the dimensions frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness.

### 5 MEASUREMENT UNCERTAINTY

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.

## 5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

Frequency band	Expanded Uncertainty on Return Los		
400-6000MHz	0.1 dB		

# 5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Lengt	
3 - 300	0.05 mm	

# 5.3 VALIDATION MEASUREMENT

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 for validation measurements.

Scan Volume	Expanded Uncertainty
1 g	20.3 %
10 g	20.1 %

Page: 5/11

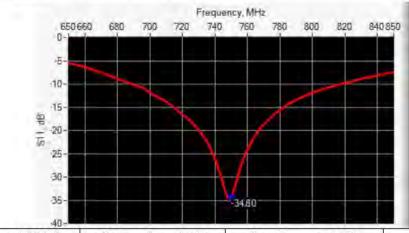




Ref. ACR.287.3.14.SATU.A

## 6 CALIBRATION MEASUREMENT RESULTS

# 6.1 RETURN LOSS AND IMPEDANCE



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
750	-34.80	-20	$50.7 \Omega + 1.6 j\Omega$

# 6.2 MECHANICAL DIMENSIONS

Frequency MHz	Ln	nm	hi mm		d r	nm
	required	measured	required	measured	required	measured
300	420.0 ±1 %.		250.0 ±1 %.		6.35 ±1 %.	
450	290.0 ±1 %.		166.7 ±1 %.		6.35 ±1 %.	
750	176.0 ±1 %.	PASS	100.0 ±1 %.	PASS	6.35 ±1 %.	PASS
835	161.0 ±1 %.		89.8 ±1 %.		3.6 ±1 %.	
900	149.0 ±1 %.	1	83.3 ±1 %.		3.6 ±1 %.	
1450	89.1 ±1 %.		51.7 ±1 %.		3.6 ±1 %.	
1500	80.5 ±1 %.		50.0 ±1 %.	1	3.6 ±1 %.	
1640	79.0 ±1 %.	11 - 1	45.7 ±1 %.	11	3.6 ±1 %.	
1750	75.2 ±1 %.	1	42.9 ±1 %.	- 1	3.6 ±1 %.	
1800	72.0 ±1 %.	1	41.7 ±1 %.		3.6 ±1 %.	
1900	68.0 ±1 %.	-	39.5 ±1 %.	1	3.6 ±1 %.	
1950	66.3 ±1 %.		38.5 ±1 %.		3.6 ±1 %.	
2000	64.5 ±1 %.		37.5 ±1 %.	1	3.6 ±1 %.	
2100	61.0 ±1 %.		35.7 ±1 %.	1	3.6 ±1 %.	
2300	55.5 ±1 %.		32.6 ±1 %.	- 1	3.6 ±1 %.	
2450	51.5 ±1 %.		30.4 ±1 %.	1	3.6 ±1 %.	
2600	48.5 ±1 %.		28.8 ±1 %.	11	3.6 ±1 %.	
3000	41.5 ±1 %.		25.0 ±1 %.	1	3.6 ±1 %.	
3500	37.0±1 %.	- 1	26.4 ±1 %.		3.6 ±1 %.	
3700	34.7±1 %.		26.4 ±1 %.		3.6 ±1 %.	

Page: 6/11





Ref. ACR 287.3.14.SATU.A

#### 7 VALIDATION MEASUREMENT

The IEEE Std. 1528, OET 65 Bulletin C and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

# 7.1 HEAD LIQUID MEASUREMENT

Frequency IMHz	Relative per	mittivity ( $\epsilon_{\rm r}'$ )	Conductiv	ity (σ) S/m
	required	measured	required	measured
300	45.3 ±5 %		0.87±5 %	
450	43.5 ±5 %		0.87 ±5 %	
750	41.9 ±5 %	PA\$5	0.89 ±5 %	PASS
835	41.5 ±5 %		0.90 ±5 %	
900	41,5 ±5 %		0.97 ±5 %	
1450	40.5 ±5 %		1.20 ±5 %	
1500	40.4 ±5 %		1.23 ±5 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	
1800	40.0 ±5 %		1.40 ±5 %	
1900	40.0 ±5 %		1.40 ±5 %	
1950	40.0 ±5 %		1.40 ±5 %	
2000	40.0 ±5 %		1.40 ±5 %	
2100	39.8 ±5 %		1.49 ±5 %	
2300	39.5 ±5 %		1.67 ±5 %	
2450	39.2 ±5 %		1.80 ±5 %	
2600	39.0 ±5 %	-	1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.91 ±5 %	

## 7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEEE Std. 1528 and CEI/IEC 62209 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

Software	OPENSAR V4	
Phantom	SN 20/09 SAM71	
Probe	SN 18/11 EPG122	
Liquid	Head Liquid Values: eps': 42,1 sigma: 0.89	
Distance between dipole center and liquid	15.0 mm	
Area scan resolution	dx=8mm/dy=8mm	

Page: 7/11

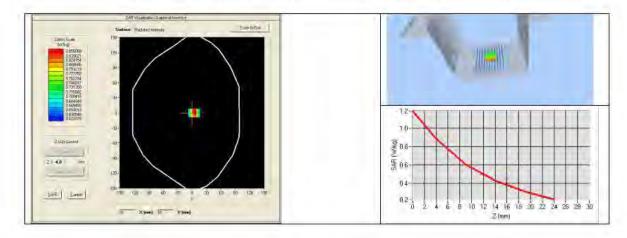




Ref: ACR.287.3.14.SATU.A

Zoon Sean Resolution	dx=8mm/dy=8m/dz=5mm	
Frequency	750 MHz	
Input power	20 dBm	
Liquid Temperature	21 °C	
Lab Temperature	21 °C	
Lab Humidity	45 %	

Frequency MHz	1 g SAR (W/kg/W)		10 g SAR	(W/kg/W)
	required	measured	required	measured
300	2,85		1.94	
450	4.58	1	3.06	
750	8.49	8.38 (0.84)	5,55	5.53 (0.55)
835	9.56		6.22	
000	10.9		6.99	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	1
1750	36.4		19.3	
1800	38.4		20.1	
1900	39.7		20.5	
1950	40.5		20.9	1
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4		24	
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	



Page: 8/11





REE ACR 287.3.14.SATU.A

# 7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative per	mittivity (&,')	Conductiv	ity (σ) S/m
	required	measured	required	measured
150	61.9 ±5 %		0.80 ±5 %	4
300	58.2 ±5 %		0.92 ±5 %	
450	56.7 ±5 %		0.94 ±5 %	
750	55.5 ±5 %	PASS	0.96 ±5 %	PASS
835	55.2 ±5 %		0.97 ±5 %	
900	55.0 ±5 %		1.05 ±5 %	
915	55.0 ±5 %		1.06 ±5 %	
1450	54.0 ±5 %		1.30 ±5 %	
1610	53.8 ±5 %		1.40 ±5 %	
1800	53.3 ±5 %		1.52 ±5 %	
1900	53.3 ±5 %		1.52 ±5 %	
2000	53.3 ±5 %		1.52 ±5 %	
2100	53.2 ±5 %		1.62 ±5 %	
2450	52.7 ±5 %		1.95 ±5 %	
2600	52.5 ±5 %		2.16 ±5 %	
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3,31 ±5 %	
5200	49.0 ±10 %		5,30 ±10 %	
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %		5.53 ±10 %	
5500	48.6 ±10 %		5,65 ±10 %	
5600	48.5 ±10 %		5.77 ±10 %	
5800	48.2 ±10 %		6.00 ±10 %	

# 7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: eps*: 56.6 sigma; 0.99
Distance between dipole center and liquid	15.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8m/dz=5mm
Frequency	750 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

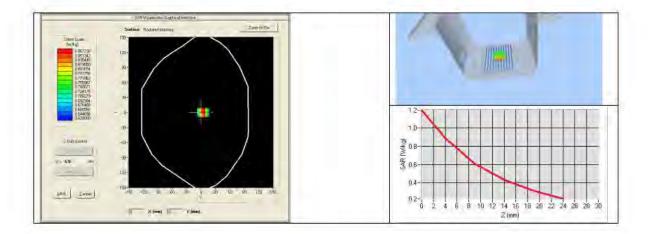
Page: 9/11





Ref: ACR.287.3.14.SATU.A

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)	
	measured	measured	
750	8.77 (0.88)	5.78 (0.58)	



Page: 10/11





Ref. ACR.287.3.14.SATU.A

# 8 LIST OF EQUIPMENT

	Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date	
SAM Phantom	Satimo	SN-20/09-SAM71	Validated. No cal required.	Validated. No ca required.	
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.	
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2021	02/2024	
Calipers	Carrera	CALIPER-01	12/2018	12/2021	
Reference Probe	Satimo	EPG122 SN 18/11	10/2021	10/2022	
Multimeter	Keithley 2000	1188656	12/2018	12/2021	
Signal Generator	Agilent E4438C	MY49070581	12/2018	12/2021	
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.	
Power Meter	HP E4418A	US38261498	12/2018	12/2021	
Power Sensor	HP ECP-E26A	US37181460	12/2018	12/2021	
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.	
Temperature and Humidity Sensor	Control Company	11-661-9	8/2021	8/2024	

Page: 11/11



# 5.3 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



09/29/2021

#### 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.





Ref: ACR.287.4.14.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	10/12/2021	25
Checked by :	Jérôme LUC	Product Manager	10/12/2021	JE
Approved by :	Kim RUTKOWSKI	Quality Manager	10/12/2021	ou weeksmich

	Customer Name
Distribution;	Shenzhen LCS Compliance Testing Laboratory Ltd.

Issue	Date	Mod.fications	
A	10/12/2021	Initial release	

Page: 2/11





Ref: ACR.287.4.14.SATU.A

# TABLE OF CONTENTS

6	inti	oduction4	
2	De	vice Under Test4	
3	Pro	duct Description4	
	3.1	General Information	4
4	Mc	asurement Method	
	4.1	Return Loss Requirements	5
	4.2	Mechanical Requirements	5
5	Mc	asurement Uncertainty5	
	5.1	Return Loss	5
	5.2	Dimension Measurement	5
	5.3	Validation Measurement	5
6	Cal	ibration Measurement Results6	
	6.1	Return Loss and Impedance	6
	6.2	Mechanical Dimensions	6
7	Va	lidation measurement	
	7.1	Head Liquid Measurement	7
	7.2	SAR Measurement Result With Head Liquid	7
	7.3	Body Liquid Measurement	9
	7.4	SAR Measurement Result With Body Liquid	9
8	Lis	t of Equipment11	

Page: 3/11





Ref: ACR 287.4.14.SATU.A

# 1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

# 2 DEVICE UNDER TEST

Device Under Test		
Device Type	COMOSAR 835 MHz REFERENCE DIPOLE	
Manufacturer	Satimo	
Model	SID835	
Scrial Number	SN 07/14 DIP 0G835-303	
Product Condition (new / used)	New	

A yearly calibration interval is recommended.

# 3 PRODUCT DESCRIPTION

# 3.1 GENERAL INFORMATION

Satimo's COMOSAR Validation Dipoles are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.



Figure 1 – Satimo COMOSAR Validation Dipole

Page: 4/11